Dealing with The Forces that Destroy Historic Structures

The SC State Preservation Conference

Thursday, March 29, 2012
Columbia, SC

Craig M. Bennett, Jr., PE

Last year we……

- Started by stepping through time, looking at historic buildings that had all been damaged by The Forces that Destroy Historic Structures (TFTDHS)

c. 1690-1710

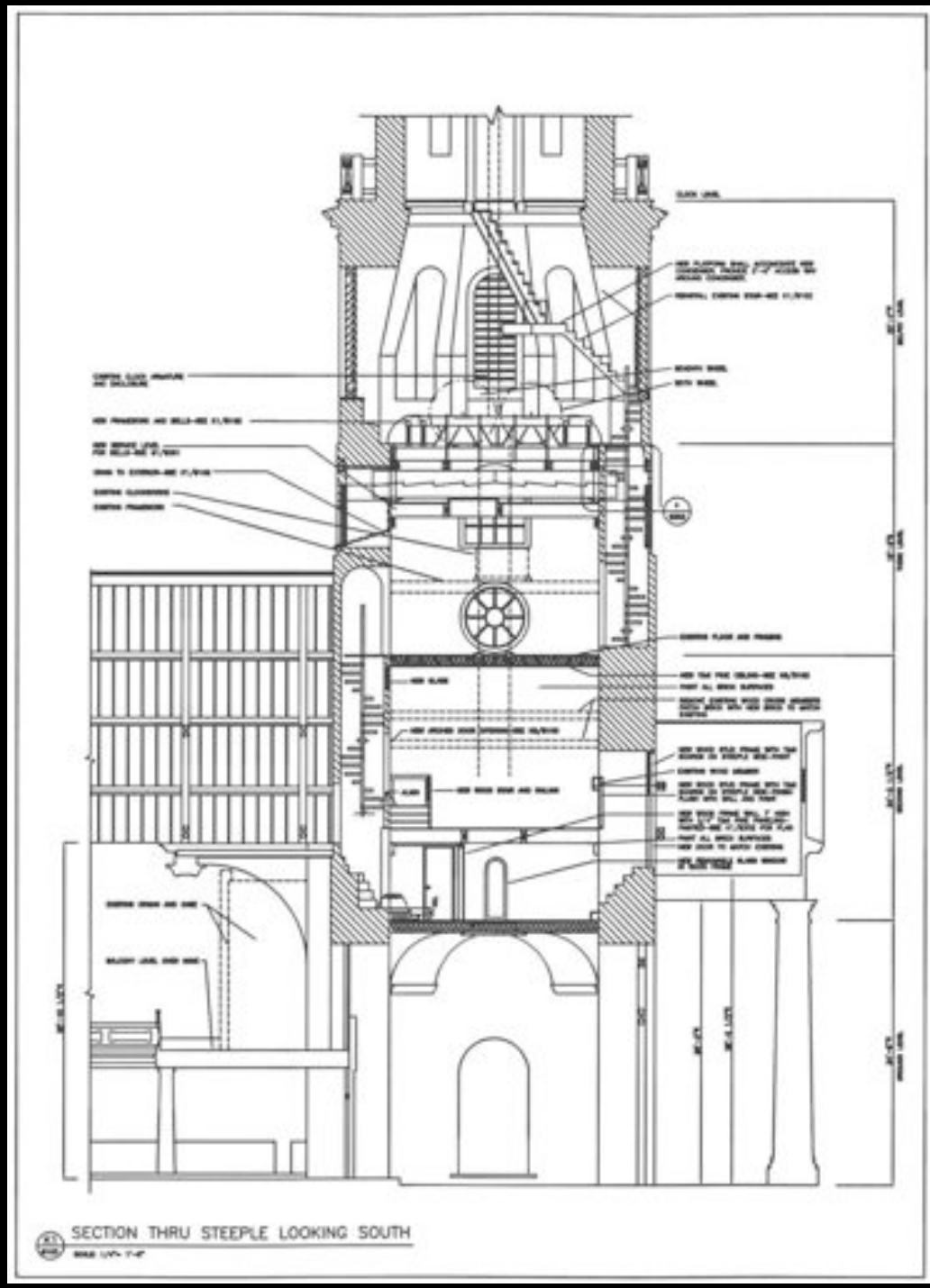
- Bermuda stone buildings on Church Street, Charleston

1751

- Heavy brick masonry:
  - St. Michael's, Charleston

1751

- St. Michael's, Charleston



1768

- Light timber framing:
  - Walnut Grove, near Spartanburg

1791

- Light timber framing again:
  - Lt. Governor Ladson House, Charleston

1791

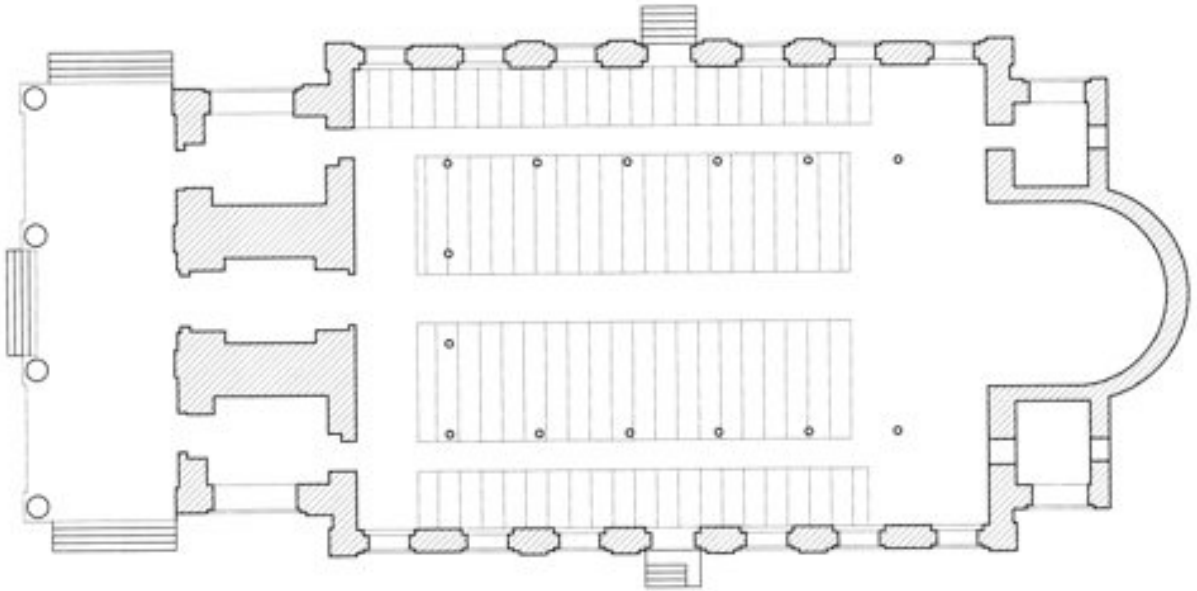
- Lt. Governor Ladson House, Charleston

1811 to 1816

- Very heavy brick masonry:
  - The Cathedral Church of St. Luke and St. Paul, Charleston

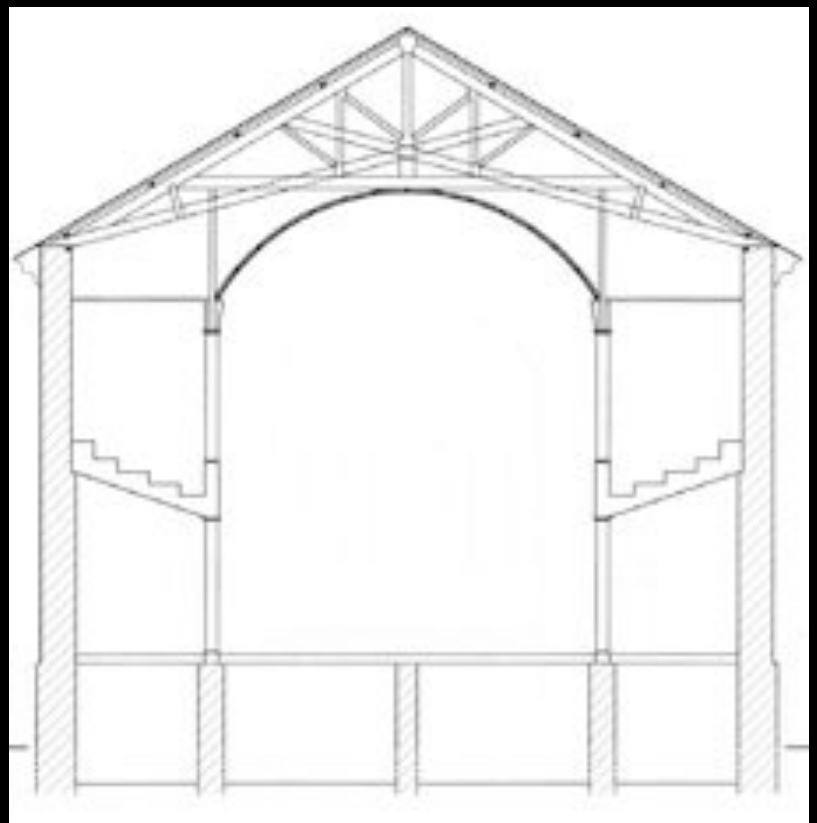
1811 to 1816

- The Cathedral Church of St. Luke and St. Paul



1811 to 1816

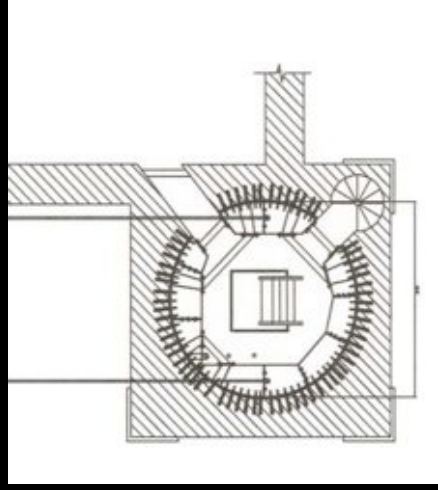
- Cathedral Church of St. Luke and St. Paul



1814

- Same period, same construction:
  - First (Scots) Presbyterian Church, Charleston

1814



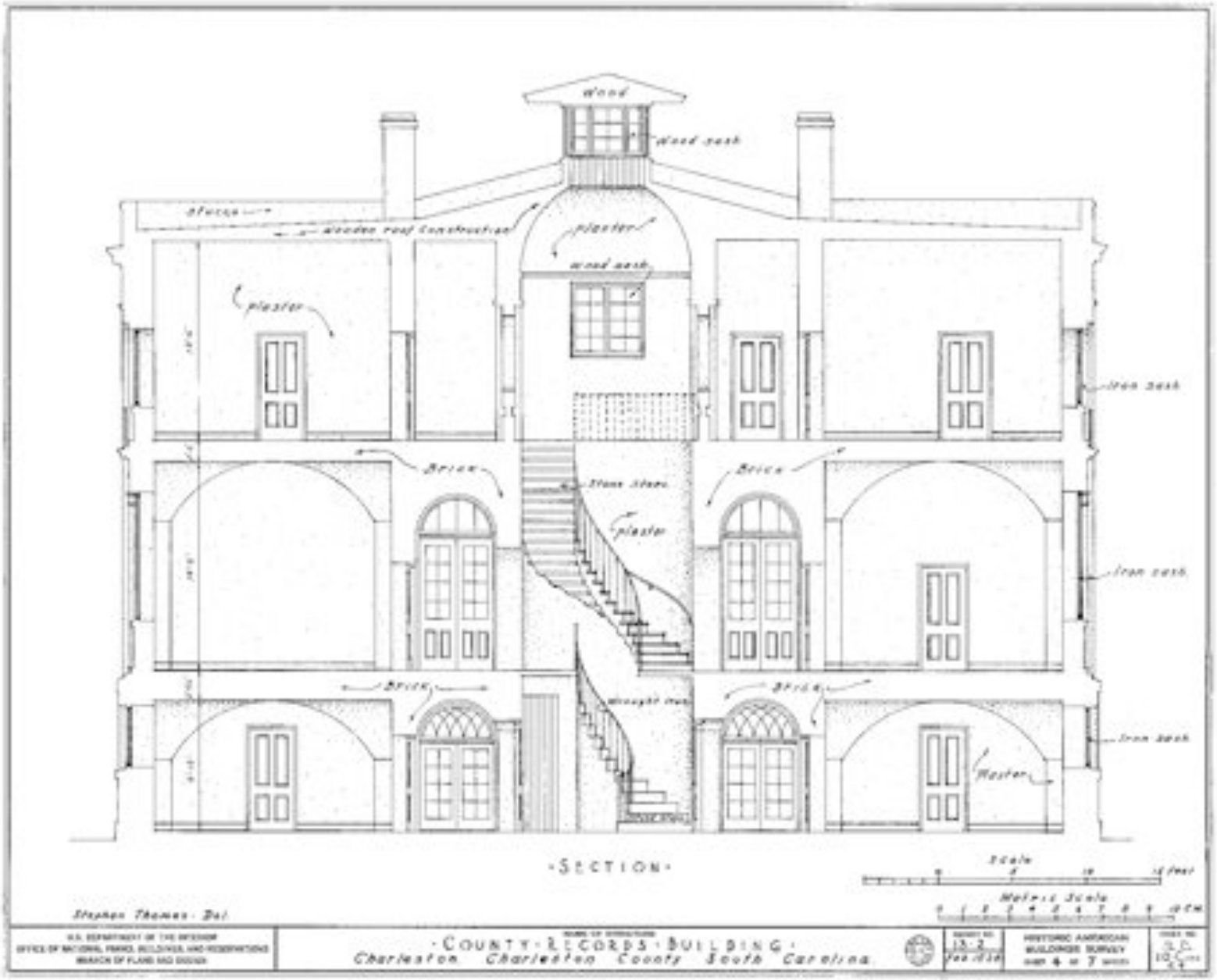
- Heavy brick masonry and timber:
  - First (Scots) Presbyterian Church, Charleston

1820

- Only slightly lighter brick masonry construction:
  - The William Mason Smith House, Charleston

1826

- The Fireproof Building, Charleston



·SECTION·

Scale
0 5 10 15 feet

Metric Scale
0 1 2 3 4 5 6 7 8 9 10 m

Stephen Thomas - Del

U.S. DEPARTMENT OF THE INTERIOR
OFFICE OF NATIONAL PARKS, BUILDINGS AND RESERVATIONS
BRANCH OF PLANS AND DESIGN

NAME OF STRUCTURE
·COUNTY·RECORDS·BUILDING·
Charleston, Charleston County, South Carolina

SHEET NO. 13-2

HISTORIC AMERICAN BUILDINGS SURVEY
SHEET 4 OF 7 SHEETS

HABS NO. SC-

1826

- Fireproof Building, Charleston

1820

- Heavy fortifications:
  - Fort Washington, Maryland

1820

- Fort Washington, Maryland

1846

- Fort Jefferson, Dry Tortugas

1846

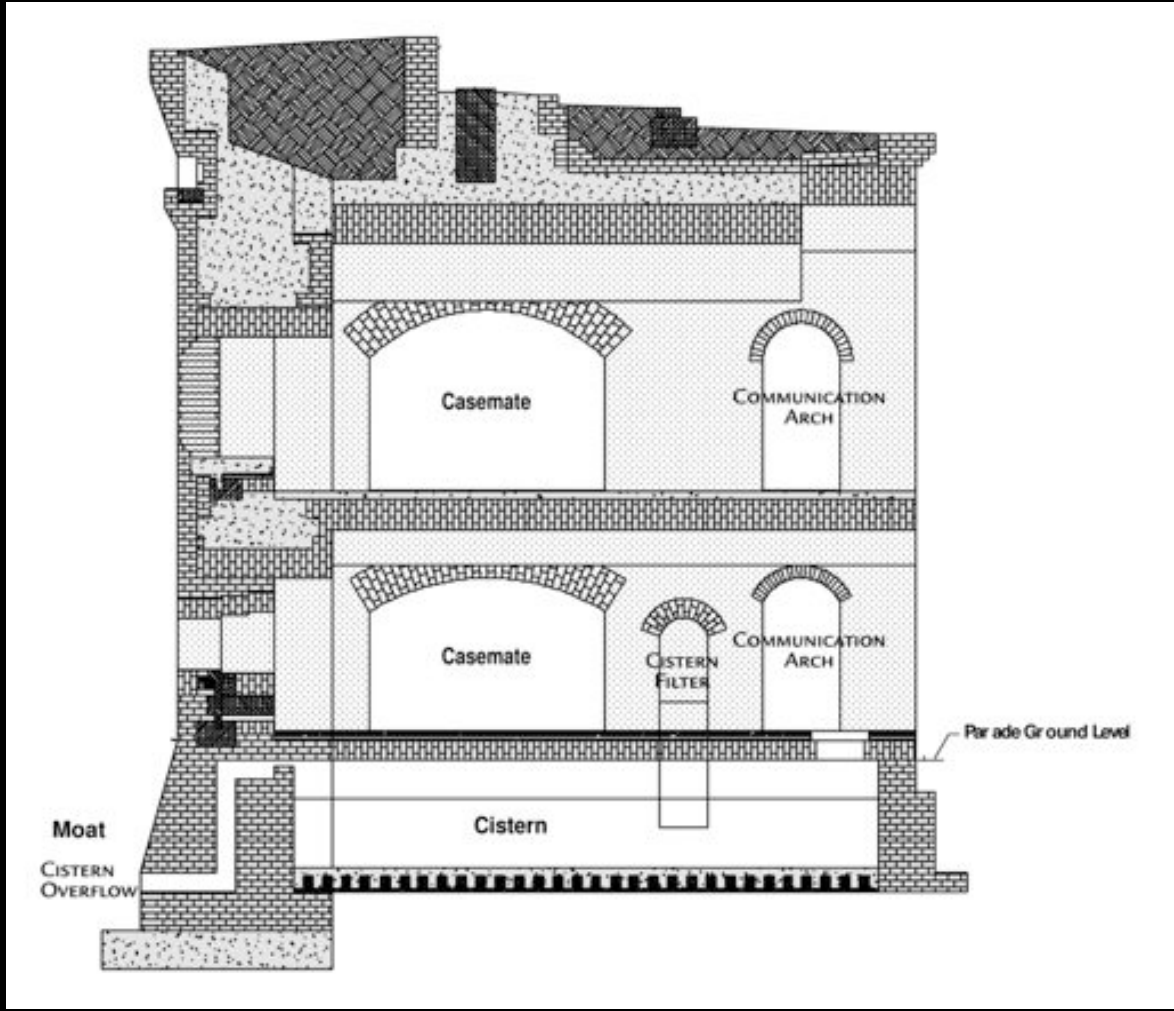
- Fort Jefferson, Dry Tortugas

1846

- Fort Jefferson, Dry Tortugas

1846

- Fort Jefferson, Dry Tortugas



1846

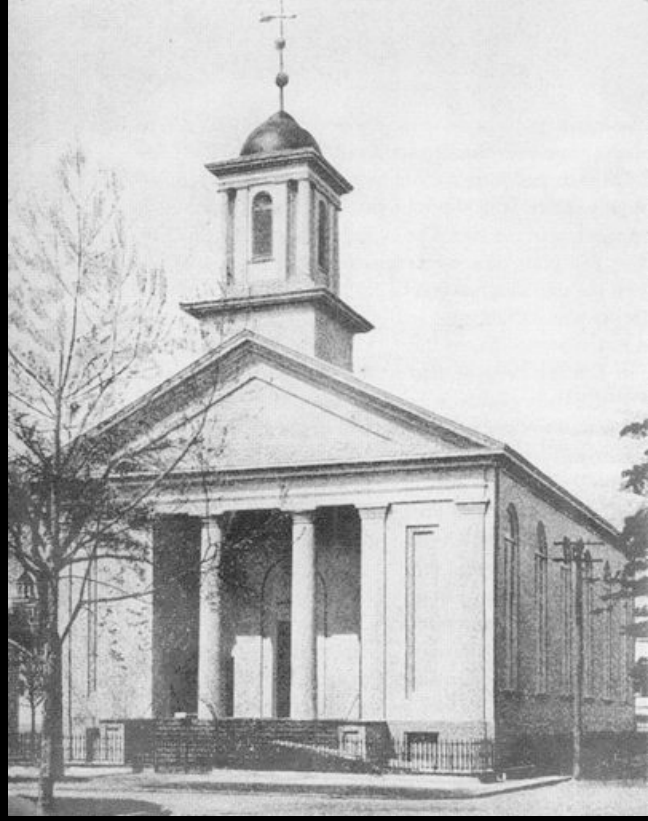
- Fort Sumter, Charleston Harbor

1846

- Fort Sumter, Charleston Harbor

1833 and 1922

- A tale of two structures:
  - First Baptist Church, Savannah



1833 and 1922

- A tale of two structures:
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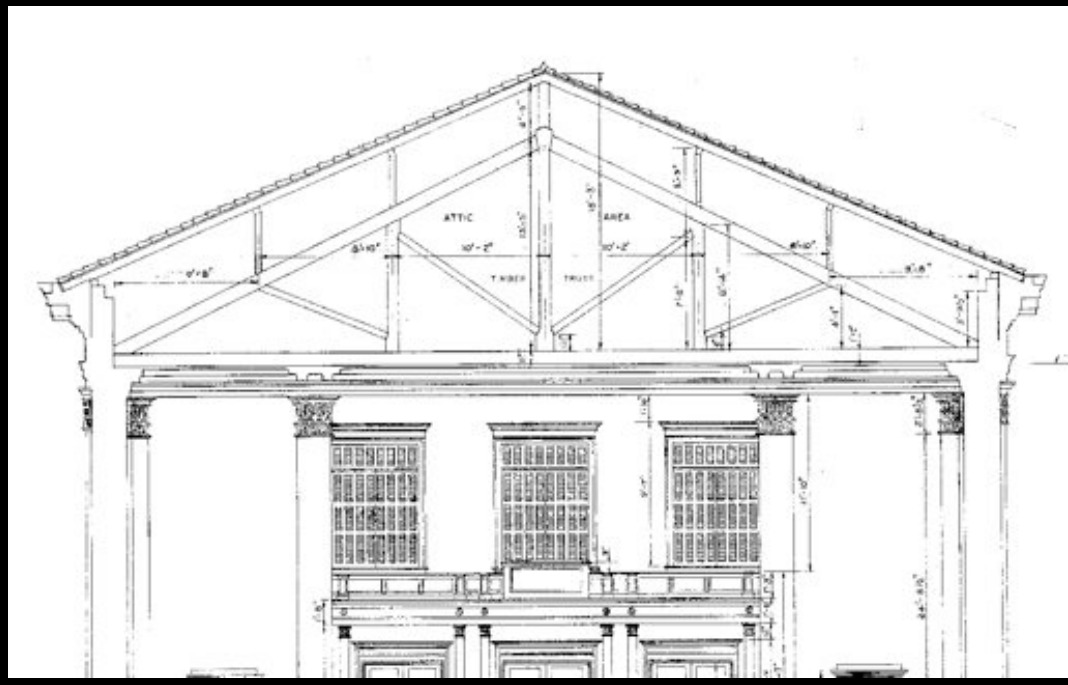


1842-1860

- Light timber construction: a real deception!
  - Gaineswood, Demopolis, Alabama

1842-1860

- Timber built to look like masonry:
  - Gaineswood, Demopolis, Alabama

1846

- Masonry thins out… and goes all wrong!
  - Grace Church, Charleston

1846

- Masonry wall thicknesses are cut in half
  - Grace Church, Charleston

1846

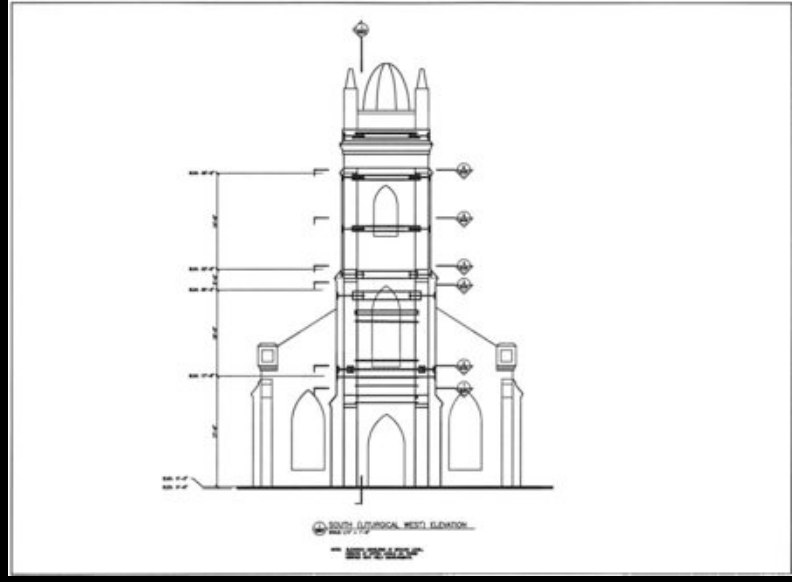
- And foundations are rarely adequate:
  - Grace Church, Charleston

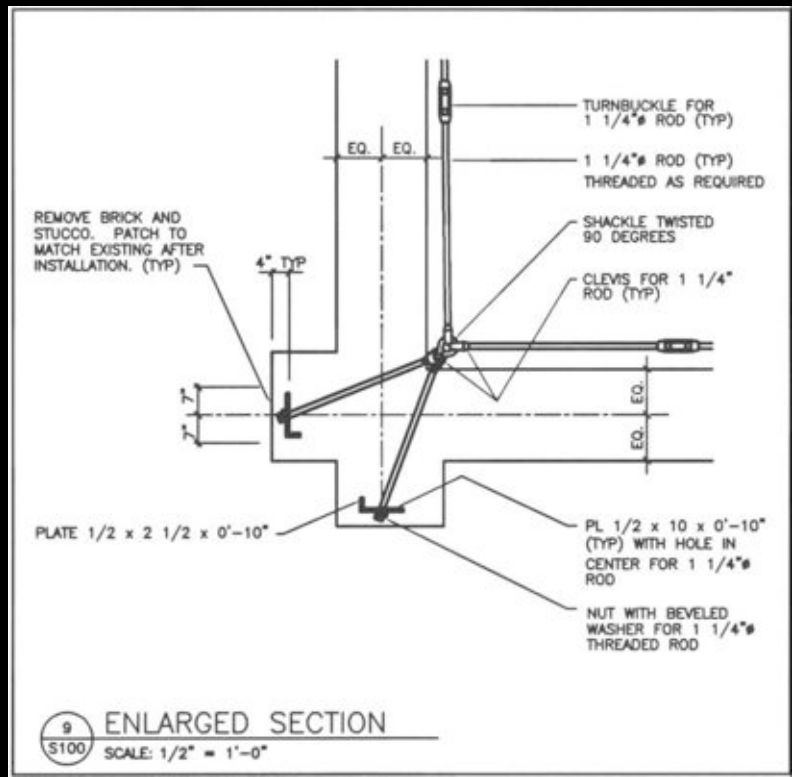
1845 and 1895

- Really thin walls:
  - 13” tower walls
  - Stella Maris, Sullivan’s Island

1845 and 1895

- Really thin walls:
  - 13” tower walls
  - Stella Maris, Sullivan’s Island





1840s additions

- A change in construction at the William Mason Smith House

1851

- Rammed earth walls:
  - Church of the Holy Cross, Stateburg

1851

- And delicate trusses:
  - Church of the Holy Cross, Stateburg

1886

- Stone masonry:
  - Breslin Tower, Sewanee TN

1886

- Stone masonry:
  - Breslin Tower, Sewanee TN

1891

- Wrought iron frame, cast iron skin:
  - Independent Presbyterian Church, Savannah

1891

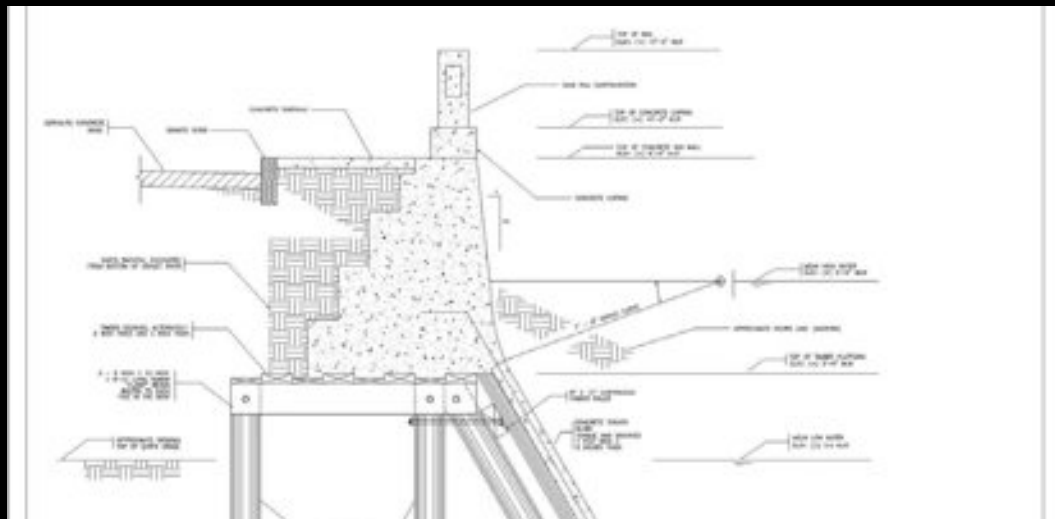
- Wrought iron frame, cast iron skin:
  - Independent Presbyterian Church, Savannah

1909-1917

- Concrete:
  - The Low Battery Seawalls, Charleston

1909-1917

- Concrete:
  - The Low Battery Seawalls, Charleston

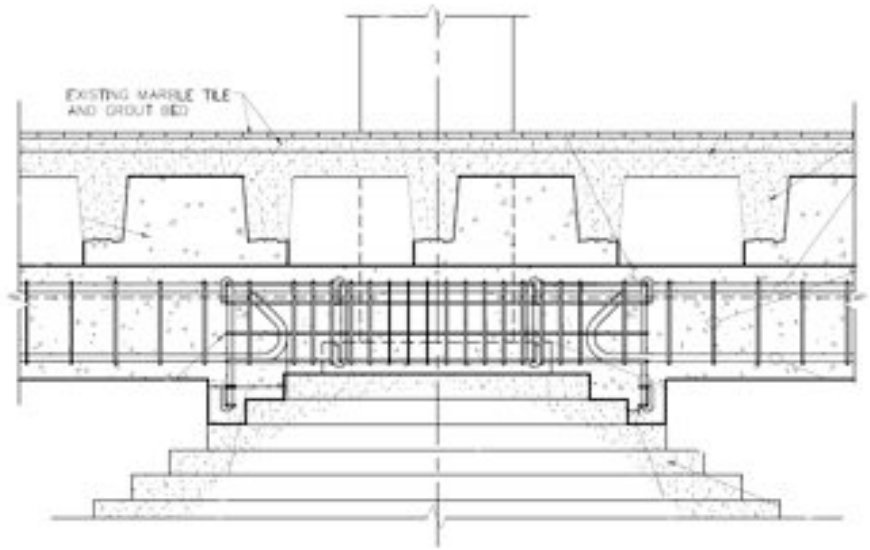


1925

- Concrete:
  - The Fort Sumter House, Charleston

1925

- Deterioration then superb repairs to concrete:
  - The Fort Sumter House, Charleston

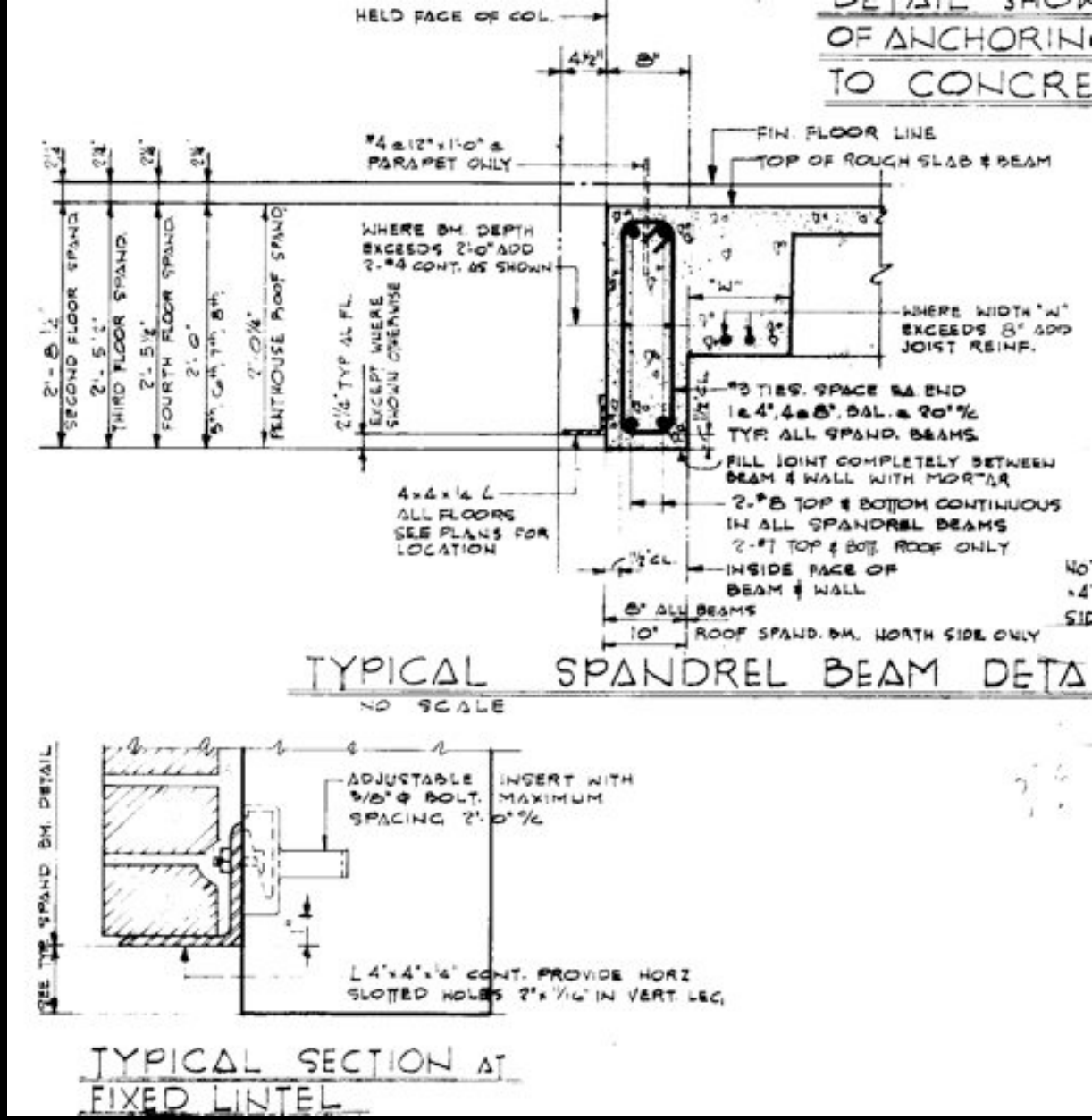


1958

- Modern framed construction:
  - The Walton Research Building

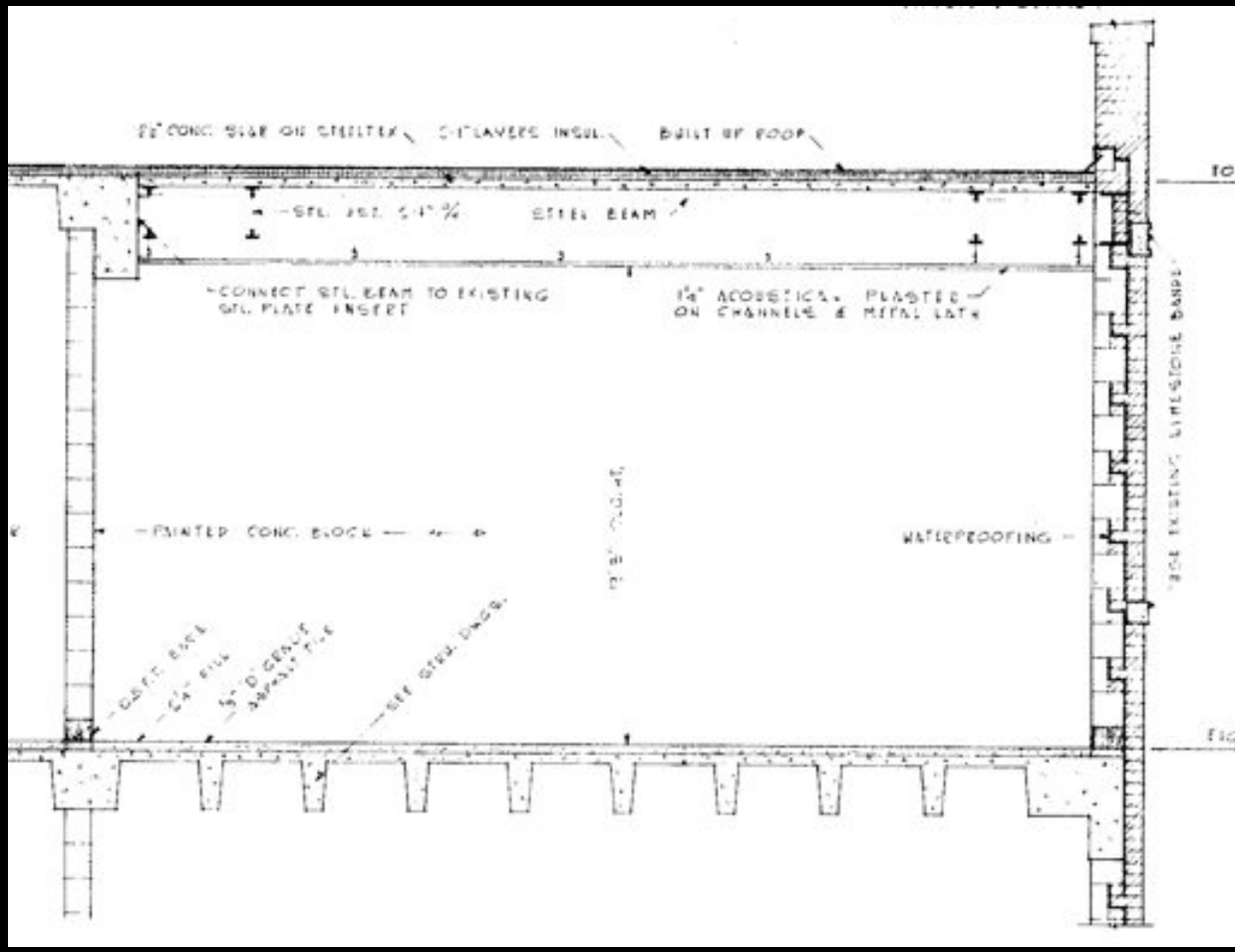
1958

- Modern framed construction:
  - The Walton Research Building



1958

- Modern framed construction:
  - The Walton Research Building



1958

- Modern framed construction:
  - The Walton Research Building

Then we came to the second most important slide in the whole lecture…..

Damage to historic structures

- Natural disasters
  - Hurricanes, tornados, floods, earthquakes and insect infestation
- Manmade disasters
  - Fire, war
- Material movement under stress (“creep”)
  - Especially support settlement
- The big one: Water intrusion

Next we followed that with a look at …..

Damage to structural materials

- Masonry
- Wood
- Iron and steel
- Concrete
- Soil

Masonry

- Deformation under stress
- Damage from corrosion of embedded iron
- Damage to masonry units
- Loss of mortar


03/24/2005


11/02/2006


1
2
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11/02/2006


11/02/2006


11/02/2006


04 21 2004


#8
I

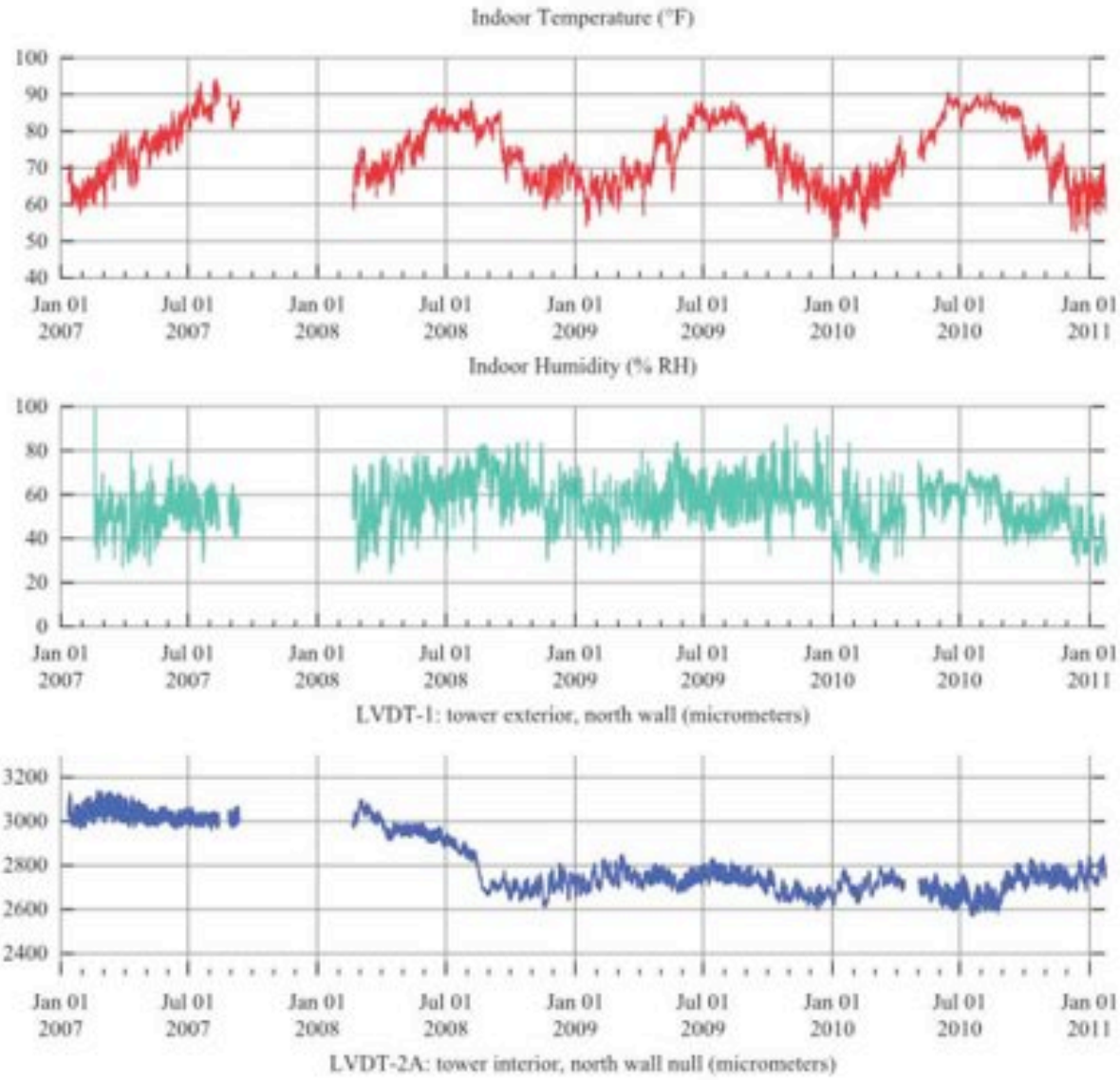

02/19/2008

Grace Church Structural Monitoring

Long-Term Crack Displacement

since beginning of project (January 1, 2007)

Note that LVDT-2A, LVDT-3, LVDT-4A, LVDT-5, LVDT-6, LVDT-12, and LVDT-15 were deactivated in August 2009.



Wood

- Rot
- Insect infestation
  - Powderpost beetles
  - Subterannean termites
  - Formosan termites
  - Carpenter bees
- Overstress

Iron and steel

- Corrosion, particularly in contact with masonry


02/11/2005


02/11/2005


02/11/2005

Concrete

- Corrosion of reinforcing
- Loss of section


02 06 2004


02 06 2004

Soil

- Overstress
  - Foundation movement and building settlement

Finally, we looked at .....

Three examples

- 1820 Fort Washington, Maryland
  - Major structural issues due to water migration

Three examples

- 1833 First Baptist Church, Savannah, GA
  - Water intrusion from 1833 to 1922

Three examples

- 1849 Trinity Cathedral, Columbia, SC
  - Major damage to the trusses due to water intrusion

- 1820 Fort Washington, Maryland
  - Major structural issues due to water migration


03/07/2006


05/16/2005


MADE IN
U. S. A.
07/06/2005


05/17/2005


05/17/2005


05/17/2005


05/17/2005


PLS5
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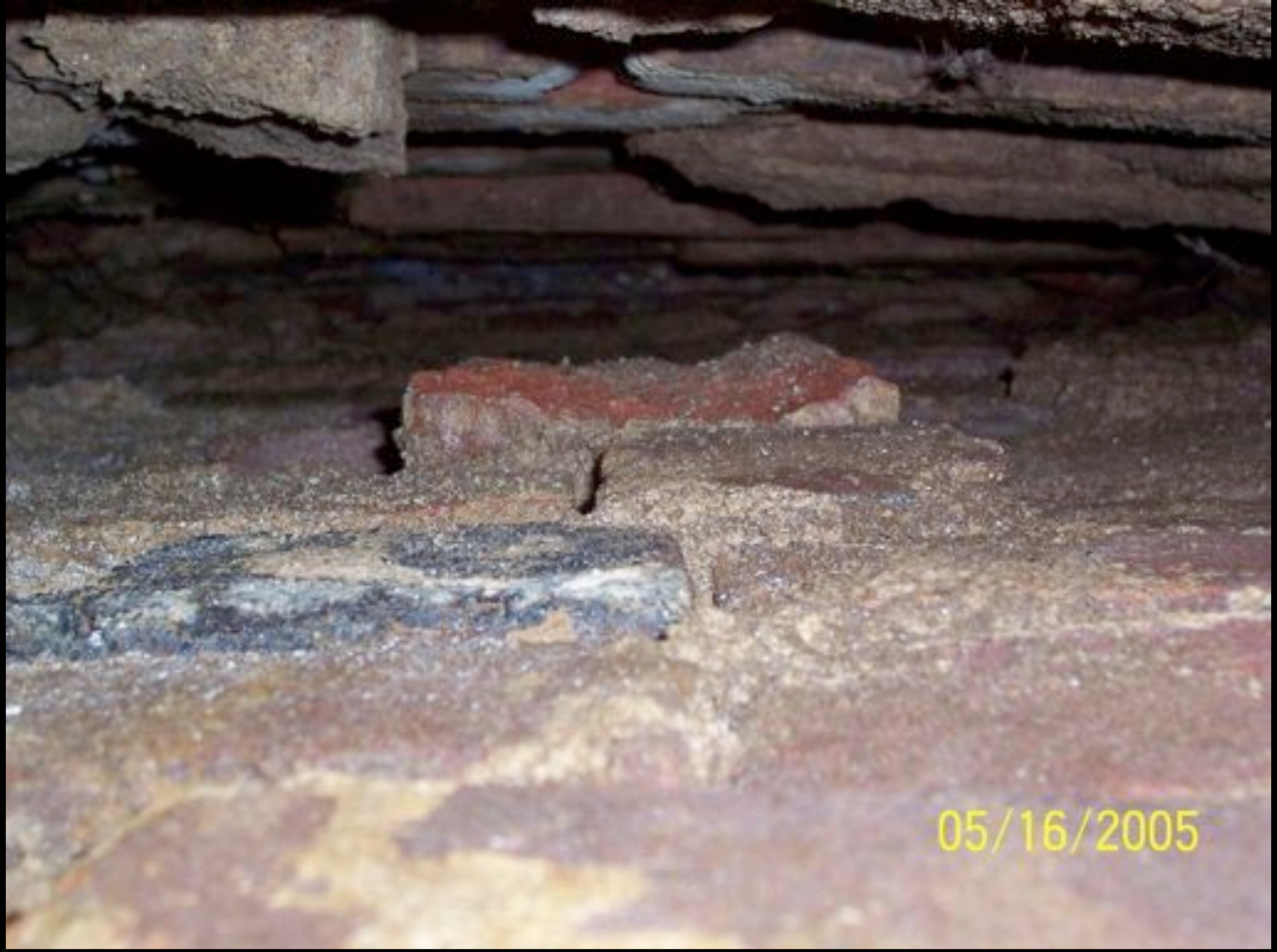
05/16/2005


05/16/2005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12/05/2005


10/13/2006


10/13/2006


07/05/2006


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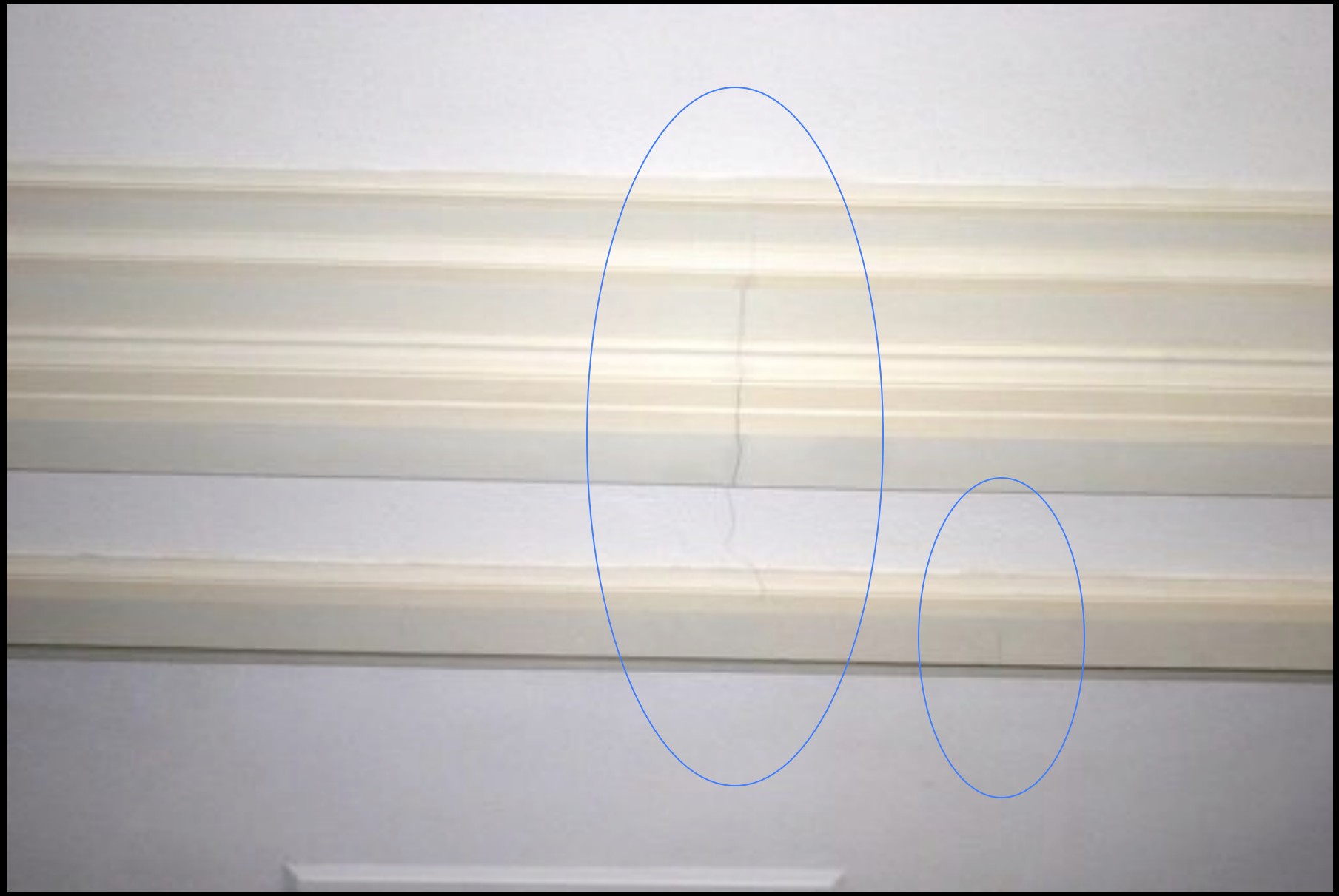
08/02/2005

- 1833 First Baptist Church, Savannah, GA
  - Water intrusion from 1833 to 1922

INITIAL CONCERNS

Plaster Cracking

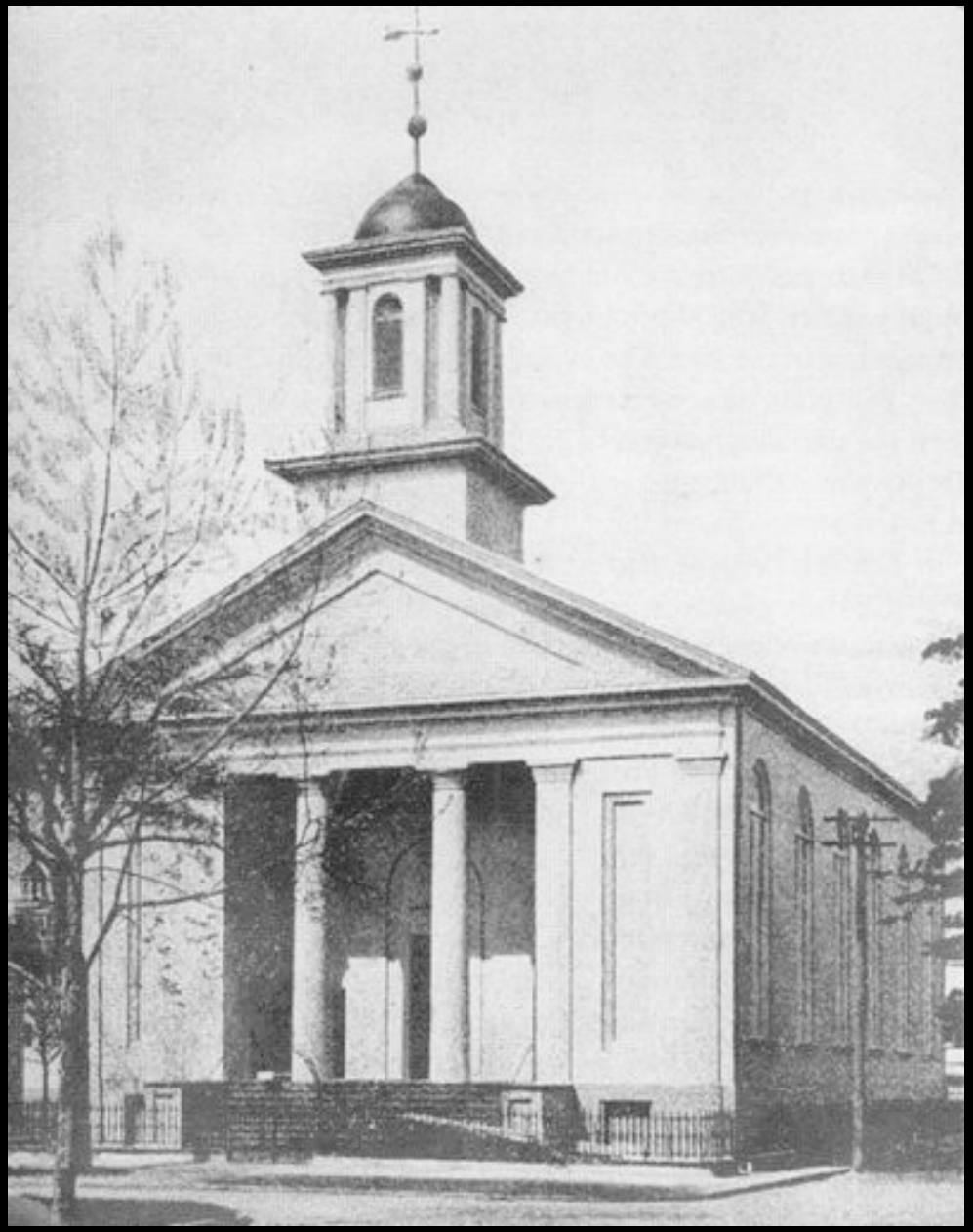


INITIAL CONCERNS

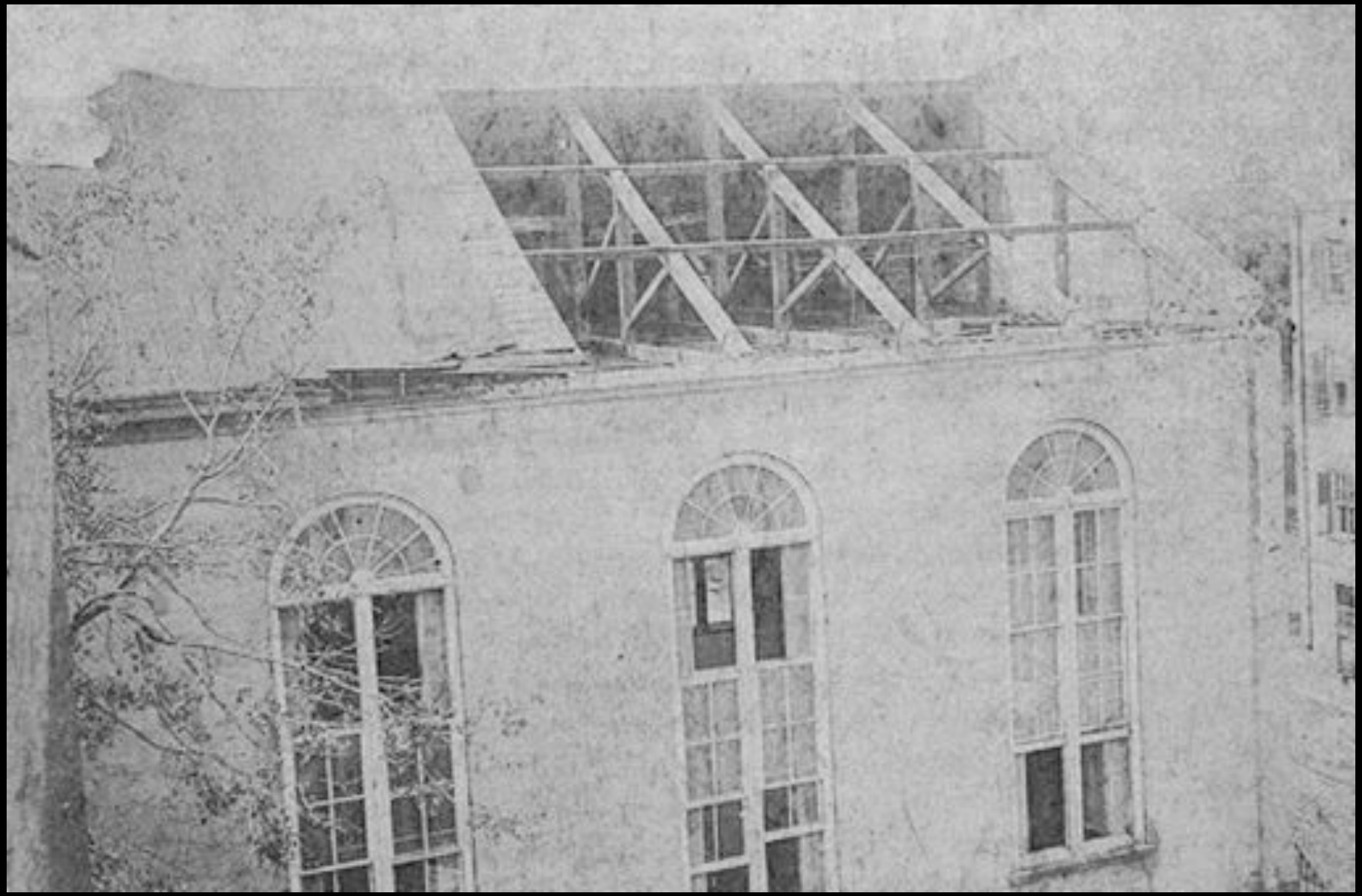
INITIAL CONCERNS

Historical Overview

Building completed, 1833
Designed by architect, Elias Carter

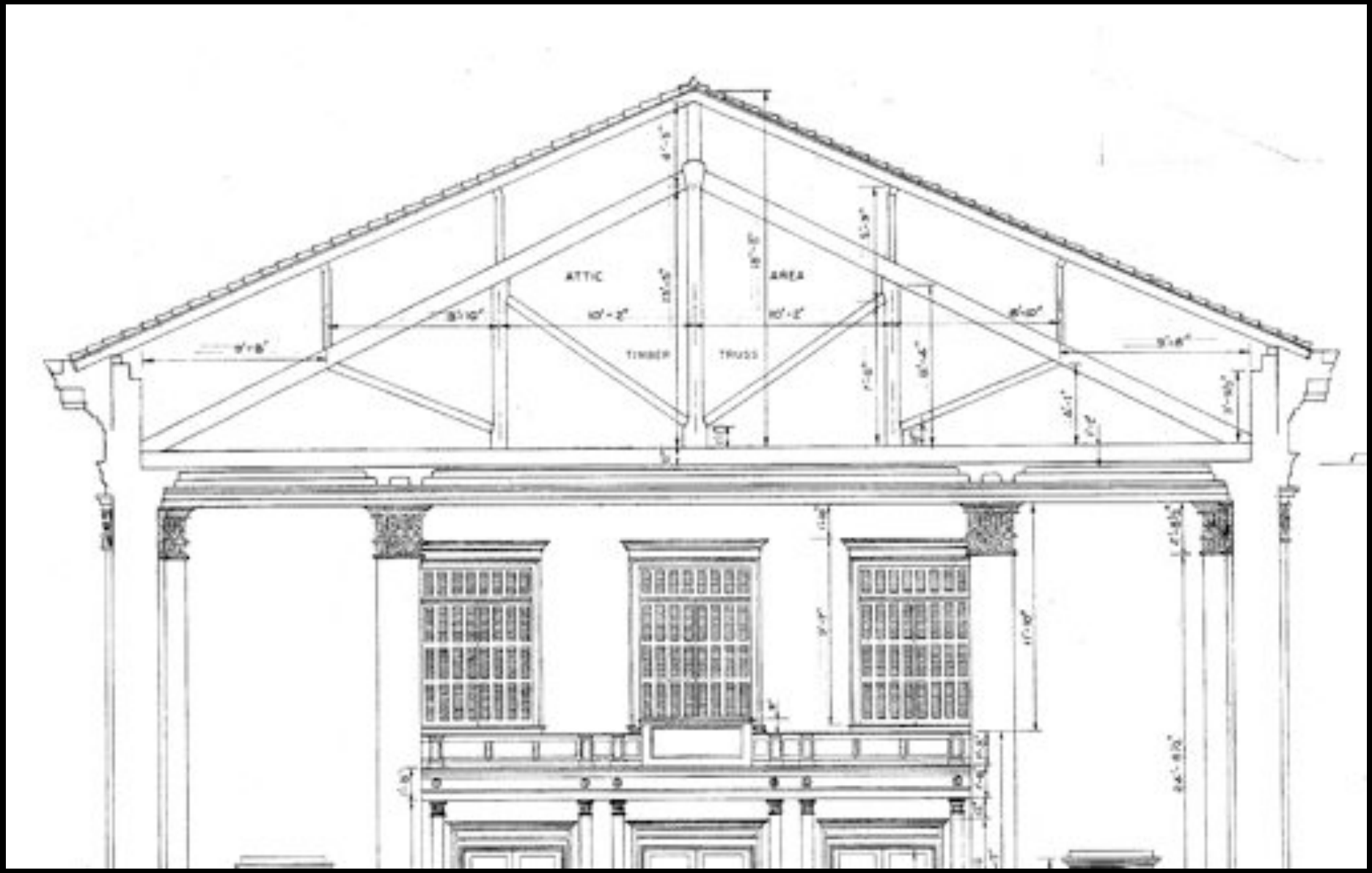


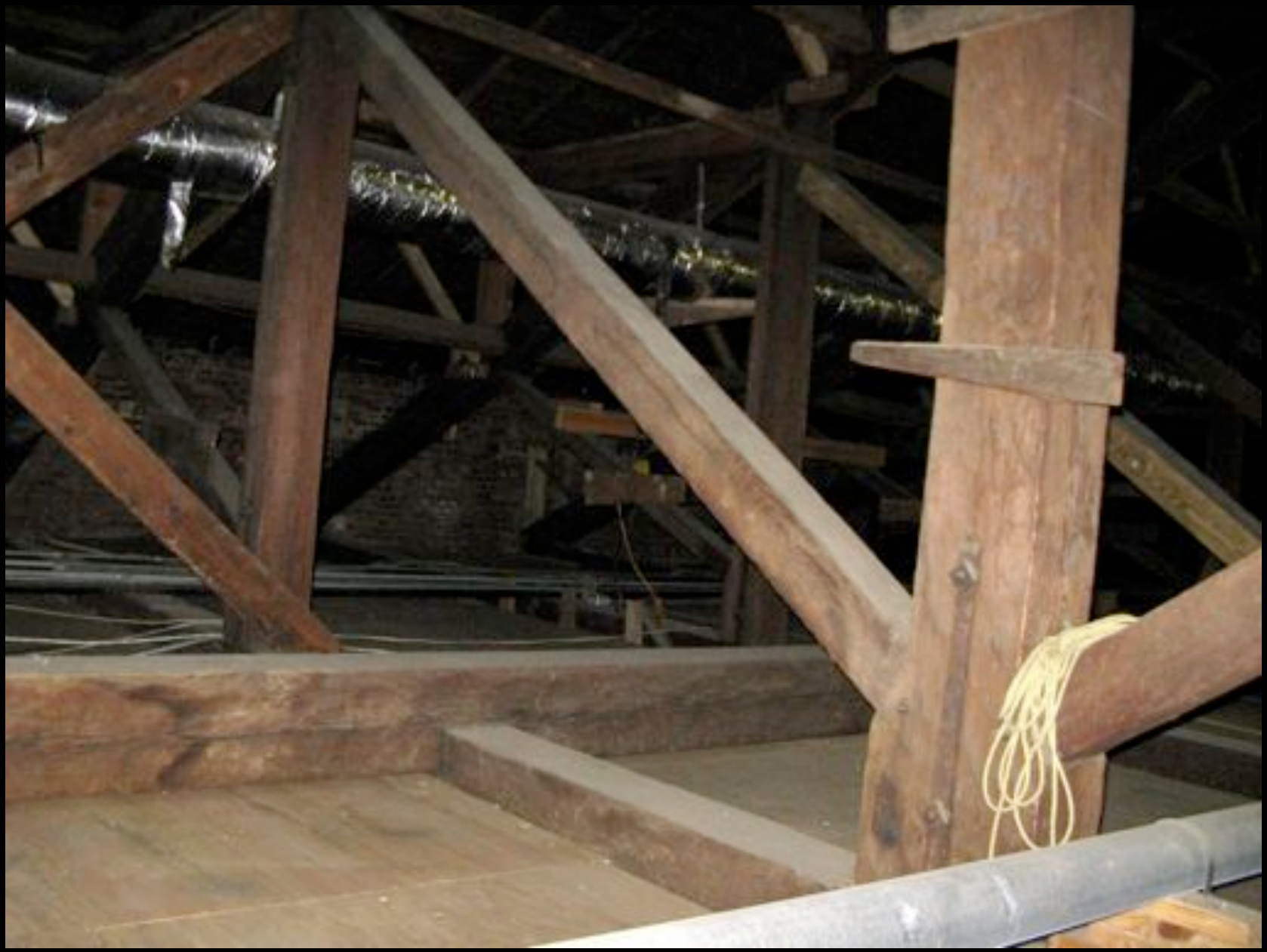
1897 Hurricane Damage



1897 Hurricane Damage

- 1921-1922 Renovations
- Architect, Henrick Wallin
- Cupola removed, portico enclosed, new portico added, and the entire façade clad in cast stone

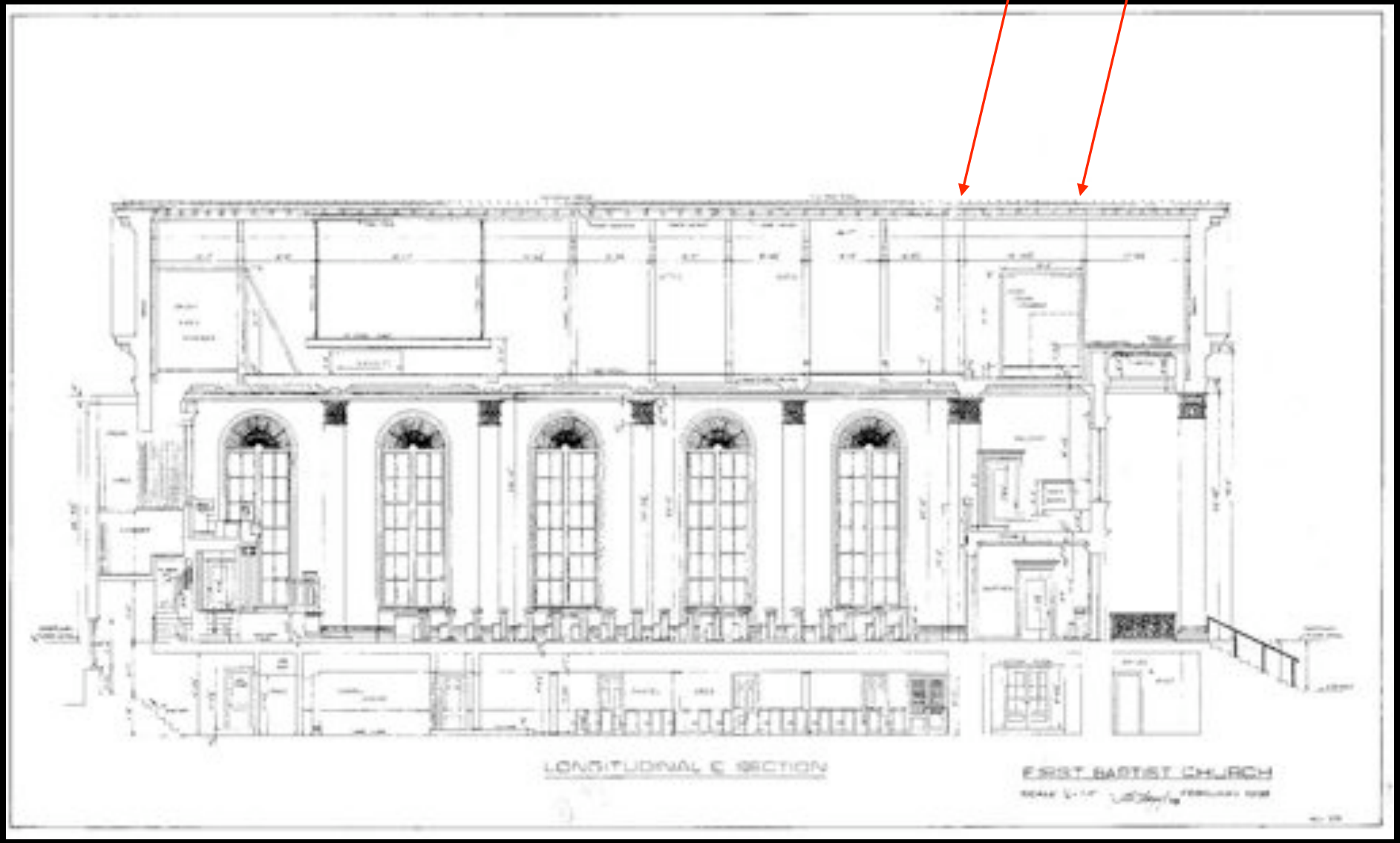

ATTIC
AREA
TIMBER
TRUSS




4

Roof line Deformation

Roof line Deformation



FINDINGS

Significant Truss Loads: Roof Loads

Plaster Cracking

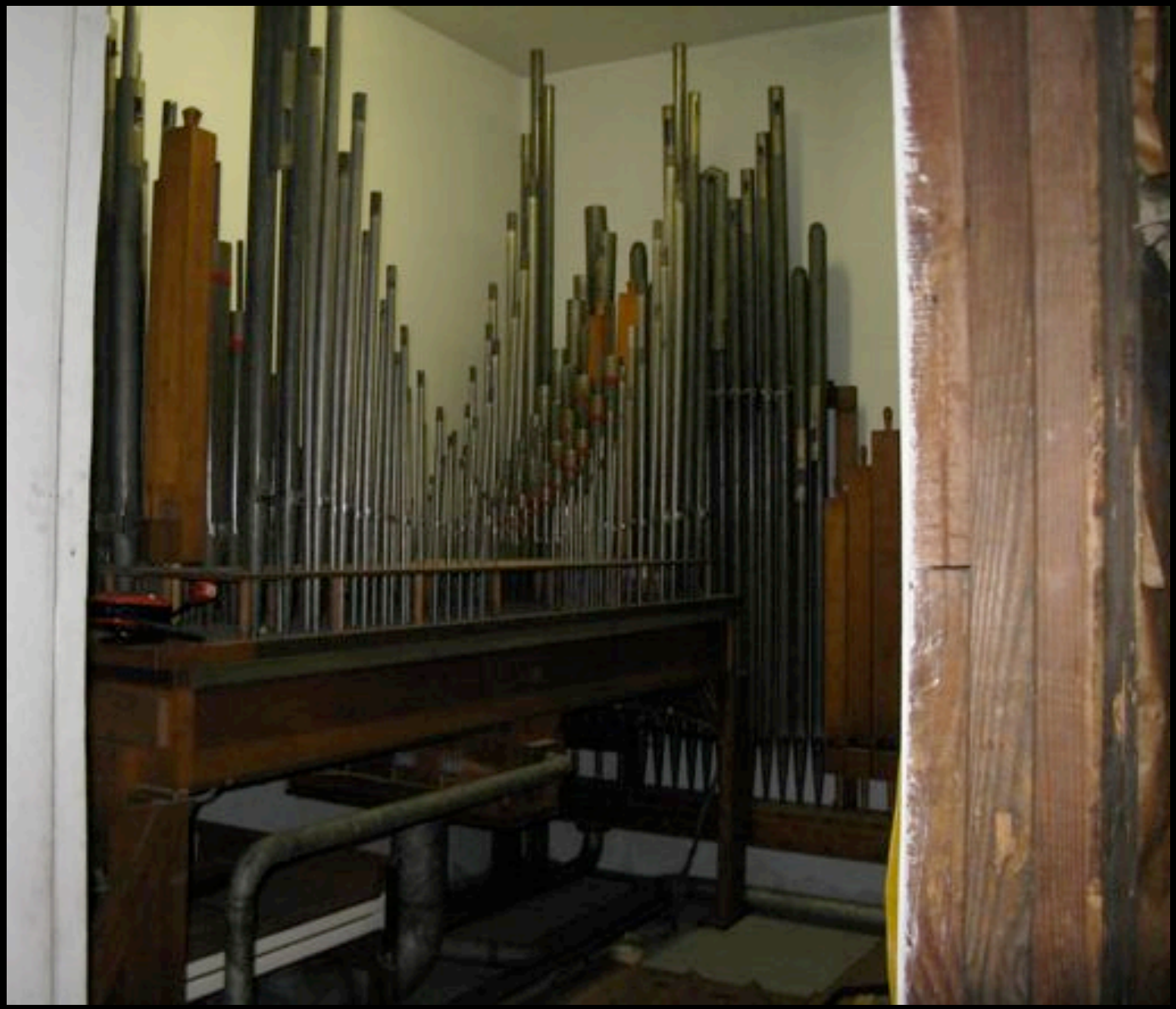
Cracking of the Pilasters

Plaster Cracking

Ceiling Deflection: Sanctuary

Significant Truss Loads: Large Girders

Significant Truss Loads: Organ Room



Significant Truss Loads: Additional Roof Framing

Bending of Bolts and Wooden Dowels

Sealed Truss Ends

Signs of Water Infiltration

Investigation of Damage and Deterioration of Trusses

FINDINGS

Investigation of Damage and Deterioration of Trusses

FINDINGS

Investigation of Damage and Deterioration of Trusses

FINDINGS

Deterioration: Truss Ends

Deterioration: Truss Ends

Termite Damage

Termite Damage

Termite Damage

Termite Damage

Splitting of Truss Members

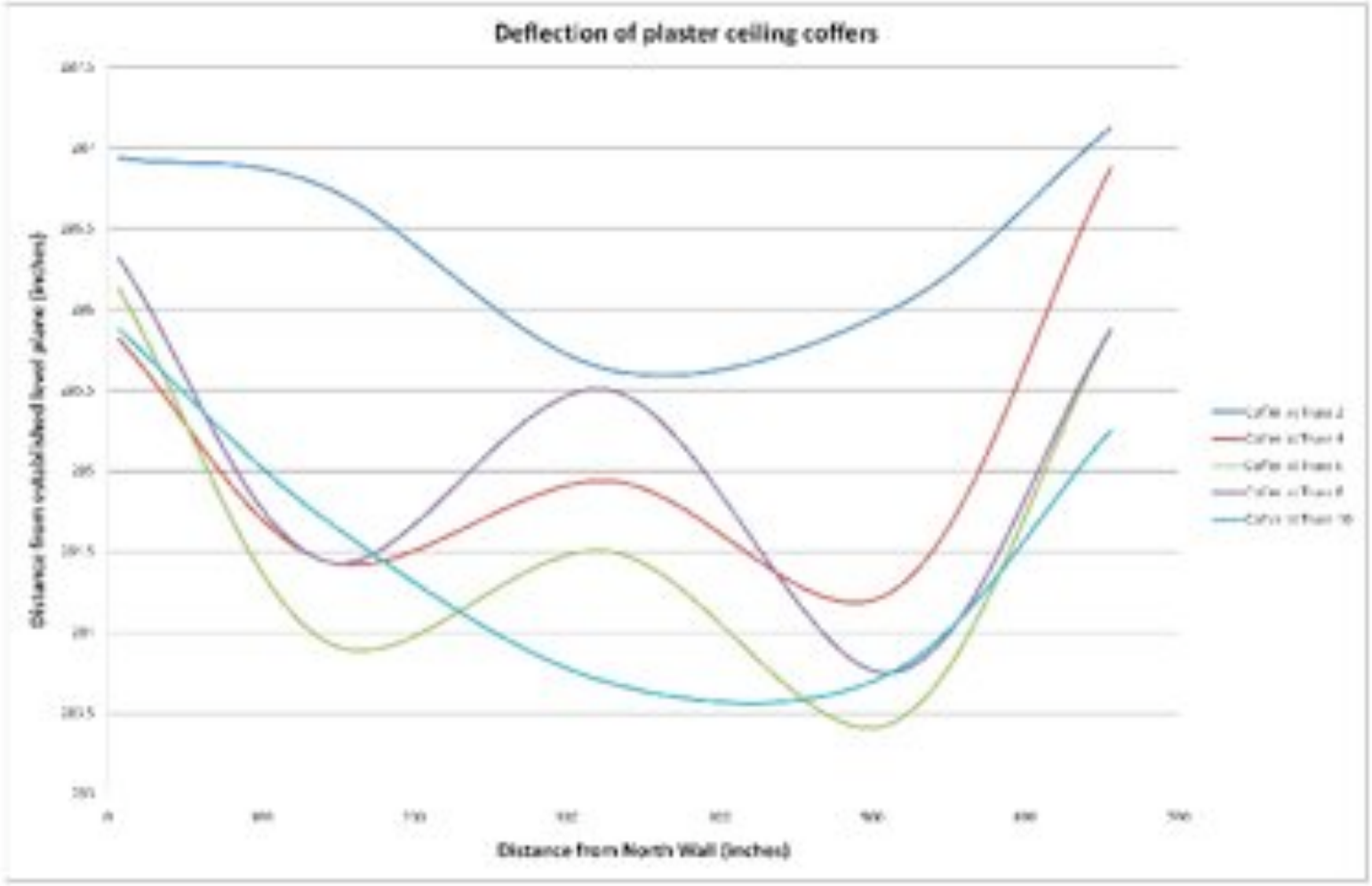
Splitting of Truss Members

Findings by Measurement

Site Measurements: Sanctuary Interior

Site Measurements: Sanctuary Interior

Ceiling Deflection Measurements



Note: Measurements for deflection recorded on October 3, 2008 using laser measurer and laser level. Benchmark at 51 7/8" above floor. Vertical clearance measured from centermost coffer.

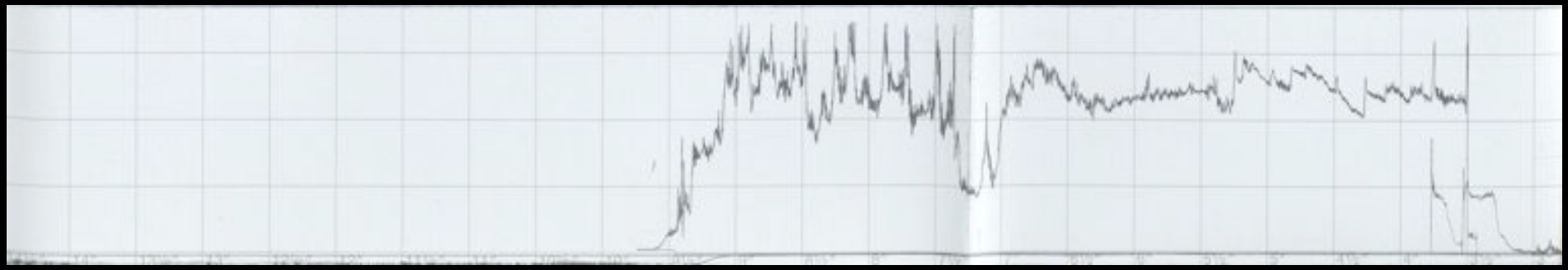
FINDINGS

Findings by Testing

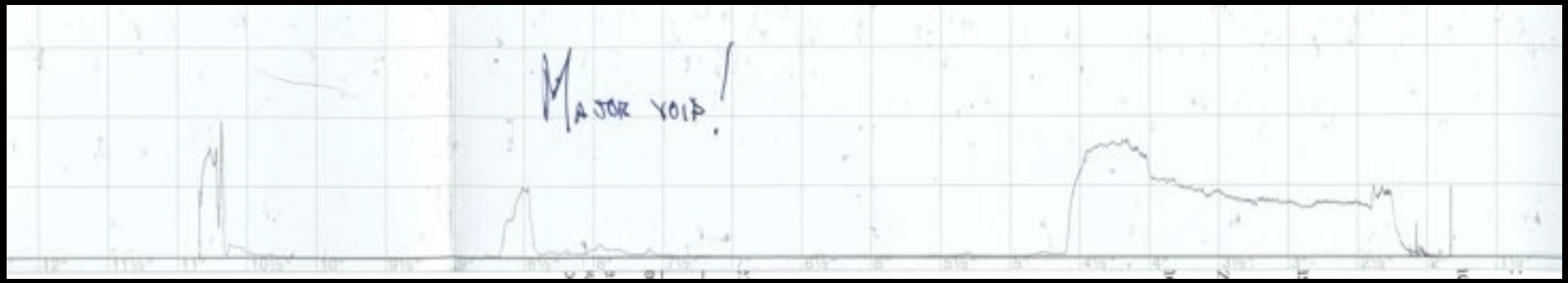
Resistance Drilling

Resistance Drilling

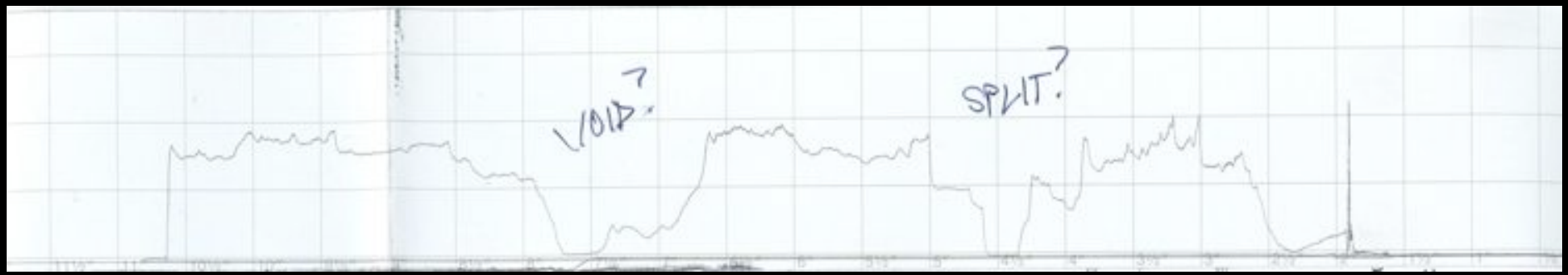
Results from Resistance Drilling



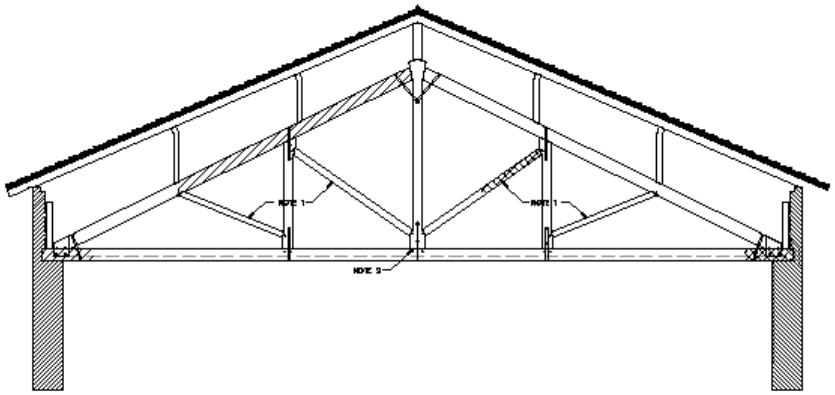
Truss 2: North end, west face



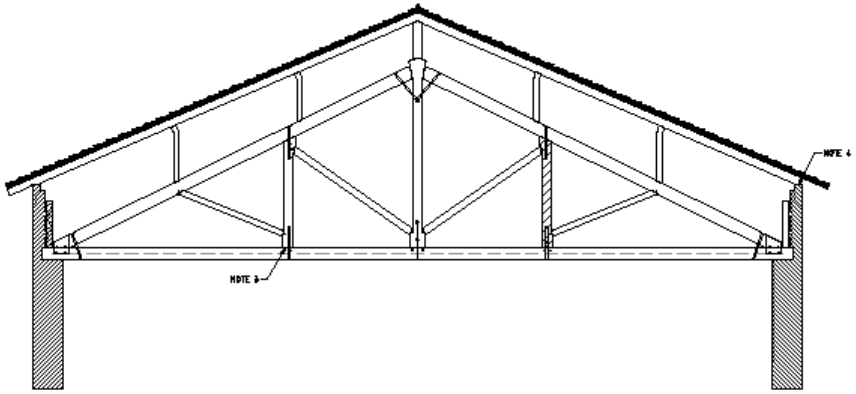
Truss 3: North end, east face



Truss 5: South end, west face



TRUSS 4 LOOKING WEST (A)
1/4" = 1'-0"



TRUSS 4 LOOKING EAST (B)
1/4" = 1'-0"

CHECKING IN MEMBER

SPLITTING IN MEMBER

TERMITE DAMAGE

1. EXISTING MEMBERS DISTORTED WITH NOMINAL GAPS, OR NO. PER 10' 1/2" SEALED AT 36" O.C. DUE TO INTERNAL INSECT INFESTATION.
2. BOTTOM CHORD HAS DROPPED 1/8" AWAY FROM KING POST. SUSPECT TERMITE DAMAGE.
3. 1/4" SEPARATION. 3 PCSS HAVE COME OUT PARTIALLY.
4. TERMITE DAMAGE IN ROOF JOISTS, RAFTERS AND SILL PLATE.

NO.	DATE	
1	–	–

First Baptist Church

Savannah, GA.

TRUSS 4

DWG JR.	
XXX	
TMA	
XXX	
AUGUST 20, 2008	
07-080	

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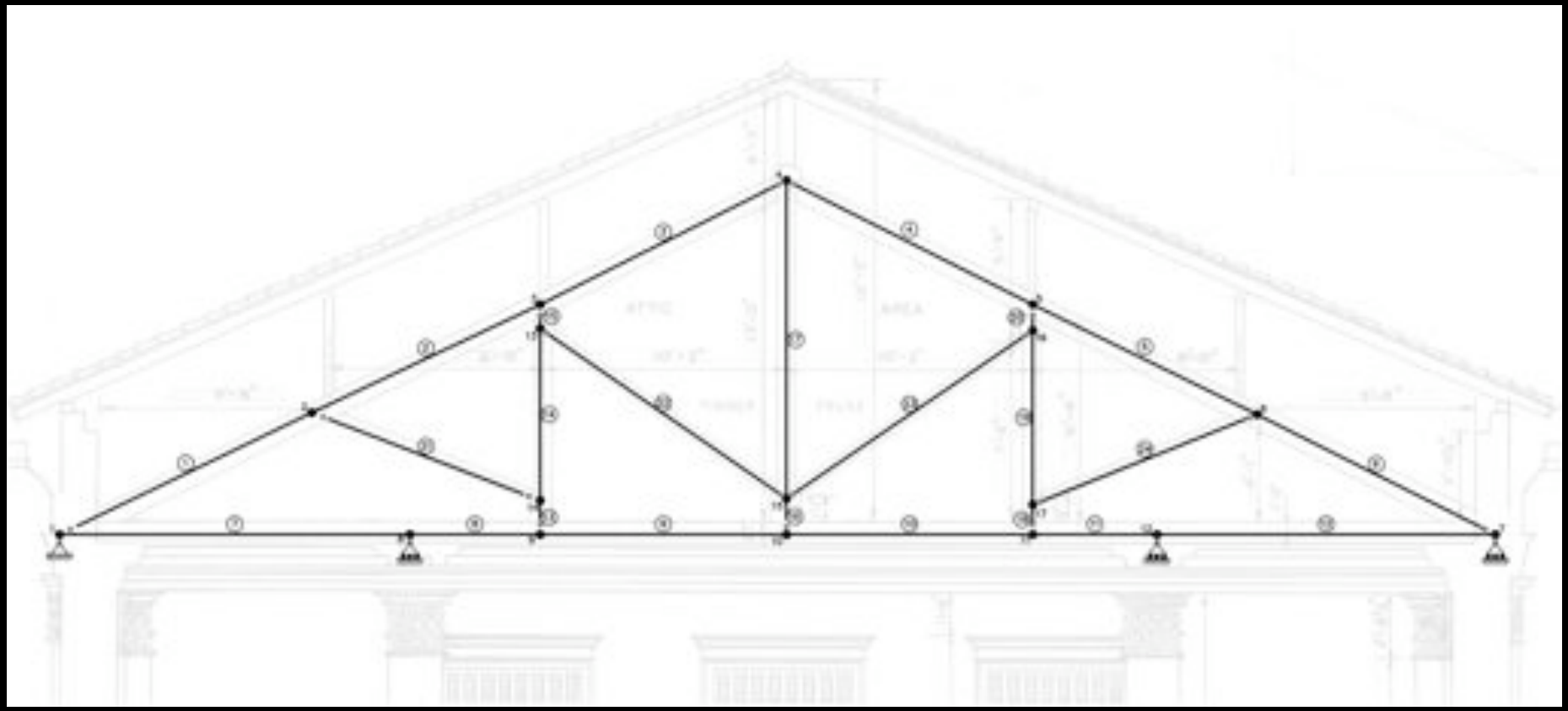
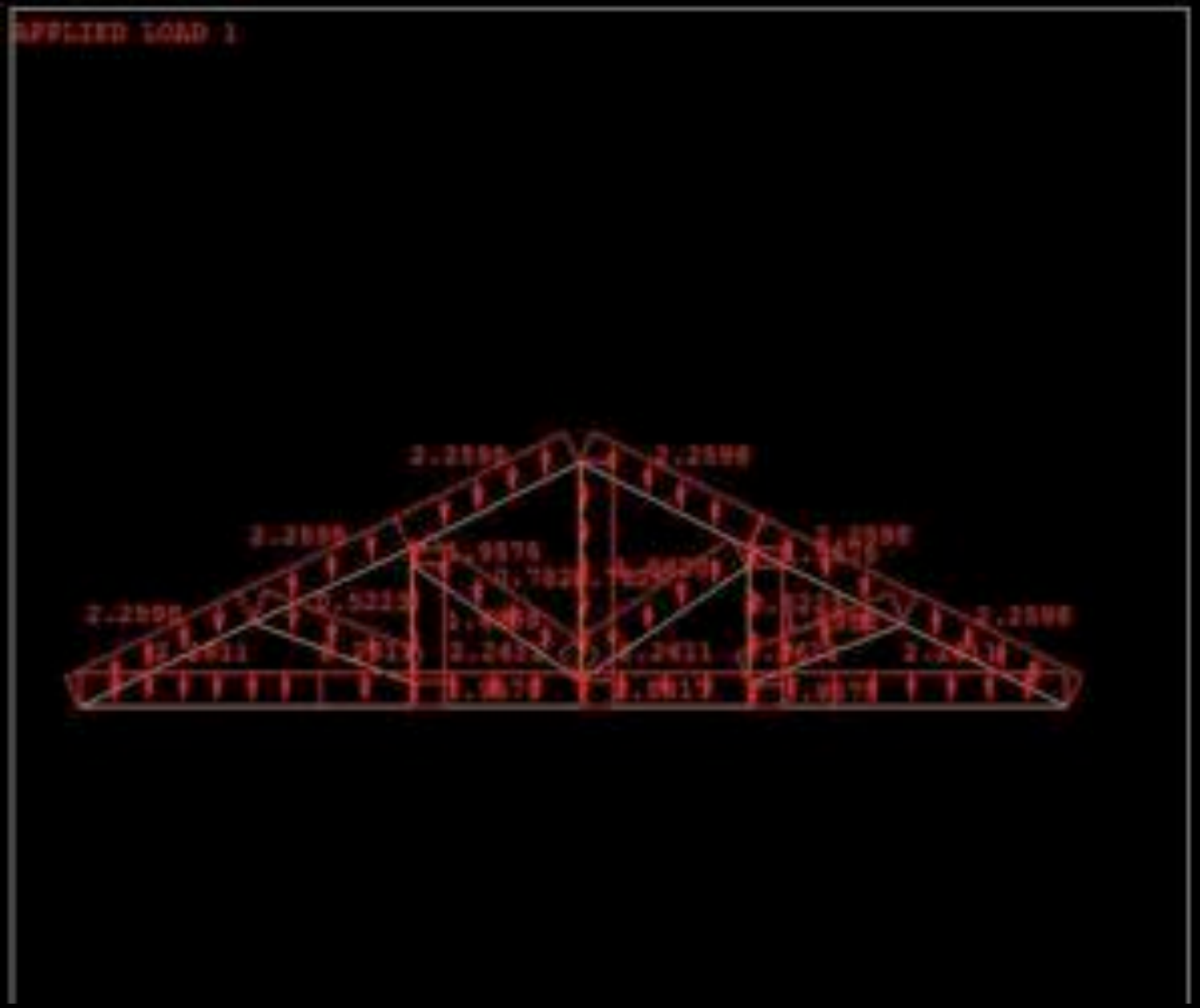
RECORDING OF CONDITIONS

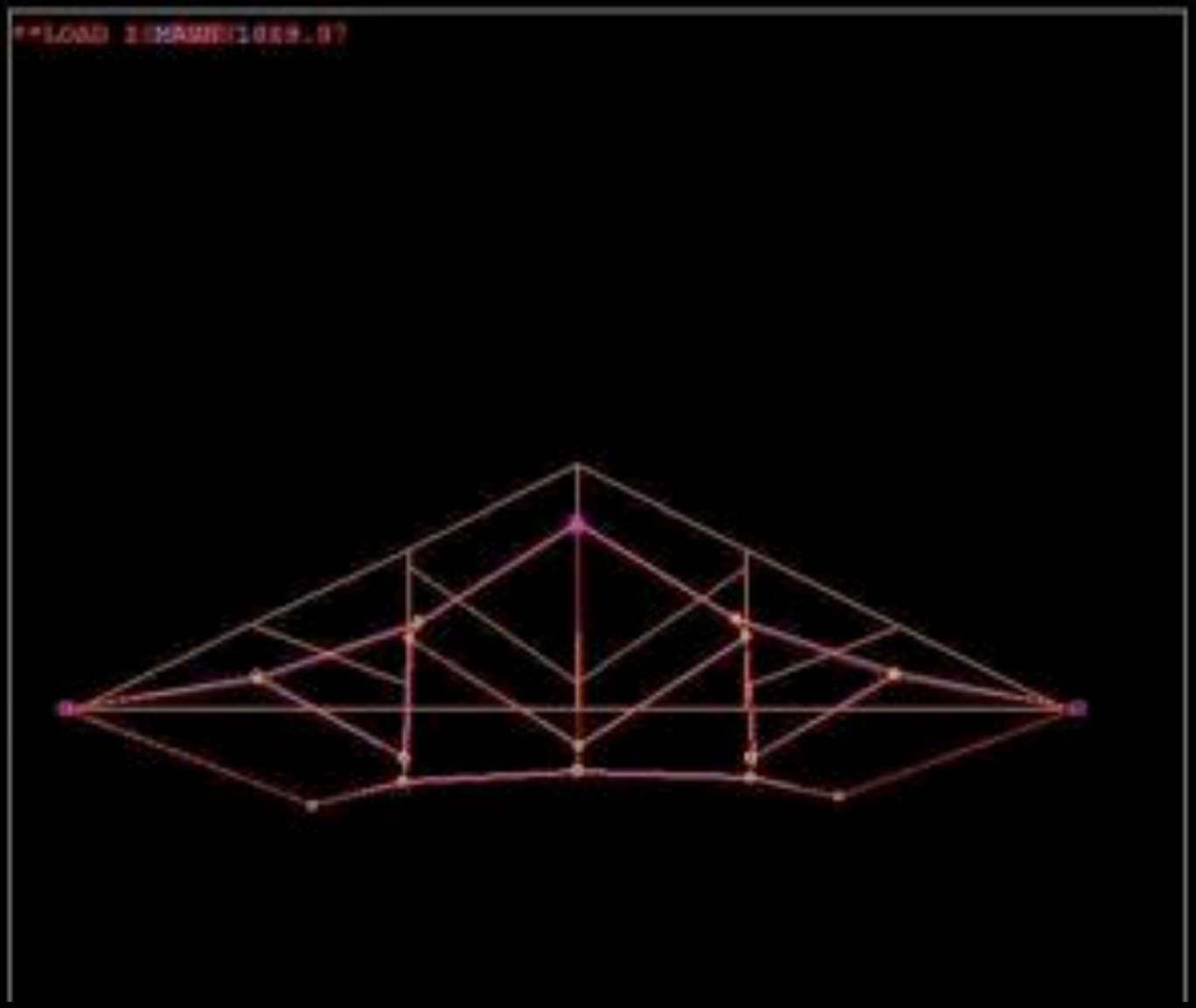
Findings by Computation



FINDINGS BY COMPUTATION

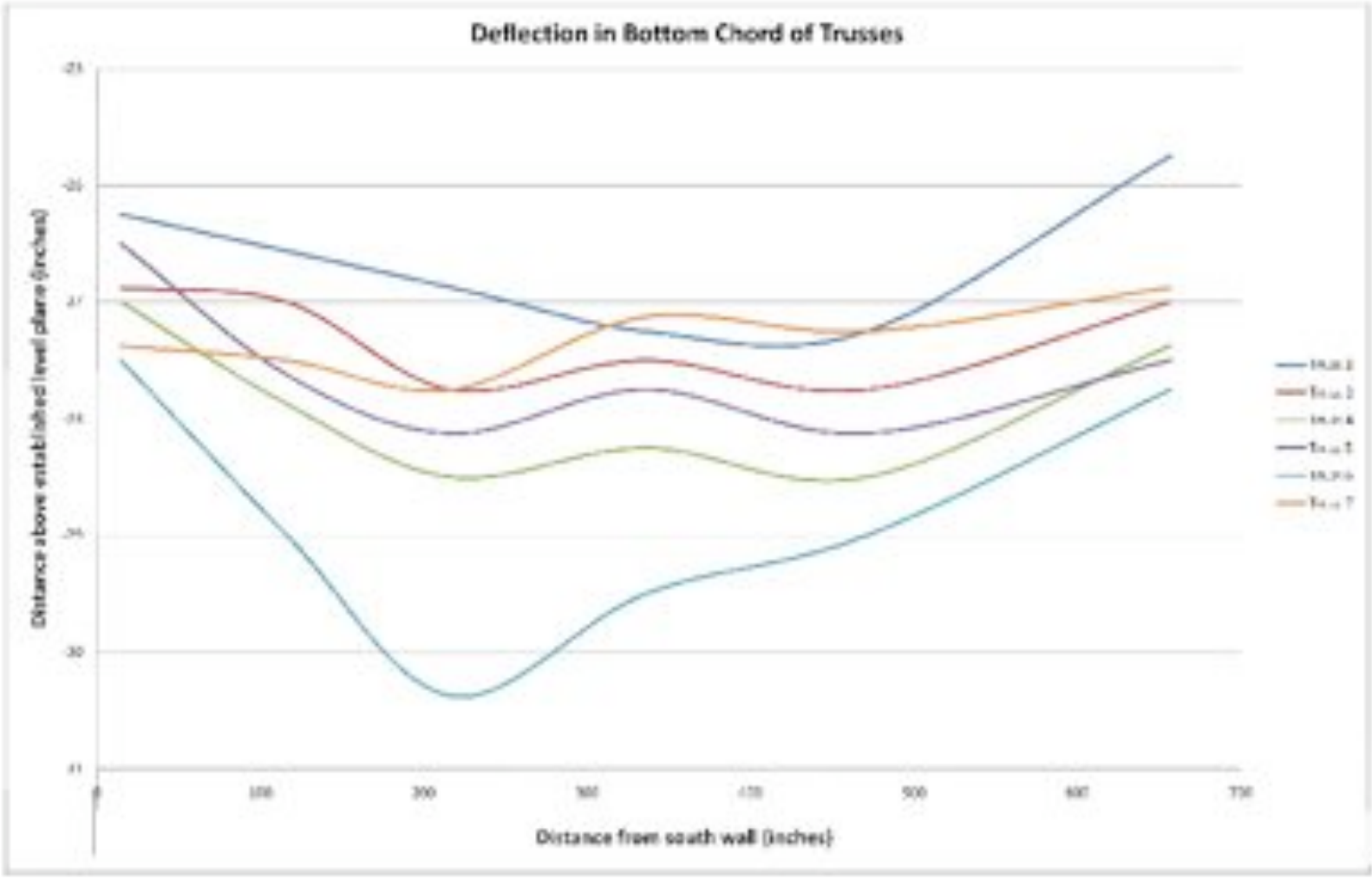


FINDINGS BY COMPUTATION



FINDINGS BY COMPUTATION

Truss Deflection Measurements



Note: Measurements for deflection recorded October 5, 2006 using laser instrument and chart level. Benchmark at 27 5/16" above bottom chord of truss (top of iron strap on west face of truss 21).

FINDINGS

Conclusions

1. The computed deflections of the trusses correlate with the observed behavior of the trusses.
2. Many truss connections are overloaded. Some of the original connections and some of the previous repairs are inadequate to carry the current loads.
3. Some of the truss members are overstressed.
4. Deterioration caused by termites and water infiltration, especially at the truss ends, has compromised the trusses.
5. There is some risk of plaster falling.

Recommendations

1. Install crack monitors on current cracks in the sanctuary ceiling.
2. Examine additional areas of termite damage to determine the extent of damage in other truss members
3. Strengthen the truss connections to adequately support the current loads and stresses.
4. Strengthen and repair truss members to adequately support the current loads and stresses.
5. Install plaster washers in the plaster ceiling of the sanctuary to better secure the ceiling to the trusses.

- 1849 Trinity Cathedral, Columbia, SC
  - Major damage to the trusses due to water intrusion

Trinity Episcopal Cathedral
Columbia, South Carolina

Structural Assessment and Recommendations for the Interior Trusses

Presentation Prepared for:

Trinity Episcopal Cathedral Vestry Meeting

Thursday, February 28, 2008

Prepared by:

Craig M. Bennett, Jr., PE, and Lyles McBratney, 4SE, Inc.

Wilson Farrell

History and Historical Significance

Date of Construction: 1846
Architect: Edward Brickell White

Initial Concerns

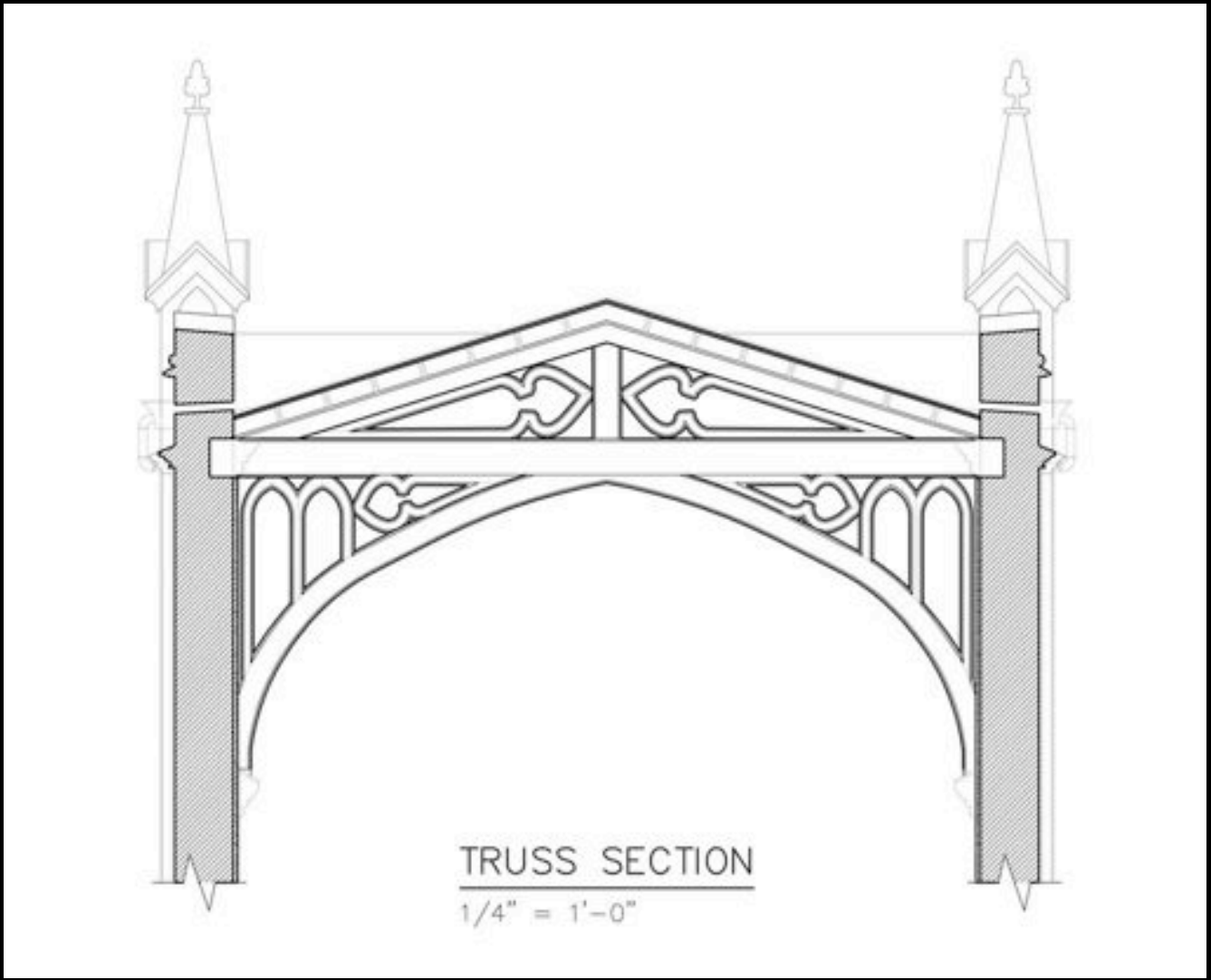
- Plaster deterioration due to water infiltration
- Separation of trusses from walls

Initial Concerns

- Plaster deterioration due to water infiltration
- Separation of trusses from walls

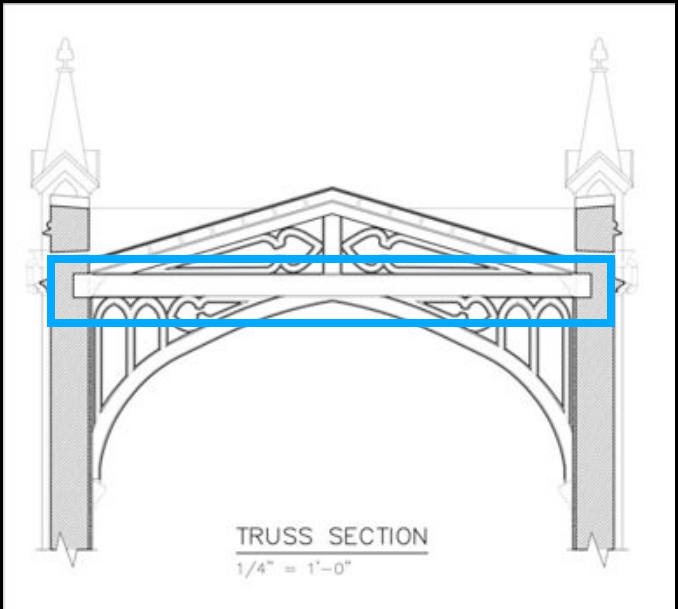
Truss Members of Transept Crossing

Truss Members of Nave

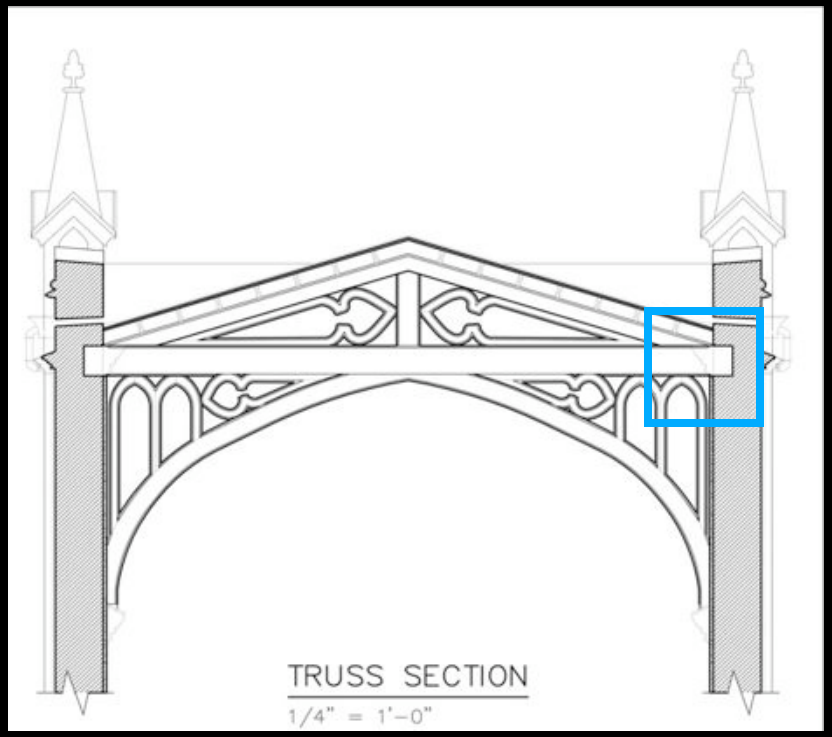


Truss Section of Nave

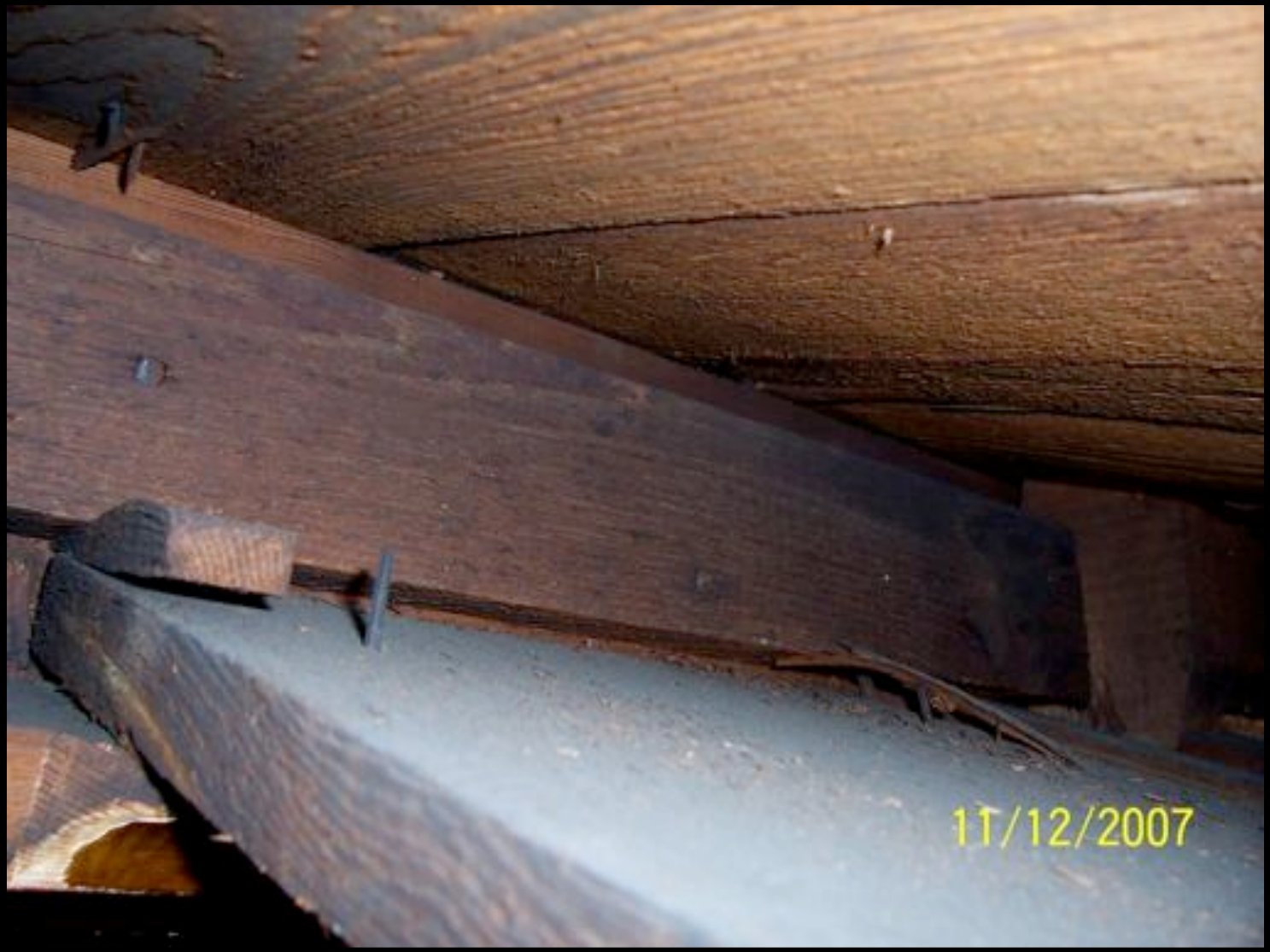
Each truss member is constructed of multiple pieces of wood.



The tie beam is constructed of a center core with four facing boards.



Intersection of tie beam
with masonry wall


11/12/2007

Surface Finishes

Investigation of Damage and Deterioration of Trusses

2 short videos

General Summary of Findings

- Termite Damage
- Truss separation from walls
- Roof line deformation
- Sagging of front rail of balcony
- Severe wood deterioration of trusses at masonry pockets
- Damage to masonry pockets
- Trusses have dropped significantly
- Crushing and splitting of truss members

Termite Damage

Truss separation from walls

Roof line deformation

Severe wood deterioration of trusses at masonry pockets

Damage to masonry pockets

Trusses have dropped significantly

Trusses have dropped significantly

Crushing and splitting of truss members

Crushing and splitting of truss members

Crushing and splitting of truss members

Crushing and splitting of truss members

Crushing and splitting of truss members

And from those three projects we learned that …..

- The fundamental causes of damage in these structures were….
  - Fort Washington, MD - Water intrusion
  - First Baptist Church, Savannah, GA - Increased load; Water intrusion leading to insect infestation
  - Trinity Cathedral, Columbia, SC - Water intrusion leading to insect infestation

- There is no single cause of damage to historic structures that can compare with water intrusion.

Finally, we came to the realization that …..

(Drum roll…. The most important slide…..)

Summary

- If you want a historic structure to last, *other than not catching it on fire*, there is nothing you can do that is more important than keeping the water out of the building.

So here's what you do with your historic structure …..

For earthquakes, hurricanes and tornados….

Masonry building:

- Keep the building in good condition,
  i.e. inspect and maintain the building.
- Tie the walls to the floors and the roof.

For earthquakes, hurricanes and tornados….

Wood frame building:

- Keep the building in good condition,
  i.e. inspect and maintain the building.

For fire ….

Any building:

- Have a fire detection system.
- Have a fire suppression system.

For termites ….

Any building:

- Inspect the building regularly.
- Treat for termites.
- Keep the water out.
- *i.e. Inspect and maintain the building.*

For creep (movement) in overstressed materials ….

Overstressed structural materials

- Strengthen the overstressed members.
- Reduce the load on the members.

For creep (movement) in overstressed materials ….

Soil settlement

- Maybe it’s not overstressed… has the water pattern around the building changed in the last couple of years?

For creep (movement) in overstressed materials ….

Soil settlement

- If it is overstressed, reduce the load on the soil, increase the bearing area or consider ground modification (very expensive.)

We've recommended inspection and maintenance. Let's look at these two.

Fortunately, Sharon Park has done all our work for us….

47 PRESERVATION BRIEFS

Maintaining the Exteriors of Small and Medium Size Historic Buildings

Sharon C. Park, FAIA

National Park Service
U.S. Department of the Interior

Heritage Preservation Services

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Preservation is defined as "the act or process of applying measures necessary to sustain the existing form, integrity and materials of an historic property. Work, including preliminary measures to protect and stabilize the property, generally focuses upon the ongoing maintenance and repair of historic materials and features rather than extensive replacement and new construction."[1]

Maintenance helps preserve the integrity of historic structures. If existing materials are regularly maintained and deterioration is significantly reduced or prevented, the integrity of materials and workmanship of the building is protected. Proper maintenance is the most cost effective method of extending the life of a building. As soon as a building is constructed, restored, or rehabilitated, physical care is needed to slow the natural process of deterioration. An older building has already experienced years of normal weathering and may have suffered from neglect or inappropriate work as well.

Decay is inevitable but deterioration can accelerate when the building envelope is not maintained on a regular basis. Surfaces and parts that were seamlessly joined when the building was constructed may gradually become loose or disconnected; materials that were once sound begin to show signs of weathering. If maintenance is deferred, a typical response is to rush in to fix what has been ignored, creating additional problems. Work done on a crisis level can favor inappropriate treatments that alter or damage historic material.

There are rewards for undertaking certain repetitive tasks consistently according to a set schedule. Routine and preventive care of building materials is the most effective way of slowing the natural process of deterioration. The survival of historic buildings in good condition is primarily due to regular upkeep and the preservation of historic materials.

Well-maintained properties tend to suffer less damage from storms, high winds, and even small earthquakes. Keeping the roof sound, structures and attachments such as shutters tightened and secured, and having joints and connections functioning well, strengthens the ability of older buildings to withstand natural occurrences.

Over time, the cost of maintenance is substantially less than the replacement of deteriorated historic features and involves considerably less disruption. Stopping decay before it is widespread helps keep the scale and complexity of work manageable for the owner.

This *Preservation Brief* is designed for those responsible for the care of small and medium size historic buildings, including owners, property administrators, in-house maintenance staff, volunteers, architects, and maintenance contractors. The Brief discusses the benefits of regular inspections, monitoring, and seasonal maintenance work; provides general guidance on maintenance treatments for historic building exteriors; and emphasizes the importance of keeping a written record of completed work.

Getting Started

Understanding how building materials and construction details function will help avoid treatments that are made in an attempt to simplify maintenance but which may also result in long-term damage. It is enticing to read about "maintenance free" products and systems, particularly waterproof sealers, rubberized paints, and synthetic siding, but there is no such thing as maintenance free when it comes to caring for historic buildings. Some approaches that initially seem to reduce maintenance requirements may over time actually accelerate deterioration.

Exterior building components, such as roofs, walls, openings, projections, and foundations, were often constructed with a variety of functional features, such as overhangs, drip edges, ventilated cavities, and painted surfaces, to protect against water infiltration, ultraviolet deterioration, air infiltration, and

Maintenance Plan, Schedules and Inspection

Organizing related work into a written set of procedures, or a Maintenance Plan, helps eliminate duplication, makes it easier to coordinate work effort, and creates a system for prioritizing maintenance tasks that takes into account the most vulnerable and character-defining elements.

The first time a property owner or manager establishes a maintenance plan or program, it is advisable to have help from a preservation architect, preservation consultant, and/or experienced contractor. Written procedures should outline step-by-step approaches that are custom- tailored to a building. No matter how small the property, every historic site should have a written guide for maintenance that can be as simple as:

1) Schedules and checklists for inspections;

2) Forms for recording work, blank base plans and elevations to be filled in during inspections and upon completion of work;

3) A set of base-line photographs to be augmented over time;

4) Current lists of contractors for help with complex issues or in case of emergencies;

5) Written procedures for the appropriate care of specific materials, including housekeeping, routine care, and preventive measures;

6) Record-keeping sections for work completed, costs, warranty cards, sample paint colors, and other pertinent material.

This information can be kept in one or more formats, such as a three-ring binder, file folders, or a computer database. It is important to keep the files current with completed work forms to facilitate long-term evaluations and planning for future work (Fig 2).

Proper maintenance depends on an organized plan with work prescribed in manageable components. Regular maintenance needs to be considered a priority both in terms of time allotted for inspections and for allocation of funding.

Maintenance work scheduling is generally based on a variety of factors, including the seriousness of the problem, type of work involved, seasonal appropriateness, product manufacturer's recommendations, and staff availability. There are other variables as well. For example, building materials and finishes on southern and western exposures will often weather faster than those on northern or eastern exposures. Horizontal surfaces facing skyward usually require greater maintenance than vertical ones; in regions with moderate or heavy rainfall, wood and other materials in prolonged shadow are subject to more rapid decay.

Maintenance costs can be controlled, in part, through careful planning, identification of the amount of labor required, and thoughtful scheduling of work. Maintenance schedules should take into account daily and seasonal activities of the property in order to maximize the uninterrupted time necessary to complete the work. Institutions generally need to budget annually between 2 and 4 percent of the replacement value of the building to underwrite the expense of full building maintenance.[2] Use of trained volunteers to undertake maintenance can help reduce costs.

Exterior inspections usually proceed from the roof down to the foundation, working on one elevation at

Cyclic Building Inspection Checklist: Horse Stable			Inspection date: 04/24/05	
Building Feature	*Material(s)*	*Condition Description*	*Maintenance Action Required*	*Work Done*
ROOF:				
Covering	Clay tile	Two slipped tiles	Reattach tiles	5/4/05
	Painted metal standing seam	Slight corrosion; blistering paint on metal roof section	Sand and repaint area that is peeling	6/8/05
Flashing	Painted metal	Flashing in good condition	N/A	N/A
Gutters/ Downspouts	6" half round galvanized metal	Gutter sagging; downspouts OK	Realign gutter and put on new hanger strap	5/4/05
			Flush out downspouts	5/5/05
Chimneys	No masonry chimney	N/A	N/A	N/A
Attachments/ Penetrations	Metal vent stack and weathervane	Vent stack hood has some peeling paint; vane OK	Sand and repaint vent stack	6/8/05

INSPECTION FREQUENCY CHART		
Feature	Minimum Inspection Frequency	Season
Roof	Annually	Spring or fall; every 5 years by roofer
Chimneys	Annually	Fall, prior to heating season; every 5 years by mason

Roof Drainage	6 months; more frequently as needed	Before and after wet season, during heavy rain
Exterior Walls and Porches	Annually	Spring, prior to summer/fall painting season
Windows	Annually	Spring, prior to summer/fall painting season
Foundation and Grade	Annually	Spring or during wet season

Building Perimeter	Annually	Winter, after leaves have dropped off trees
Entryways	Annually; heavily used entries may merit greater frequency	Spring, prior to summer/fall painting season
Doors	6 months; heavily used entry doors may merit greater frequency	Spring and fall; prior to heating/ cooling seasons

Doors	6 months; heavily used entry doors may merit greater frequency	Spring and fall; prior to heating/ cooling seasons
Attic	4 months, or after a major storm	Before, during and after wet season
Basement/ Crawlspace	4 months, or after a major storm	Before, during and after rain season

47 PRESERVATION BRIEFS

Maintaining the Exteriors of Small and Medium Size Historic Buildings

Sharon C. Park, FAIA

Getting Started

Cautions During Maintenance Work

Maintenance Plan, Schedules and Inspection

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6) Record-keeping sections for work completed, costs, warranty cards, sample paint colors, and other pertinent material.

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Exterior inspections usually proceed from the roof down to the foundation, working on one elevation at a time, moving around the building in a consistent direction. On the interior, the attic, inside surfaces of exterior walls, and crawlspaces or basements should be examined for signs of potential or existing problems with the building envelope.

The following chart lists suggested inspection frequencies for major features associated with the building's exterior, based on a temperate four-season climate and moderate levels of annual rainfall. For areas of different climate conditions and rainfall, such as in the more arid southwest, the nature of building decay and frequency of inspections will vary. For buildings with certain inherent conditions, heavy use patterns, or locations with more extreme weather conditions, the frequency of inspections should be altered accordingly.

Note: All building features should be inspected after any significant weather event such as a severe rainstorm or unusually high winds.

Cyclic Building Inspection Checklist: Horse Stable			Inspection date: 04/26/05	
Building Feature	Materials	Condition Description	Maintenance Action Required	Work Done
ROOF				
Covering	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
Flashing	[illegible]	[illegible]	N/A	N/A
Gutters/ Downspouts	[illegible]	[illegible]	[illegible]	[illegible]
			[illegible]	[illegible]
Chimney(s)	[illegible]	N/A	N/A	N/A
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

INSPECTION FREQUENCY CHART		
Feature	Minimum Inspection Frequency	Season
Roof	Annually	Spring or fall; every 3 years by roofer
Chimneys	Annually	Fall, prior to heating season; every 3 years by mason
Roof Drainage	6 months; more frequently as needed	Before and after wet season; during heavy rain
Exterior Walls and Porches	Annually	Spring, prior to summer/fall painting season
Windows	Annually	Spring, prior to summer/fall painting season
Foundation and Grade	Annually	Spring or during wet season
Building Perimeter	Annually	Winter, after leaves have dropped off trees
Entryways	Annually; heavily used entries may merit greater frequency	Spring, prior to summer/fall painting season
Doors	6 months; heavily used entry doors may merit greater frequency	Spring and fall, prior to heating/cooling seasons
Attic	6 months, or after a major storm	Before, during and after wet season
Basement/ Crawlspace	6 months, or after a major storm	Before, during and after rain season

Survey observations can be recorded on a standardized report form and photographs taken as a visual record. All deficient conditions should be recorded and placed on a written schedule to be corrected or monitored.

BUILDING COMPONENTS

For purposes of this discussion, the principal exterior surface areas have been divided into five components and are presented in order from the roof down to grade. While guidance for inspection and maintenance is provided for each component, this information is very general in nature and is not intended to be comprehensive in scope. Examples have been selected to address some typical maintenance needs and to help the reader avoid common mistakes.

Roofs/chimneys

The roof is designed to keep water out of a building. Thus one of the principal maintenance objectives is to ensure water flows off the roof and into functional gutters and downspouts directly to grade and away from the building – and to prevent water from penetrating the attic, exterior walls, and basement of a building. (Note: Some buildings were designed without gutters and thus assessments must be made as to whether rain water is being properly addressed at the foundation and perimeter grade.) Keeping gutters and downspouts cleared of debris is usually high on the list of regular maintenance activities (Fig. 3). Flashing around chimneys, parapets, dormers, and other appendages to the roof also merit regular inspection and appropriate maintenance when needed. The material covering the roof – wood shingles, slate, tile, asphalt, sheet metal, rolled roofing – requires maintenance both to ensure a watertight seal and to lengthen its service life; the type and frequency of maintenance varies with the roofing material. Older chimneys and parapets also require inspection and maintenance. With the exception of cleaning and minor repairs to gutters and downspouts, most roof maintenance work will necessitate use of an outside contractor.

Inspection:

The functioning of gutters and downspouts can be safely observed from the ground during rainy weather and when winter ice has collected. Binoculars are a useful tool in helping to identify potential roofing problems from the same safe vantage point. Careful observation from grade helps to identify maintenance needs between close-up inspections by an experienced roofer. Observation from the building interior is also important to identify possible leak locations. When access can be safely gained to the roof, it is important to wear shoes with slip-resistant soles and to use safety ropes.

Figure 3. Keeping gutters clean of debris can be one of the most important cyclical maintenance activities. On this small one-story addition, a garden hose is being used to flush out the trough to ensure that the gutter and downspouts are unobstructed. Gutters on most small and medium size buildings can be reached with an extension ladder and a garden hose. Photo: Bryan Blundell.

Depending on the nature of the roof, some common conditions of concern to look for are:

- sagging gutters and split downspouts;
- debris accumulating in gutters and valleys;
- overhanging branches rubbing against the roof or gutters;
- plant shoots growing out of chimneys;
- slipped, missing, cracked, buckling, delaminating, pooling, or broken roof coverings;
- deteriorated flashing and failing connections at any intersection of roof areas or of roof and adjacent wall;
- bubbled surfaces and moisture ponding on flat or low-sloped roofs;
- evidence of water leaks in the attic;
- misaligned or damaged chimney elements, such as deteriorated cowling, lightning rods, or antennas; and
- cracked masonry or damaged chimney caps.

Maintenance

• Remove leaves and other debris from gutters and downspouts. Utilize a ladder with a brace device, if necessary, to keep the ladder from crushing the gutter. Use a garden hose to flush out troughs and downspouts. Patch or repair holes in gutters using products such as fiberglass tape and epoxy adhesive to metal gutters. Avoid asphalt compounds since acidic material can cause further deterioration of metal gutters.

• Correct misaligned gutters and adjust, if necessary, so that water flows to drains and does not pond. If gutter edges sag, consider inserting wooden wedges between the fascia board and the back of the gutter to add support. Seal leaking seams or pinholes in gutters and elbows.

• Broom sweep branch or leaf debris away from shingles, valleys, and crickets, particularly around chimneys and dormers.

• Where mechanical equipment is mounted on flat or low-sloped roofs, ensure that access for maintenance can be provided without damaging the roof. Clean out trapped leaves and debris from around equipment base and consider adding a protective walkway for access.

• Remove biological growth where it is causing erosion or exfoliation of roofing. Use low-pressure garden hose water and a natural or nylon scrubbing brush to remove such growth, scraping with a plastic putty knife or similar wood or plastic tool as needed on heavier buildup. Most growth is acidic and while there are products designed to kill spores, such as diluted chlorine bleach, they should be avoided. Even fairly weak formulas can still cause unexpected color changes, efflorescence, or even splash damage to plantings or surfaces below the roof. Where appropriate, trim adjacent tree branches to increase sunlight on the roof since sunlight will deter further biological growth.

• Re-secure loose flashing at the dormers, chimneys or parapets. Clean out old mortar, lead, lead wool, or hemming material and make sure that flashing is properly inserted into joint (slot) seams, taking care not to damage the substrate. Avoid installing new step flashing to a single metal component where multiple pieces are required to provide proper waterproofing. Also avoid attaching step flashing with sealants or sealant. Properly re-bed all step flashing. Use appropriate non-ferrous flashing metal or painted metal if needed. Street cap, step, valley, cricket, and apron flashings each have specific overlap and orientation requirements; replacement flashing should match the existing material unless there has been a previous deficiency.

Figure 4. Damage to roofs often requires immediate attention. As a temporary measure, this damaged roof tile could be replaced with a brown aluminum sheet wedged between the existing tiles. Photo: Chad Randl.

• Repoint joints on chimneys, parapet, or hallcondo copying mortar using a hydraulic lime mortar or other suitable mortar where the existing mortar has eroded or cracked, allowing moisture penetration. In general, a mortar that is slightly weaker than the adjacent masonry should be used. This allows trapped moisture in the masonry to migrate out through the mortar and not the masonry. Spalled masonry is often evidence of the previous use of a mortar mix that was too hard.

• Use professional services to repair chimneys and caps. Avoid the use of mortar washes on masonry since they tend to crack, allowing moisture to penetrate and promoting masonry spalling. Repoint masonry with a durable mortar that is slightly weaker than the adjacent masonry. Shape the masonry mortar cap to ensure drainage away from the flue. If a chimney cap is not installed, ensure adequate venting and exhaust.

• As a temporary measure, slip pieces of non-corrosive metal flashing under or between damaged and missing roofing units until new slate, shingles, or tile can be attached. Repair broken, missing or damaged roofing units with ones that match. Follow roofing supplier and industry guidance on mounting and attaching replacement units (Fig 4). Avoid using temporary asphalt patches as it makes a proper repair difficult later on.

• For long-term preservation of wooden shingle roofs coated with a preservative, reseal every few years following the manufacturer's recommendations. Be aware of environmental considerations.

• Scrape and repaint selected areas of coated ferrous metal roofing as needed, repaint on a regularly

Figure 5. The use of a vented tri-axial or capped roof is an always an effective long-term solution. Where this decorative metal element connects to the slate roof, the original has failed within a short time and a proper metal flashing collar is being fitted instead. (Photo: Bryan Blundell)

scheduled basis. Ferrous metal roofs can last a long time if painted regularly. Alkyd coatings are generally used on metal roofs; be sure to wash and properly prepare the area beforehand. Environmental regulations may restrict the use of certain types of paints. Apply the coating system in accordance with manufacturer's recommendations. Prepare the surface prior to application to obtain good adhesion with the prime coat. Apply both a prime coat and a topcoat for good bonding and coverage; select primer and topcoat products from the same manufacturer.

• To secure loose decorative elements, such as finials and weathervanes. Seek professional advice if decorative elements exhibit considerable corrosion, wood rot, or structural instability. Small surface cracks may benefit from a flexible sealant to keep moisture out; sealants have a limited life and require careful inspection and periodic replacement (Fig 5).

Exterior Walls

Exterior walls are designed to help prevent water infiltration, control air infiltration, and serve as a barrier for unwanted animals, birds and insects. The primary maintenance objective is to keep walls in sound condition and to prevent water penetration, insect infestation, and needless decay (Fig 6). Depending on the materials and construction methods, walls should have an even appearance, free from unwanted cracks, and should be able to shed excess moisture. Where surfaces are significantly misaligned or where there are bulging wall surfaces

or cracks indicative of potential structural problems, seek professional guidance as to the cause of distress and appropriate corrective measures. Wood-frame construction generally will require more frequent maintenance than buildings constructed of brick, stone, or terra cotta (Fig 7).

Inspections

It is best to inspect walls during dry as well as wet weather. Look for moisture patterns that may appear on the walls after a heavy or sustained rainfall or snow, recording any patterns on elevation drawings or standard recording forms. Monitoring the interior wall for moisture or other potential problems is important as well. Look for movement in cracks, joints, and around windows and doors and try to establish whether movement is seasonal in nature (such as related to shrinkage of wood during dry weather) or signs of an ongoing problem. For moderate size buildings, a ladder or mechanical lift may be necessary though in some cases the use of binoculars and observations made from windows and other openings will be sufficient. When examining the walls, some common conditions of concern to look for are:

- Misaligned surfaces, bulging wall sections, cracks in masonry units, diagonal cracks in masonry joints, spalling masonry, open joints, and nail popping.
- Evidence of wood rot, insect infestation, and potentially damaging vegetative growth.
- Deficiencies in the attachment of wall-mounted lamps, flag pole brackets, signs, and similar items.
- Potential problems with penetrating features such as water spigots, electrical outlets, and vents.
- Excessive damp spots, often accompanied by staining, peeling paint, stress or mold, and
- General paint problems (Fig 8).

Maintenance

• Trim tree branches away from walls. Remove ivy and tendrils of climbing plants by first cutting at the base of the vine to allow tendrils to die back, and later using a plastic scraper to dislodge debris and an appropriate digging tool to dislodge and remove root systems. Be cautious if using a commercial chemical to accelerate root decay; follow safety directions and avoid contact of chemicals with windows and wall materials.

• Wash exterior wall surfaces if dirt or other deposits are causing damage or hiding deteriorating material

Figure 6. Stucco applied to an exterior wall or foundation was intended to function as a watertight surface. Unless maintained, moisture will penetrate open joints and cracks that may occur over time. A spalled section of stucco indicates some damage has occurred and a wooden mallet is being used to tap the surface to determine whether the remainder exists has lost adhesion. Photo: Bryan Blundell.

Figure 7. One of the advantages of wood shingles as a wall covering is that individual shingles that are damaged can easily be replaced. On this highly exposed corner, worn shingles have been selectively replaced to help safeguard against water damage. The new shingles will be stained to match the existing shingles.

Figure 8. The paint on the siding of this south-facing wall needs to be scraped, sanded, primed and repainted. Postponing such work will lead to further paint failure, require greater preparatory work, and could even result in the need to replace some siding. Photo: Charles Fisher.

Figure 9. To help extend a repainting cycle, dirt and chalky soils should be removed before permanent staining occurs. In this case, a natural bristle brush and a soft damp cloth are being used to remove loose debris and refresh the surface appearance.

scheduled times for cleaning for cosmetic purposes to reduce frequency (Fig 9). When cleaning, use the gentlest means possible, start with natural bristle brushes and water and only add a mild phosphate-free detergent if necessary. Use non-abrasive cleaning methods and low-pressure water from a garden hose. For most building materials, such as wood and brick, avoid abrasive methods such as mechanical scrapers and high-pressure water or air and such additives as sand, natural soda, ice crystals, or rubber products. All abrasives remove some portion of the surface and power-washing drives excessive moisture into wall materials and even into wall cavities and interior walls. If using a mild detergent, two people are recommended, one to brush and one to prevent soil reuse. When graffiti or stains are present, consult a preservation specialist who may use poultices or mild chemicals to remove the stain. If the entire building needs cleaning other than described above, consult a specialist.

• Repoint masonry in areas where mortar is loose or where masonry units have settled. Besides cause of cracks or failure before treating units and repointing. Rake out joints by hand, generally avoiding rotary saws or drills, to a depth of 2 ½ times the width of the joint (or until sound mortar is encountered), to make sure that fresh mortar will not pop out. Repointing mortar should be lime-rich and formulated to be slightly weaker than the masonry units and to match this historic mortar in color, width, appearance, and tooling. Off-the-shelf pre-mixed cement mortars are not appropriate for most historic buildings. Avoid use of joint sealants in place of mortar on vertical masonry wall surfaces, as they are not breathable and can lead to moisture-related damage of the adjacent masonry (Fig 10).

• Correct areas that trap unwanted moisture. Damaged brick or stone units can sometimes be corrected, turned around, and reset, or replaced with salvaged units. Other, using traditional or contemporary materials for patching, wood, masonry, stucco, or other materials, ensure that the materials are compatible with the substrate in terms of strength, vapor permeability, and thermal expansion, as well as appearance.

• When patching is required, select a compatible patch material. Prepare substrate and install patch material according to manufacturer's recommendations respect existing joints. Small or shallow surface defects may not require patching. Large or deep surface defects may be better addressed by installation of a dutchman unit than by patching.

• Where a damaged area is too large to patch, consider replacing the section with in-kind material. For stucco and adobe materials, traditional patching techniques are recommended.

• When temporarily removing wood siding to repair framing or to tighten corner boards and frieze trim, reuse the existing siding where possible. Consider using stainless steel or high-strength aluminum nails as appropriate. Fully or fill nail holes flush with siding prior to repainting. Back-prime any installed wood with

[illegible] Portland cement mortar trapped water and resulted in further damage to these 19th century bricks. [illegible]

one coat of primer and rust and grain that might be exposed with two coats of primer.

• Prepare, prime, and spot paint areas needing repainting. Remember that preparation is the key to a successful long lasting paint job. Ensure beforehand the compatibility of new and existing paints to avoid premature paint failure. Remove loose paint to a sound substrate, sand or gently rough surface if needed for a good paint bond, wipe clean, and repaint with appropriate primer and topcoats. Follow manufacturer's recommendations for application of coatings, including temperature parameters for paint application. Use top quality coating materials. Generally paint when sun is not shining directly onto surfaces to be painted.

• Remove deteriorated caulks and sealants, clean, and reapply appropriate caulks and sealants using backer rods as necessary. Follow manufacturer's instructions regarding preparation and installation.

• Correct deficiencies in any wall attachments such as awning and flag pole anchors, improperly installed electrical outlets, or loose water spigots.

Openings

Exterior wall openings primarily consist of doors, windows, storefronts, and passageways. The major maintenance objectives are to retain the functioning nature of the opening and to keep in sound condition the connection between the opening and the wall in order to reduce air and water infiltration.

Inspection:

Wall openings are typically inspected from inside as well as out. Examinations should include the overall material condition; a check for unwanted water penetration, insect infiltration, or animal entry; and identification of where openings may not be properly functioning. Frames should be checked to make sure they are not loose and to ascertain whether the intersection between the wall and the frame is properly sealed. Secure connections of glazing to sash and between sash and frames are also important. Particular attention should be placed on exposed horizontal surfaces of storefronts and window frames as they tend to deteriorate much faster than vertical surfaces. Inspections should identify:

- loose frames, doors, sash, shutters, screens, storefront components, and signs that present safety hazards;
- slipped sills and tipped or cupped thresholds;
- poorly fitting units and storm assemblies, misaligned frames, drag marks on thresholds from sagging doors and storm doors;
- loose, open, or decayed joints in door and window frames, doors and sash, shutters, and storefronts;
- loose hardware, broken sash cords/chains, worn sash pulleys, cracked awning, shutter and window hardware, locking difficulties, and deteriorated weatherstripping and flashing;
- broken/cracked glass, loose or missing glazing and putty;
- peeling paint, corrosion or rust stains; and
- window well debris accumulation, heavy bird droppings, and termite and carpenter ant damage.

Maintenance:

• Replace broken or missing glass as soon as possible; in some cases cracked glass may be repaired using specialty glues. For historic crown glass and early cylinder glass, a conservation approach should be considered to repair limited cracks. Where panes with a distinct appearance are missing, specialty glass should be obtained to match, with sufficient inventory kept for future needs. Avoid using mechanical devices to remove old putty and match historic putty bevels or details when undertaking work.

• Reputty window glazing where putty is deteriorated or missing. Take care in removing putty so as not to crack or break old glass or damage muntins and sash frames. Re-glaze with either traditionally formulated

Figure 11. Glazing putty should be maintained in sound condition to prevent unwanted air infiltration and water damage. [illegible]

oil putties or modern synthetic ones, making sure to properly bed the glass and secure with glazing points (Fig 11).

• Clean window glass, door glazing, storefronts, transom prism lights, garage doors, and storm panels using a mild vinegar and water mixture or a non-alkaline commercial window cleaner. Be cautious with compounds that contain ammonia as they may stain brass or bronze hardware elements if not totally removed. When using a squeegee blade or sponge, wipe wet corners with a soft dry cloth. Avoid high-pressure washes.

• Clean handles, locks and similar hardware with a soft, damp cloth. Use mineral spirits or commercial cleaners very sparingly as repeated use may remove original finishes. Most metal cleaners include ammonia that can streak and stain metal, so it is important to remove all cleaning residue. Polished hardware subject to tarnishing or oxidation, particularly doorknobs, often benefits from a thin coat of paste wax (carnauba), hand buffed to remove extra residue. Avoid lacquer finishes for high use areas, as they require more intensive maintenance. Patinated finishes should not be cleaned with any chemicals, since the subtle aged appearance contributes to the building's character.

• Remove and clean hardware before painting doors and windows; reinstall after the paint has dried.

• Tighten screws in doorframes and lubricate door hinges, awning hardware, garage door mechanisms, window sash chains, and pulleys using a graphite or silicone type lubricant.

Contracting Maintenance and Repair Work

Many contractors are very proficient in using modern construction methods and materials; however, they may not have the experience or skill required to carry out maintenance on historic buildings. The following are tips to use when selecting a contractor to work on your historic building:

1. [illegible]
2. Be as specific as possible in defining the scope of work you expect to undertake.
3. Ask potential contractors for multiple references. [illegible]
4. [illegible]
5. [illegible]
6. Ensure that the contractor has all necessary insurance, licenses and workers' compensation.

• Check weather stripping on doors and windows and adjust or replace as necessary. Use a durable type of weather stripping, such as spring metal or high quality synthetic material, avoiding common brush and felt or pile weather stripping that require more frequent replacement.

• Adjust steel casement windows as needed for proper alignment and tight fit. Avoid additional weather stripping as this may lead to further misalignment, creating pathways for air and water infiltration.

• Check window sills for proper drainage. Fill cracks in wood sills with a wood filler or epoxy. Follow manufacturer's instructions for preparation and installation. Do not cover over a wood sill with metal paneling, as it may trap moisture and promote decay.

• Repair, prime, and repaint windows, doors, frames, and sills when needed. Clean out putty debris and paint chips from windows using a wet paper towel and dispose of debris prior to repair or repainting. Take appropriate additional precautions when removing lead-based paint. Sand and prepare surfaces and use material-specific patching compounds to fill any holes or areas collecting moisture (Fig 12). Avoid leaving exposed wood unpainted for any length of time, as light will degrade the wood surface and lead to premature failure of subsequent paint applications. Immediately prime steel sash after paint is removed and the substrate prepared for repainting.

• Adjust wood sash that bind when operated. Apply beeswax, paraffin, or similar material to tracks or sash runs for ease of movement. If sash are loose, replace worn parting beads. Sash runs traditionally were separated between the stop and parting bead; removing subsequent paint applications will often help improve sash operation.

• Correct perimeter cracks around windows and doors to prevent water and air infiltration. Use traditional material or modern sealants as appropriate. If fillers such as lead wool have been used, new wool can be inserted with a thin blade tool, taking care to avoid damage to adjacent trim. Reduce excess air infiltration around windows by repairing and lubricating sash locks so that windows close tightly.

Figure 12. Good surface preparation is essential for long lasting paint. Scraping loose paint, filling nail holes and cracks, sanding, and wiping with a damp cloth prior to repainting are all important steps whether touching up small areas or repainting an entire feature. Always use a manufacturer's best quality paint. Windows and shutters may need repainting every five to seven years, depending on exposure and climate.

Figure 13. Window air conditioning units can cause damage to surfaces below where condensation drips in an uncontrolled manner. Drip extension tubes can sometimes be added to direct the discharge.

• Remove debris beneath window air conditioning units and ensure that water from units does not drain onto sills or wall surfaces below (Fig 13). Removal of air conditioning units when not in season is recommended.

• Adjust storm panels and clean weep holes; check that weep holes at the bottom of the panels are open so water will not be trapped on the sill. Exterior applied storm windows are best attached using screws and not tightly adhered with sealant. Use of sealant makes storm units difficult to remove for maintenance and can contribute to moisture entrapment if weep holes become clogged.

• Remove weakened or loose shutters and store for later repair. Consider adding a zinc or painted metal top to shutters as a protective cap to cover the wood's exposed end grain. This will extend the life of the shutters.

Projections

Numerous projections may exist on a historic building, such as porches, dormers, skylights, balconies, fire escapes, and bonnets/eyes. They are often composed of several different materials and may include an independent roof. Principal maintenance objectives include directing moisture off these features and keeping weathered surfaces in good condition. Secondary projections may include brackets, lamps, hanging signs, and similar items that tend to be exposed to the elements.

Inspection

In some cases, projections are essentially independent units of a building and so must be evaluated carefully for possible settlement, separation from the main body of the building, and materials deterioration. Some electrical features may require inspection by a electrician or service technician. Common conditions of concern to look for are:

- damaged flashing or tie-in connections of projecting elements;
- misaligned posts and railings;
- deteriorated finishes and materials, including peeling paint, cupped and warped decking, wood deterioration, and hazardous steps;
- evidence of termites, carpenter ants, bees, or animal pests (Fig 14);
- damaged lamps, unsafe electrical outlets or deteriorated seals around connections;
- loose blanket plaques, signs, or wind farers; and

Figure 14. When inspecting connections between projections and the main building, look for areas where birds, bees and pests may enter or nest. Birds have been nesting in this porch roof and the area is being cleaned of their debris. Where an opening exists, it may be necessary to cover it with a wire mesh, screening, or similar. Photo: Bryan Blundell

- rust and excessive wear of structural, anchorage and railing features of balconies and fire escapes.

Maintenance

• Selectively repair or replace damaged roofing materials on porches and other projections. Ensure adequate drainage away from the building. Repair flashing connections as needed; clean and seal open joints as appropriate.

• Secure any loose connections, such as on porch rails or fire escapes.

• Maintain bonnet metal components by following manufacturer's recommendations for cleaning and repainting. Remove rust and corrosion from porch handrails, balconies, fire escapes, and other metal features; prepare, prime, and repaint using a corrosion inhibitive coating system. Apply new primer before new corrosion sets in, followed by new topcoat. Take appropriate safety measures when dealing with existing lead-based paint and in using corrosion removal products (Fig 15).

• Maintain loose brackets, lamps, or signs. With electrical boxes for outlets or lighting devices, ensure that cover plates are properly sealed. Prime and paint metal elements as needed.

• Keep porch decks and steps free from dust, dirt, leaf debris, and snow as much as is accommodated using a broom or plastic blade shovel.

• Repair areas of wood decay or other damage to railings, posts, and decorative elements. Repair with wood dutchman, wood putty, or epoxy filler, as appropriate; replace individual elements as needed.

Figure 11. Metal projecting elements on a building, such as sign armatures and railings, are easily subject to rust and decay. Proper surface preparation to remove rust is essential. Special metal primers and topcoats should be used.

Prime and repaint features where necessary and repaint horizontal surfaces on a more frequent basis.

• Sand and repaint porch floorboards to keep weather surfaces protected. The exposed ends of porch floorboards are especially susceptible to decay and may need to be treated every year or two.

• Carefully cut out damaged or buckled porch flooring and replace with wood to match. Back-prime new wood that is being installed, treat and grain with wood preservative and paint primer. Ensure that new wood is adequately kiln or air-dried to avoid shrinkage and problems with paint adherence.

• Repair rotted stair stringers, offset goods or add stone pavers at stair base to keep wooden elements from coming into direct contact with soil.

• Consider durable hardwoods for replacement material where beading, chamfering, or other decorative work is required in order to match existing features being replaced. Although appropriate for certain applications, pressure treated lumber is hard to tool and may inhibit paint adherence if not allowed to weather prior to coating application.

• Clean out any debris from carpenter bees, ants, termites, and rodents; particularly from under porches. Replace damaged wood and add screening or lattice to discourage rodents. Consider treating above ground features with a borate solution to deter termites and wood rot and repaint exposed surfaces.

Foundations and Perimeter Grades

The foundation walls that penetrate into the ground, the piers that support raised structures, and the ground immediately around a foundation (known as grade) serve important structural functions. To help sustain these functions, it is important that there is good drainage around and away from the building. The maintenance goal is to prevent moisture from entering foundations and crawl spaces and damaging materials close to the grade, and to provide ventilation to damp areas.

Inspection

Inspections of the foundation should be done in conjunction with the inspection of the downspouts to ensure that water is being discharged a sufficient distance from the building perimeter to avoid excessive dampness in basements or crawl spaces. In addition, crawl spaces should be adequately vented to deter mold and decay and should be screened or otherwise secured against animals. Look for:

- depressions or grade sloping toward the foundation; standing water after a storm;

Figure 12. This chronically wet area has a window frame brought on by heat generated from the air conditioning condenser unit. The dampness could be caused by clogged roof gutter, improper grading, or a leaking hose bibb.

Sealants and Caulks

Using sealants and caulks has become a familiar part of exterior maintenance today. As the use of portland cement and certain traditional materials to render joints more weathertight has waned in recent years, caulks and most other elastomeric sealants are used to seal cracks and joints to keep out moisture and to serve as lubrication. While cracks and failing joints are indications of a serious problem, sealants and caulks may be used as a temporary measure. In some cases they may actually exacerbate the existing problem, such as by trapping moisture in adjacent materials, and lead to more costly repairs.

Manufacturer's recommendations provide instructions on the proper application of caulks and sealants. Special attention should be placed on ensuring that the substrates at joint is properly prepared and cleaned. Backer rods may be necessary for joints or cracks. Tooling of the caulk or sealant to modify concavity to ensure contact with all edge surfaces and for a neat and consistent appearance.

Caulks generally refer to older oil-based products, which have relatively limited life span and limited flexibility. Contemporary elastomeric sealants are composed of polymer synthesis. Elastomeric sealants are more durable than caulks and have greater flexibility and wider application. Caulks and sealants can become maintenance problems only if used to deteriorate faster than their substrates and must be replaced periodically as a part of cyclical maintenance of the structure.

The selection criteria for caulks and sealants include type of substrate, adhesive properties, size and configuration of joint, intended application and use and permeability, movement characteristics, and service life. Both one-part and two-part sealants are available; the latter requires mixing as part of the application process. Sealants are commonly used on a variety of places on the exterior of a building such as around windows and doors, at interfaces between masonry and wood, between exterior wall features such as chimneys, and at attachments to or through walls or roofs, such as with lamps, signs, or exterior plumbing fixtures. Their effectiveness depends on numerous factors including proper surface preparation and application. Applications of sealants and caulks should be examined as part of routine maintenance inspection, irrespective of their projected life expectancy.

Installation of caulks and sealants can not be undertaken by site personnel. For large and more complex projects, a contractor experienced in sealant installation may be needed. In other cases, the sealant manufacturer should be consulted on proper sealant selection, preparation, and installation procedures.

- material deterioration at or near the foundation, including loss of mortar in masonry, rotting wood clapboards, or settlement cracks in the lower sections of wall;
- evidence of animal or pest infestation;
- vegetation growing close to the foundation, including trees, shrubs and planting beds;
- evidence of moisture damage from lawn and garden or ground sprinkler systems;
- evidence of moss or mold from damp conditions or poorly situated downspout splash blocks (Fig. 16); and
- blocked downspout drainage from or clogged masonry grates.

Maintenance

• Remove leaves and other debris from drains to prevent accumulation. Detach drain grates from paved areas and extract clogged debris. Flush with a hose to ensure that there is no blockage. Use a professional drain service to clear obstructions if necessary.

• Conduct annual termite inspections. Promptly address termite and other insect infestations. Use only licensed company for treatment where needed.

• Keep the grade around the foundation sloping away from the building. Add soil to fill depressions particularly around downspouts and splash blocks. Make sure that soil does not come too close to wooden or metal elements. A 6" separation between wooden siding and the grade is usually recommended.

• Avoid use of mulching material immediately around foundations as such material may promote termite infestation, retain moisture or change existing grade slope.

• Route splash blocks at the end of downspouts or add secondary tubes to the end of downspouts as necessary (Fig 17).

• Lubricate operable foundation vent grilles to facilitate seasonal vent point as needed.

• Manage vegetation around foundations to allow sufficient air movement for wall surfaces to dry out during damp periods. Trim plantings and remove weeds and climbing vine vines. Be careful not to scar foundations or porch piers with grass or weed cutting equipment. If tree roots appear to be damaging a foundation wall, consult an engineer as well as a tree company.

• Wash off discoloration on foundations caused by splash back, algae, or mildew. Use plain water and a soft natural or nylon bristle brush. Unless thoroughly researched and tested beforehand on a discreet area of the wall, avoid chemical products that may dissolve certain types of stone. If cleaning products are used, test beforehand in a discreet area, and avoid over spray to plantings and adjacent building materials.

• Selectively repoint unit masonry as needed. Follow guidance under the wall sections in regard to compatible mix, appearance, and texture for pointing mortar.

• Avoid using salts for de-icing and fertilizers with a high acid or petrochemical content around foundations, as these materials can cause salt contamination of masonry. Use sand or organic materials without chloride additives that can damage masonry. Where salt is used on icy walks, distribute it sparingly and sweep up residual salt after walks have dried.

• Use snow shovels and brooms to clean snow from historic paths and walkways. Avoid blade-type snow removers as they may chip or abrade cobblestones, brick, or stone paving. Note that use of steel snow removal tools in areas where salt-containing snow melters are used may result in rust staining from steel fragments left on the paving.

Conclusion

Maintenance is the most important preservation treatment for extending the life of a historic property. It is also the most cost-effective. Understanding the construction techniques of the original building and the performance qualities of older building materials, using traditional maintenance and repair methods, and selecting in-kind materials where replacements are needed will help preserve the building and its historic character.

Maintenance can be managed in small distinct components, coordinated with other work, and scheduled over many years to ensure that materials are properly cared for and their life span maximized. A written maintenance plan is the most effective way to organize, schedule, and guide the work necessary to properly care for a historic building. The maintenance plan should include a description of the materials and methods required for each task, as well as a schedule for work required for maintenance of different building materials and components.

Historic house journals, maintenance guides for older buildings, preservation consultants, and preservation maintenance firms can assist with writing appropriate procedures for specific properties. Priorities should be established for intervening when unexpected damage occurs such as from broken water pipes or high winds.

Figure 37. Extending downspouts at their base is one of the best steps to reduce dampness in basements, crawl spaces and around foundations. Extensions should be buried. Carefully, for aesthetic ease of lawn care, and to avoid creating a tripping hazard. Figure: NPS files.

Worker safety should always be paramount. When work is beyond the capabilities of in-house personnel and must be contracted, special efforts should be made to ensure that a contractor is both experienced in working with historic buildings and utilizes appropriate preservation treatments.

A well-maintained property is a more valuable property and one that will survive as a legacy for generations to come.

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Acknowledgements

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Contracting Maintenance and Repair Work

Many contractors are very proficient in using modern construction methods and materials; however, they may not have the experience or skill required to carry out maintenance on historic buildings. The following are tips to use when selecting a contractor to work on your historic building:

1. Become familiar with work done on similar historic properties in your area so that you can obtain names of possible preservation contractors.

2. Be as specific as possible in defining the scope of work you expect to undertake.

3. Ask potential contractors for multiple references (three to five) and visit previous work sites. Contact the building owner or manager and ask how the job proceeded; if the same work crew was retained from start to finish; if the workers were of a consistent skill level; whether the project was completed in a reasonable time; and whether the person would use the contractor again.

4. Be familiar with the preservation context of the work to be undertaken. Use the written procedures in your maintenance plan to help define the scope of work in accordance with preservation standards and guidelines. Always request that the gentlest method possible be used. Use a preservation consultant if necessary to ensure that the work is performed in an appropriate manner.

5. Request in the contract proposal a detailed cost estimate that clearly defines the work to be executed, establishes the precautions that will be used to protect adjoining materials, and lists specific qualified subcontractors, if any, to be used.

6. Insure that the contractor has all necessary business licenses and carries worker compensation.

47 PRESERVATION BRIEFS

Maintaining the Exteriors of Small and Medium Size Historic Buildings

Sharon C. Park, FAIA

National Park Service
U.S. Department of the Interior

Heritage Preservation Services

And when it comes down to actually figuring out how to do the maintenance, go to …..

The National Park Service's *Preservation Briefs*

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2 Repointing Mortar Joints in Historic Masonry Buildings

3 Improving Energy Efficiency in Historic Buildings

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6 Dangers of Abrasive Cleaning to Historic Buildings

7 The Preservation of Historic Glazed Architectural Terra-Cotta

8 Aluminum and Vinyl Siding on Historic Buildings: The Appropriateness of Substitute Materials for Resurfacing Historic Wood Frame Buildings

9 The Repair of Historic Wooden Windows

10 Exterior Paint Problems on Historic Woodwork

11 Rehabilitating Historic Storefronts

12 The Preservation of Historic Pigmented Structural Glass (Vitrolite and Carrara Glass)

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43 The Preparation and Use of Historic Structure Reports

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47 Maintaining the Exterior of Small and Medium Size Historic Buildings

47 PRESERVATION BRIEFS

Maintaining the Exteriors of Small and Medium Size Historic Buildings

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Preservation is defined as "the act or process of applying measures necessary to sustain the existing form, integrity and materials of an historic property. Work, including preliminary measures to protect and stabilize the property, generally focuses upon the ongoing maintenance and repair of historic materials and features rather than extensive replacement and new construction."[1]

Maintenance helps preserve the integrity of historic structures. If existing materials are regularly maintained and deterioration is significantly reduced or prevented, the integrity of materials and workmanship of the building is protected. Proper maintenance is the most cost effective method of extending the life of a building. As soon as a building is constructed, restored, or rehabilitated, physical care is needed to slow the natural process of deterioration. An older building has already experienced years of normal weathering and may have suffered from neglect or inappropriate work as well.

Decay is inevitable but deterioration can accelerate when the building envelope is not maintained on a regular basis. Surfaces and parts that were seamlessly joined when the building was constructed may gradually become loose or disconnected; materials that were once sound begin to show signs of weathering. If maintenance is deferred, a typical response is to rush in to fix what has been ignored, creating additional problems. Work done on a crisis level can favor inappropriate treatments that alter or damage historic material.

There are rewards for undertaking certain repetitive tasks consistently according to a set schedule. Routine and preventive care of building materials is the most effective way of slowing the natural process of deterioration. The survival of historic buildings in good condition is primarily due to regular upkeep and the preservation of historic materials.

Well-maintained properties tend to suffer less damage from storms, high winds, and even small earthquakes. Keeping the roof sound, structures and attachments such as shutters tightened and secured, and having joints and connections functioning well, strengthens the ability of older buildings to withstand natural occurrences.

Over time, the cost of maintenance is substantially less than the replacement of deteriorated historic features and involves considerably less disruption. Stopping decay before it is widespread helps keep the scale and complexity of work manageable for the owner.

This *Preservation Brief* is designed for those responsible for the care of small and medium size historic buildings, including owners, property administrators, in-house maintenance staff, volunteers, architects, and maintenance contractors. The Brief discusses the benefits of regular inspections, monitoring, and seasonal maintenance work; provides general guidance on maintenance treatments for historic building exteriors; and emphasizes the importance of keeping a written record of completed work.

Getting Started

Understanding how building materials and construction details function will help avoid treatments that are made in an attempt to simplify maintenance but which may also result in long-term damage. It is enticing to read about "maintenance free" products and systems, particularly waterproof sealers, rubberized paints, and synthetic siding, but there is no such thing as maintenance free when it comes to caring for historic buildings. Some approaches that initially seem to reduce maintenance requirements may over time actually accelerate deterioration.

Exterior building components, such as roofs, walls, openings, projections, and foundations, were often constructed with a variety of functional features, such as overhangs, drip edges, ventilated cavities, and painted surfaces, to protect against water infiltration, ultraviolet deterioration, air infiltration, and

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- Your local library

Sources

- And finally if you don’t find exactly what you need, go to the black box that contains all knowledge… Google

Thank you!

- Craig M. Bennett, Jr., PE