

# Trinity Episcopal Church: Preservation Case Study of a Gothic Revival Church



MEADORS CONSERVATION

Betty Prime, AIA, Architectural Conservator  
Kalen McNabb, Architectural Conservator

# [Case Study: Trinity Episcopal Church]



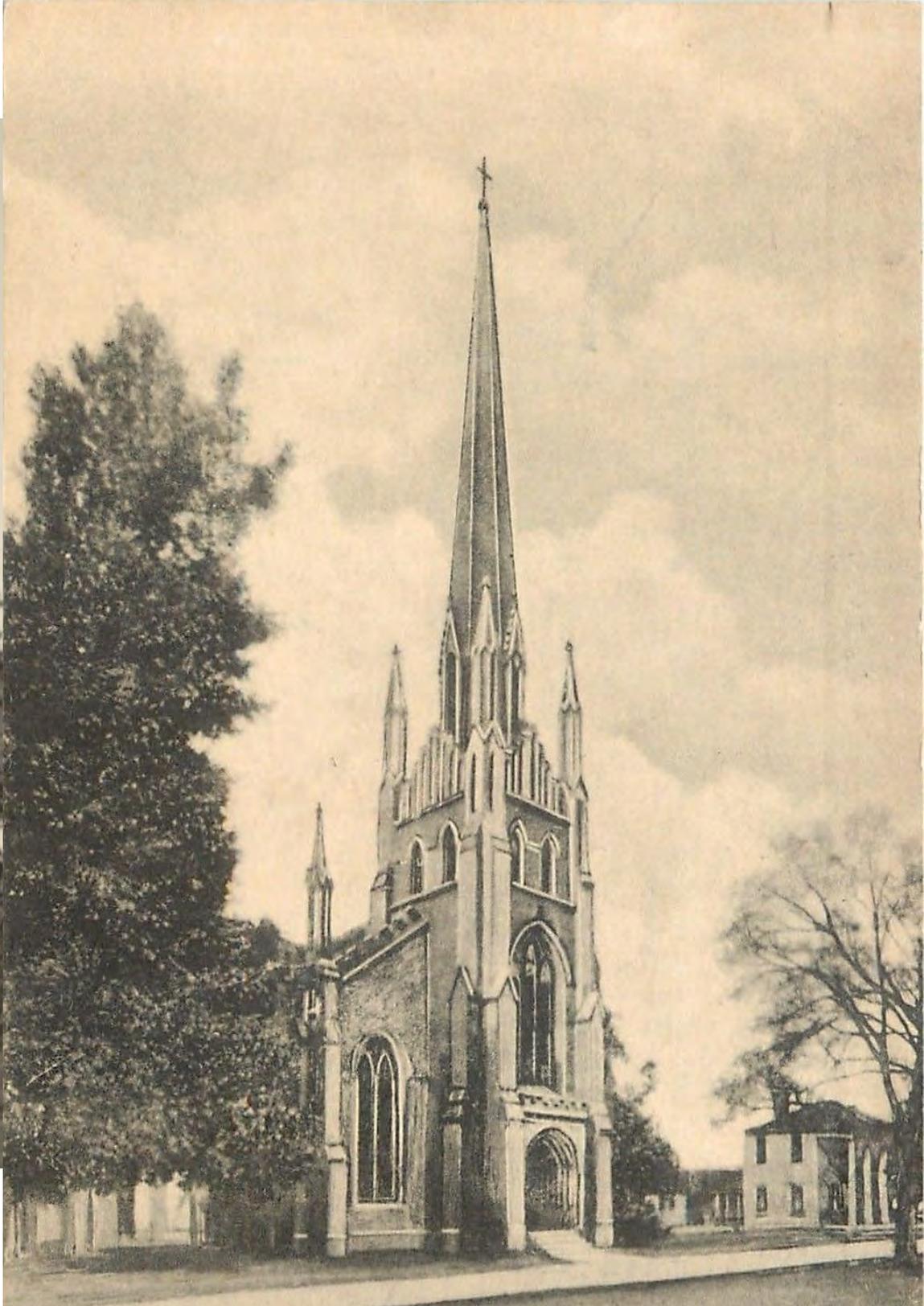
*Abbeville, SC*



# [Historic Overview]



*Early 20th Century*

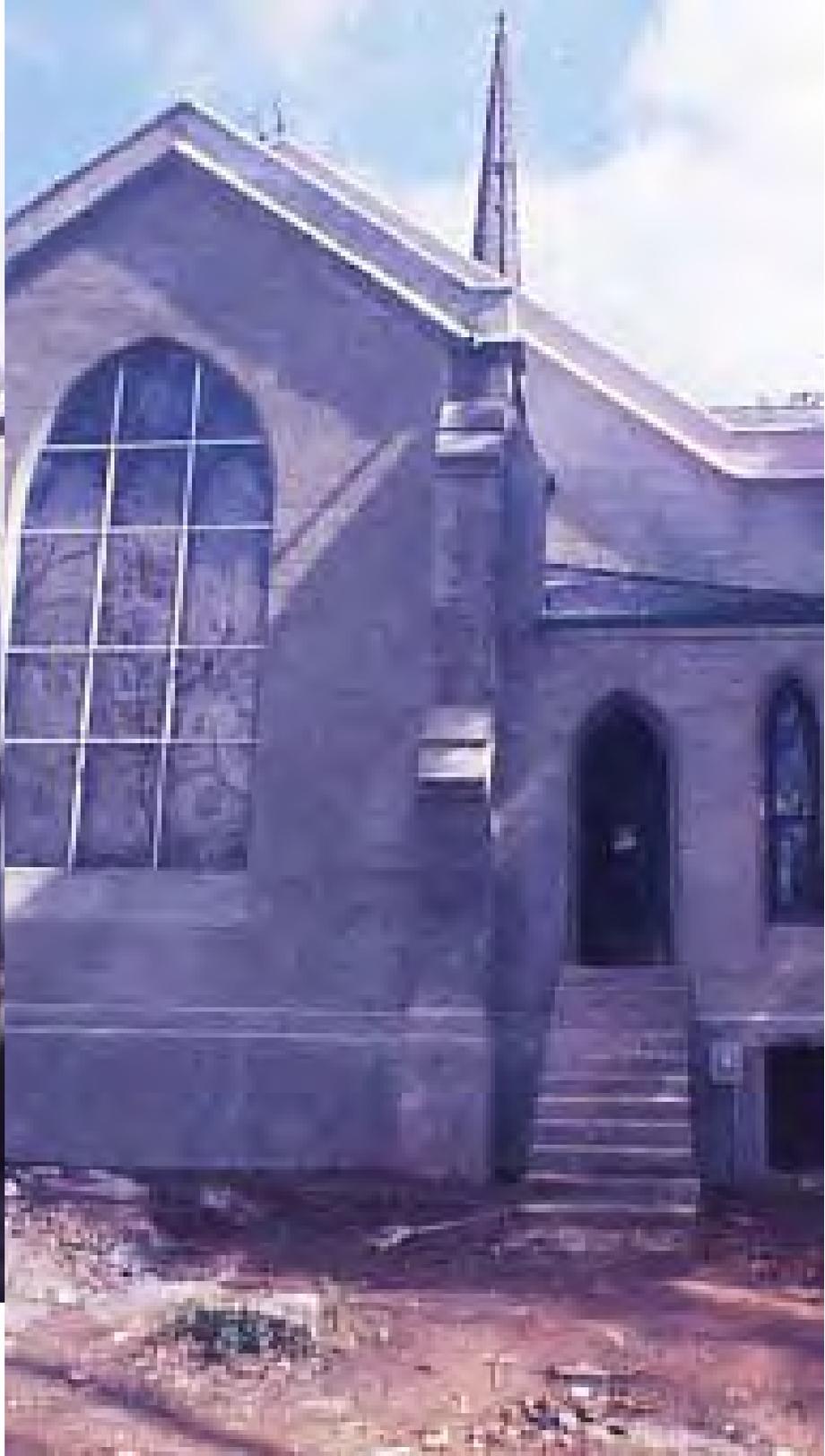


# [Historic Overview]



*C. 1960-1970*

# [Historic Overview]



1974



# [Furniture & Intact Interior Elements]



# [Furniture & Intact Interior Elements]



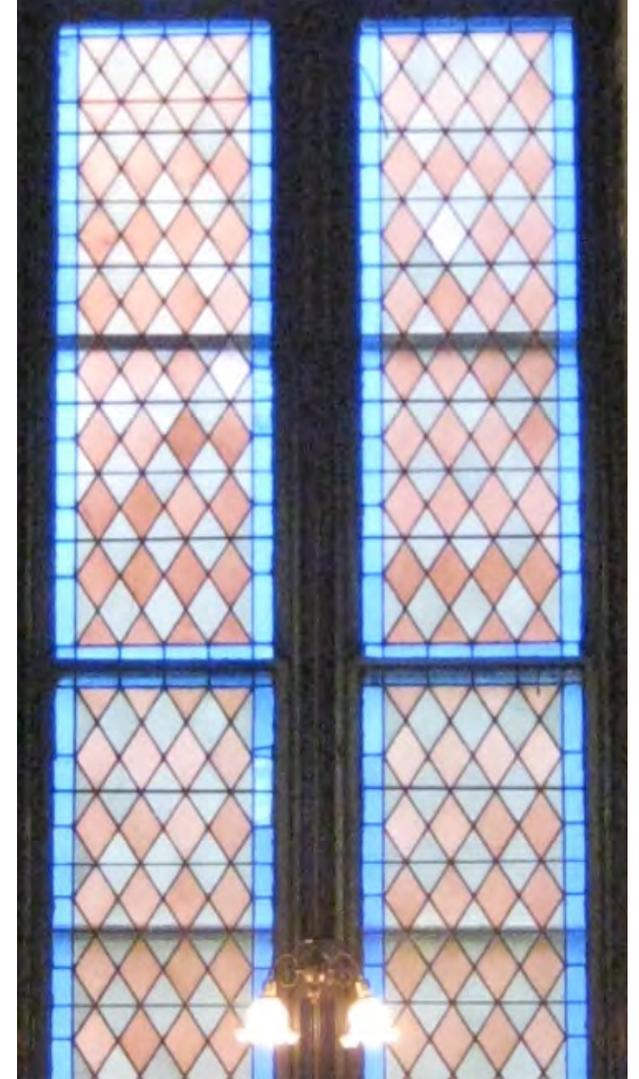
# [Decorative Glass]



**Painted Glass**  
**William Gibson**  
**c. 1860**

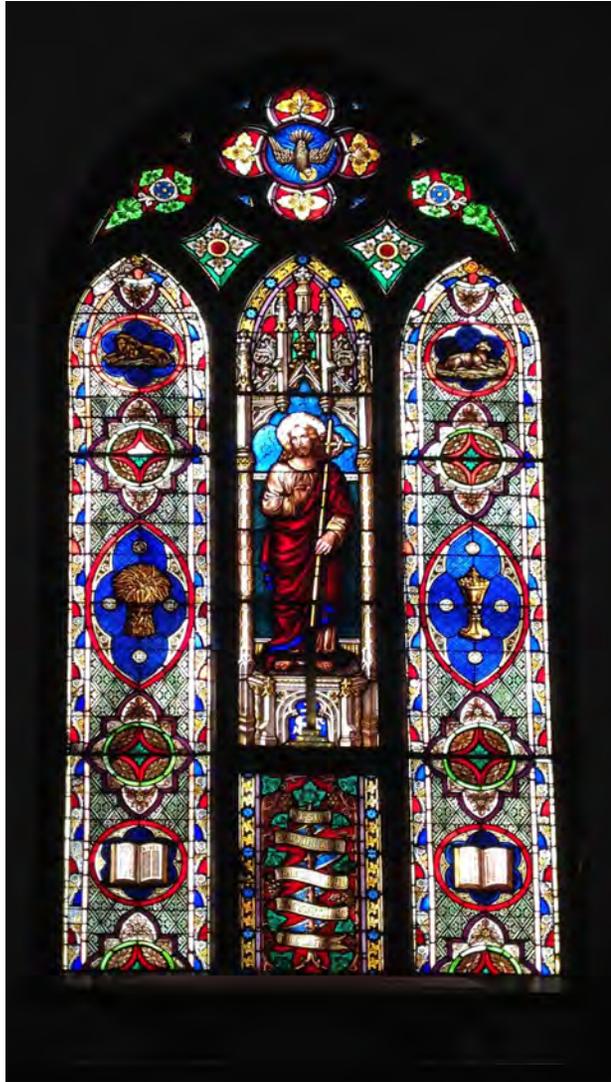


**Stenciled Glass**  
**Unknown**  
**19th century**



**Stained Glass**  
**Unknown**  
**19th century**

# [William Gibson: "Father of Stain Glass Painting in America"]



**Chancel Window**  
**William Gibson**  
c. 1860



**"Suffer Little Children" Window**  
**William Gibson**  
c. 1860

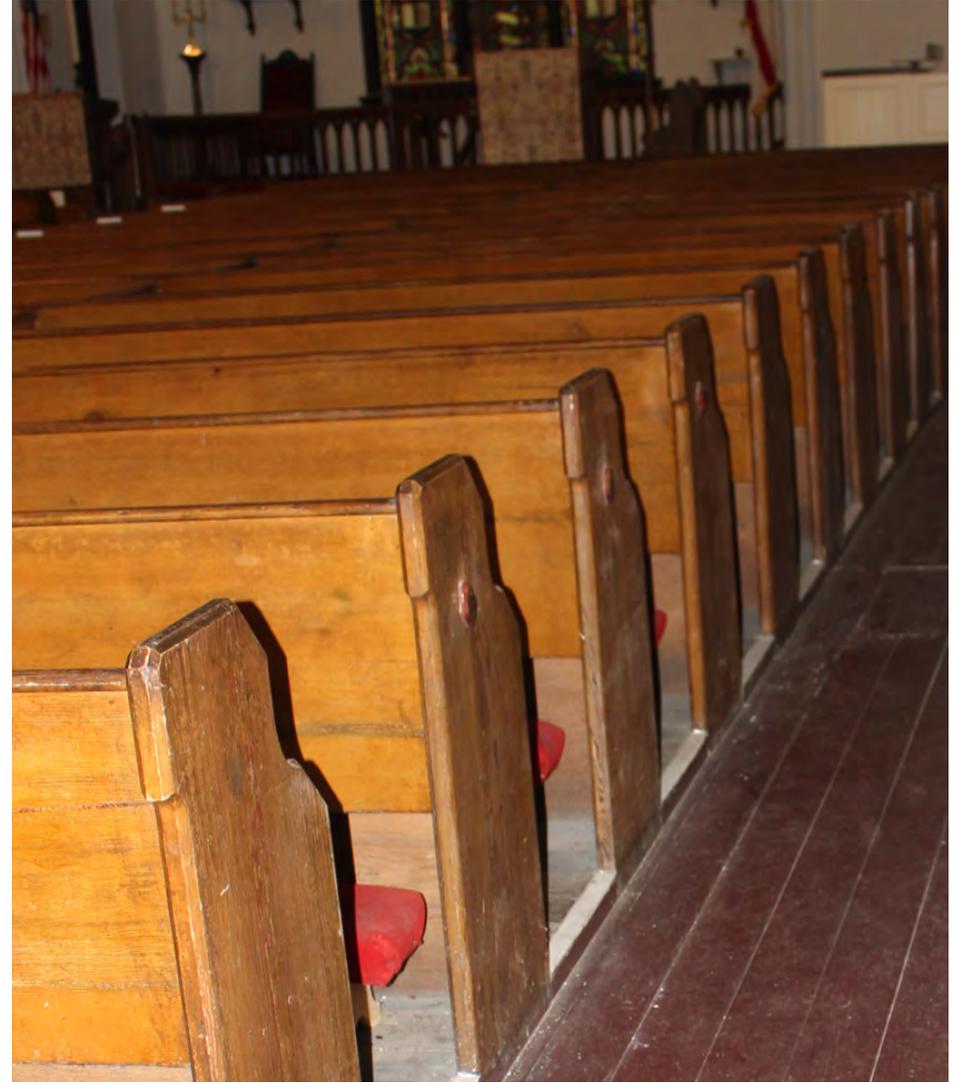


**10 Medallions**  
**William Gibson**  
c. 1860

# [Furniture & Intact Interior Elements]



**Imitation Grain Painting**  
c.1860



**Pews**  
c.1860

# [Furniture & Intact Interior Elements]



**Bell**  
c. 1860



**Organ and Choir Seating**  
c. 1860

# [Trinity Episcopal Church: Building Assessment]

## *Areas of Major Concern:*

- Water Infiltration
  - Failure of the Exterior Stucco
  - Structural Stability of the North Wall
- 

## *Investigative Tools:*

- Historic Research
- Visual Observation
- Tactile Investigation
- Monitoring
- Infrared Thermography
- Materials Analysis



# [Assessing Buildings Through Observation and Tactile Methods]

## *Information Yielded:*

- Visually and Physically Inspect and Record the Condition of the Building
- Identify Areas of Deterioration & Determine Mechanisms for Conditions Observed
- Decipher Changes and Alterations to the Building



# [Access]































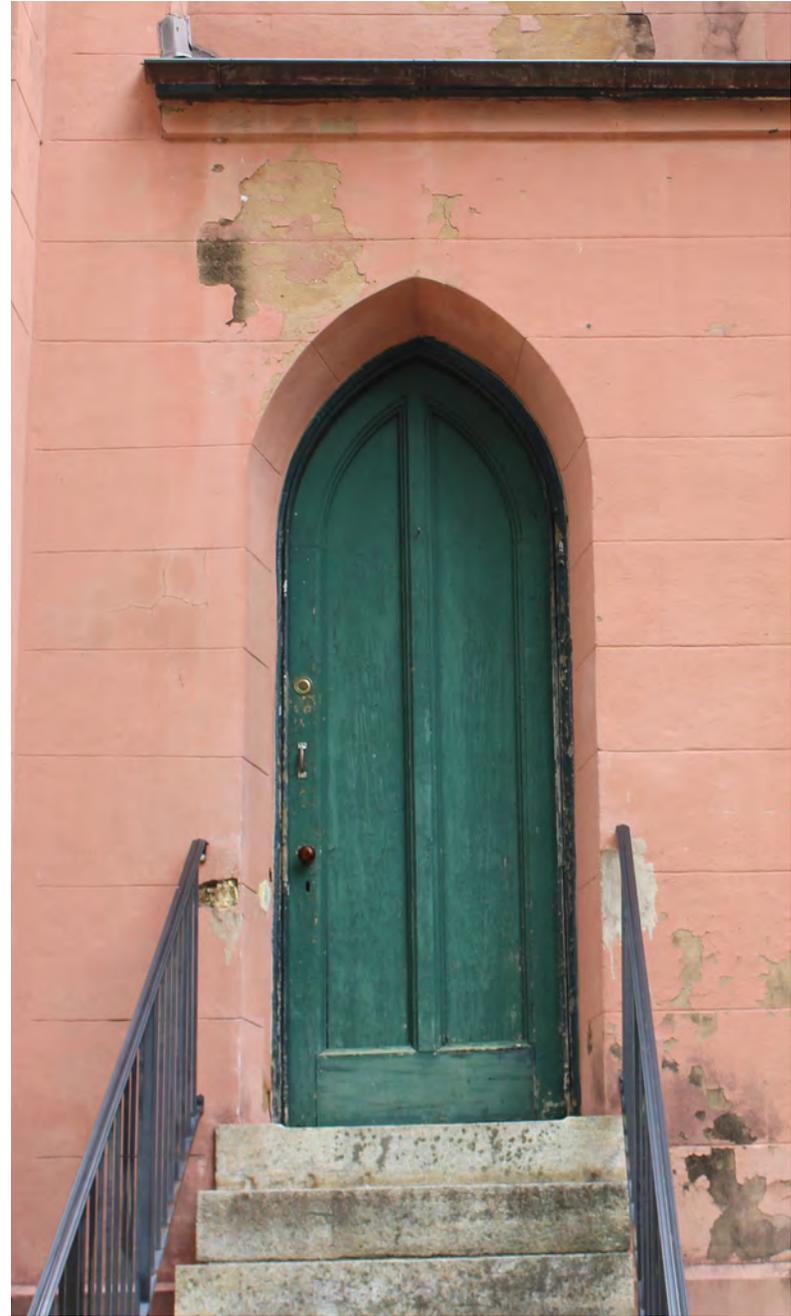


# [Assessing Buildings: Windows]





# [Assessing Buildings: Doors]



# [Moving Forward]



# [Assessing Buildings Through Research & Monitoring]

*“Is the north wall stable ?”*

## ***Information Yielded from Research and Monitoring:***

- An Understanding of Past Structural Issues and Interventions
- Create Baseline Measurements and Diagrams Recording Movement (Deviation from Plumb) in the North and South Walls
- Quantify Movement to Understand North and South Walls Deviation from Plumb
- Use Baseline, Repeatable Measurement Methodology to Monitor Movement Over Time
- Determine Whether the Building is Actively Moving



# [North Wall: Structural Movement]



# [Interior Trusses]



# [Structural Diagrams: Interventions Over Time]

c. 1860 Church Completed

— 1900 Scissor Bracing Added

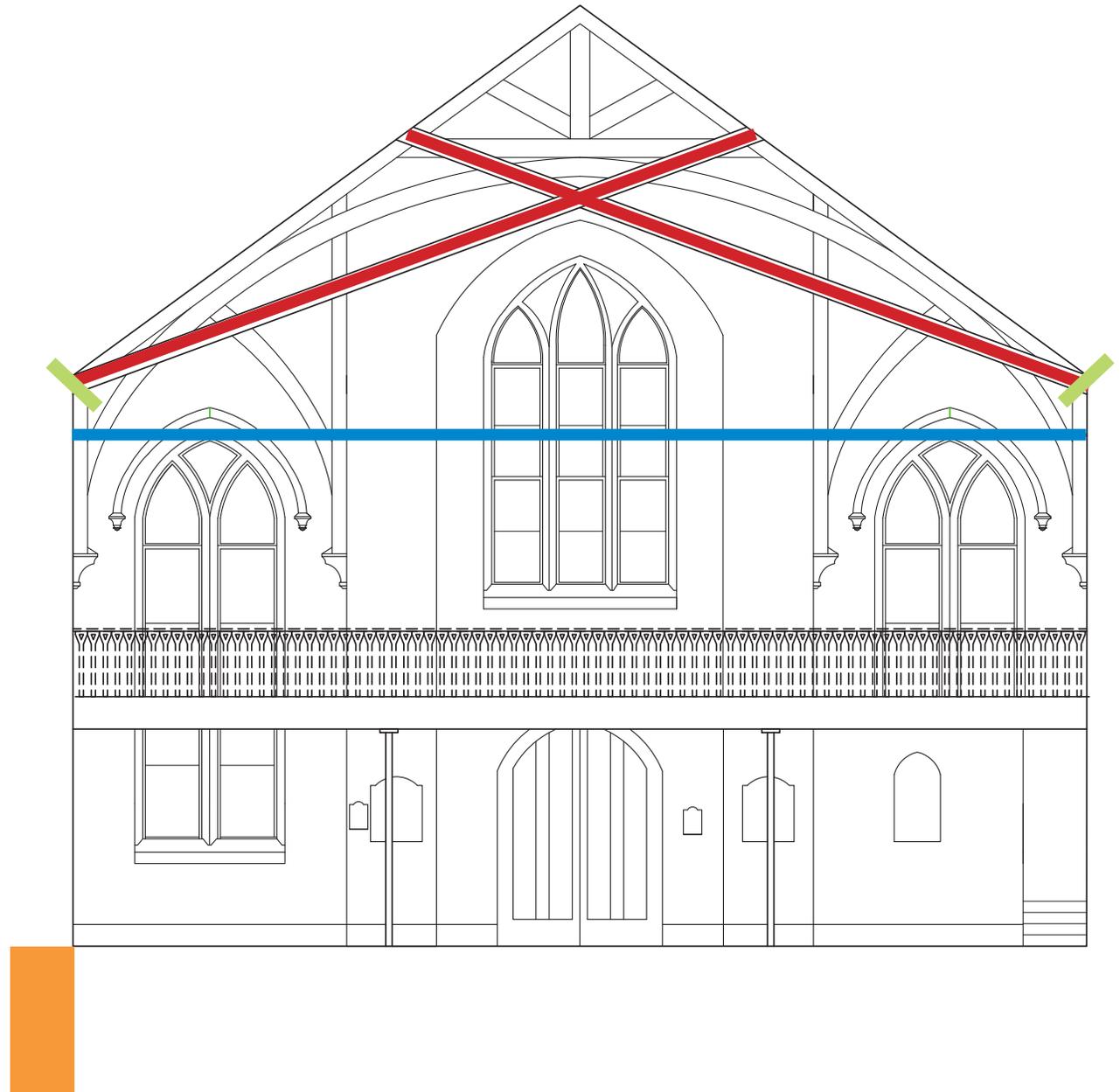
— 1957 Horizontal Tie Rods Installed

— 1993 Steel Tube to Masonry Wall Bearing Plate Connection Installed

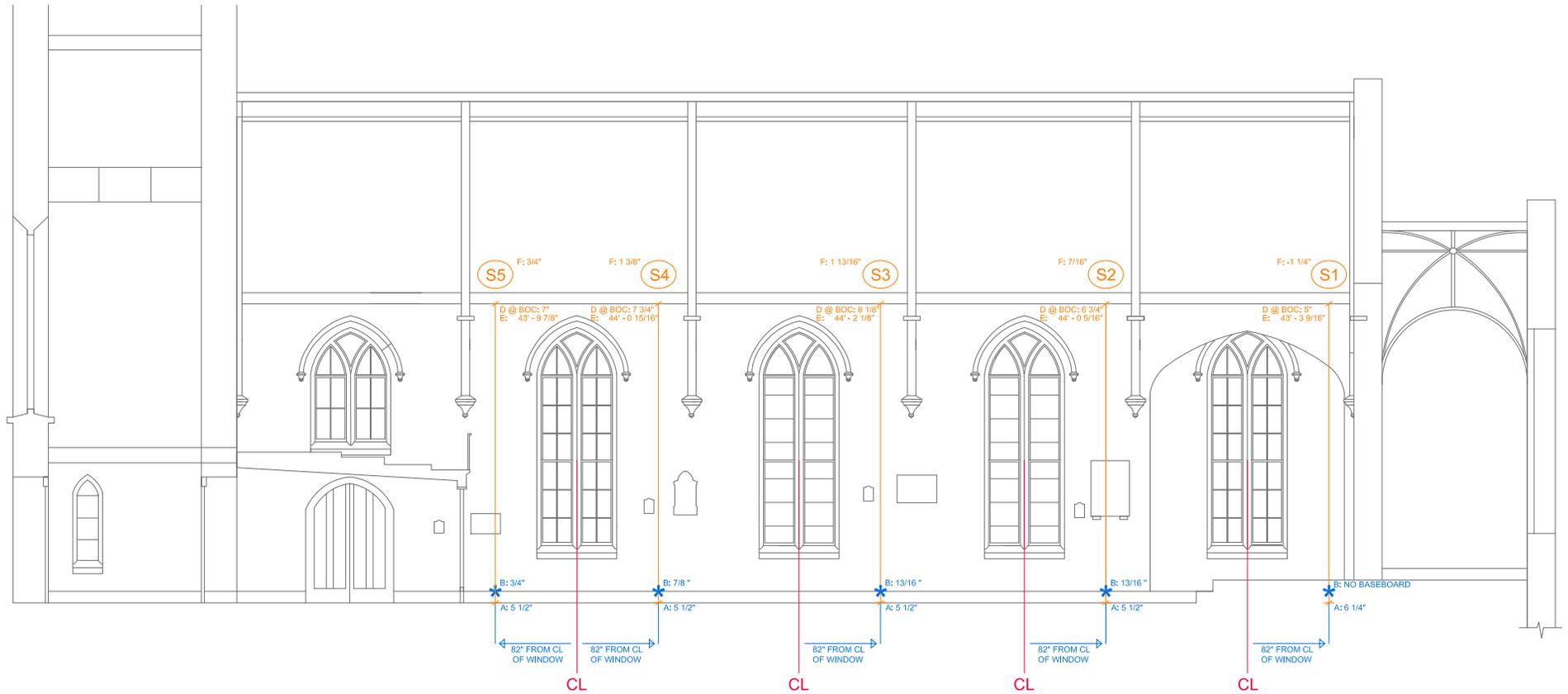
— 2006 Earth Adjacent to the North Wall was Excavated to Install Underpinning, Underpinning never Installed and Area was Backfilled

2014 Soils Testing Completed, Determined that Backfilling was Not Compacted Appropriately

2015 Meadors Conservation and Structural Engineer Mike Hance Asses the Building Structure



# [Wall Reference Diagrams: Quantifying Movement]



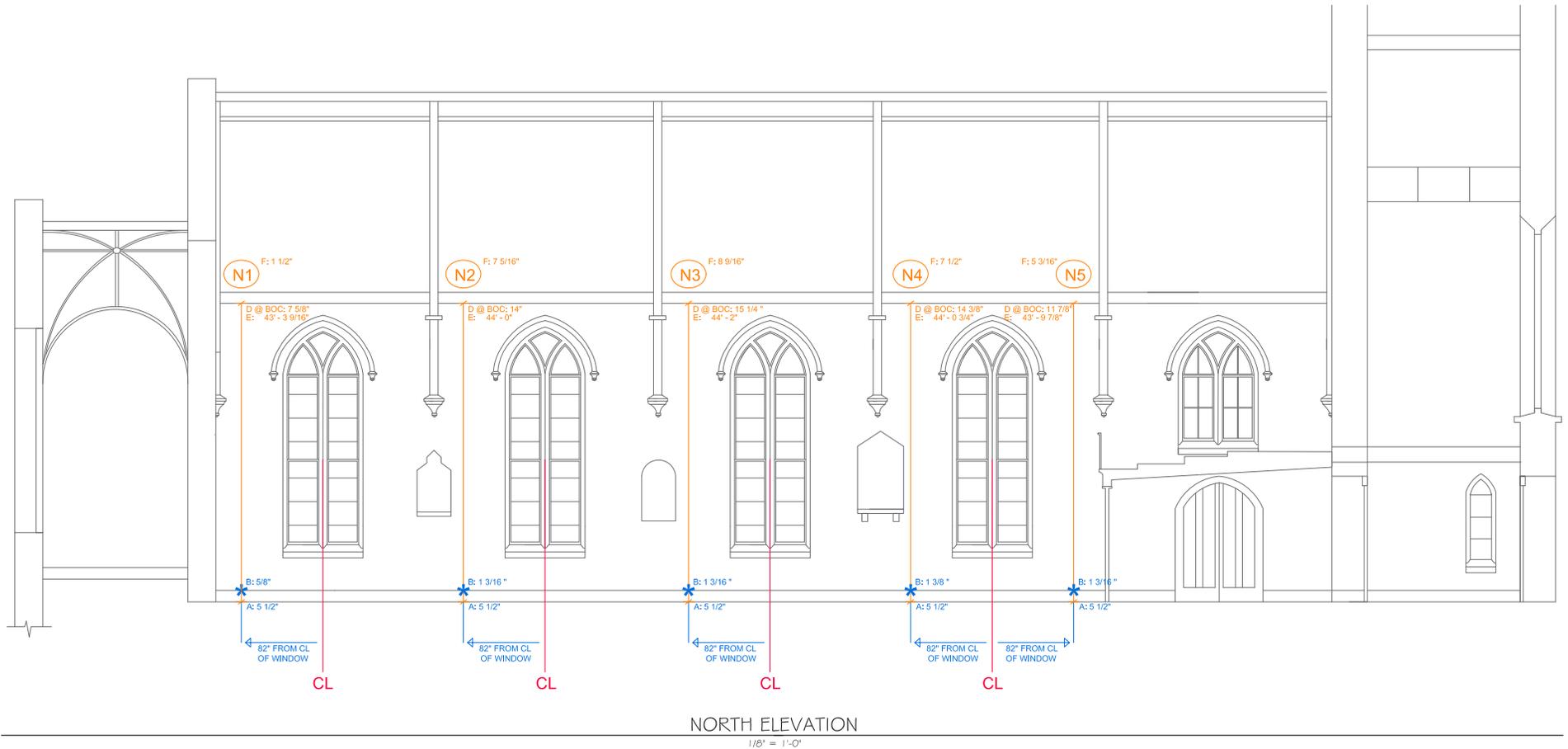
SOUTH ELEVATION

1/8" = 1'-0"

- |   |  |  |                        |
|---|--|--|------------------------|
| A: Distance Measured off of Baseboard               | C: (A-B)   | E: Distance at Top of Wall (BOC) to Opposite Top of Wall (BOC) N-S | CL: Centerline         |
| B: Baseboard Thickness at 82" from the CL of Window | D: Distance Measured from Top of Wall (BOC) to Plumb Point Set From Floor Location A | F: (D-C) Distance Wall is Out of Plumb From the Base               | BOC: Bottom of Cornice |



# [Wall Reference Diagrams: Quantifying Movement]



- |   |  |  |                        |
|---|--|--|------------------------|
| A: Distance Measured off of Baseboard               | C: (A-B)   | E: Distance at Top of Wall (BOC) to Opposite Top of Wall (BOC) N-S | CL: Centerline         |
| B: Baseboard Thickness at 82" from the CL of Window | D: Distance Measured from Top of Wall (BOC) to Plumb Point Set From Floor Location A | F: (D-C) Distance Wall is Off of Plumb From the Base               | BOC: Bottom of Cornice |



# [Quantifying Structural Movement]

## INTERIOR WALL MEASUREMENTS

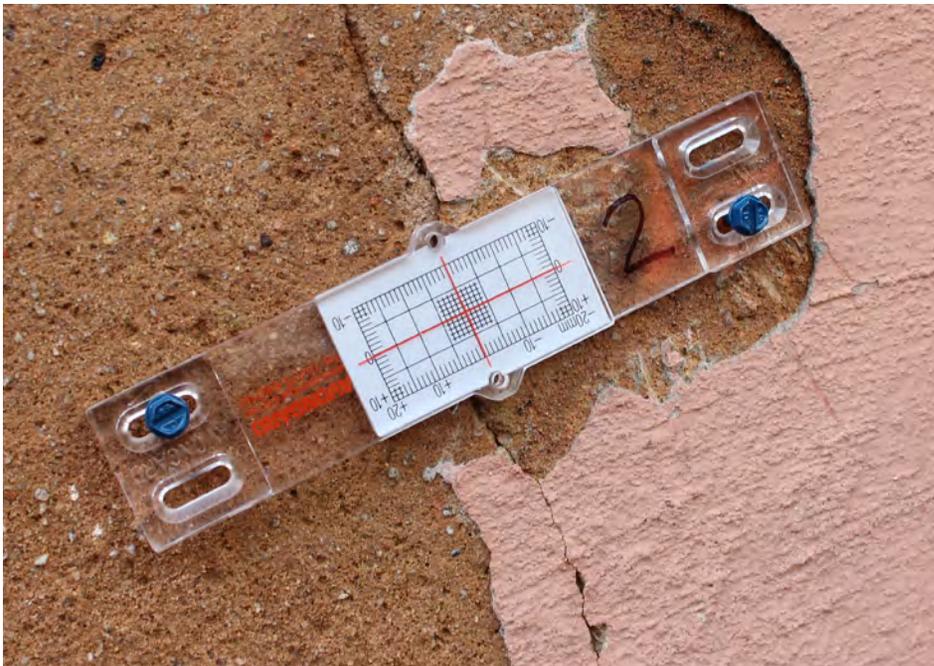
See Wall References  
Diagrams for  
Measurement Locations  
of A-F

A (Distance Measured Off Baseboard) unit = inches	B (Thickness of Baseboard at Measurement Location) unit = inches	C (A-B) unit = inches	D (Top of Wall) unit = inches	E (Distance to Opposite Wall) unit = feet & inches	Average E (Average of measurements taken from N & S) unit = feet & inches	F (D-C) Distance the Wall is out of Plumb from the base unit = inches
--	---	--------------------------	----------------------------------	---	--	--

South Wall Locations							
S1	6 1/4	N/A (no baseboard at location)	6 1/4	5	43'- 3 9/16	43'- 3 9/16	-1 1/4
S2	5 1/2	13/16	6 5/16	6 3/4	44'-0 15/16	44'-0 1/2	7/16
S3	5 1/2	13/16	6 5/16	8 1/8	44'- 2 1/8	44 2 1/16	1 13/16
S4	5 1/2	7/8	6 3/8	7 3/4	44'-0 15/16	44'-0 14/16	1 3/8
S5	5 1/2	3/4	6 1/4	7	43'- 9 7/8	43'- 9 7/8	3/4
North Wall Locations							
N1	5 1/2	5/8	6 1/8	7 5/8	43'- 3 9/16	43'- 3 9/16	1 1/2
N2	5 1/2	1 3/16	6 11/16	14	44'-0	44'-0 1/2	7 5/16
N3	5 1/2	1 3/16	6 11/16	15 1/4	44'- 2	44 2 1/16	8 9/16
N4	5 1/2	1 3/8	6 7/8	14 3/8	44'-0 3/4	44'-0 14/16	7 1/2
N5	5 1/2	1 3/16	6 11/16	11 7/8	43'- 9 7/8	43'- 9 7/8	5 3/16



# [Assessing Buildings Through Monitoring]



# CRACK MONITORING RECORD

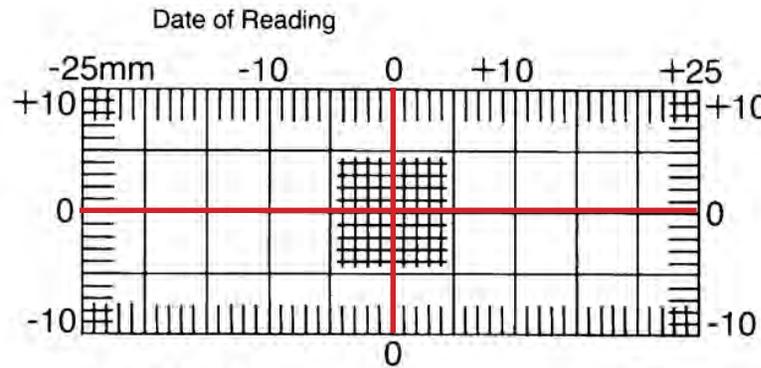
PROJECT Trinity Episcopal Church

LOCATION OF CRACK MONITOR Exterior, East Elevation Below Window #3

Indicate on the diagrams below the movement at each reading.

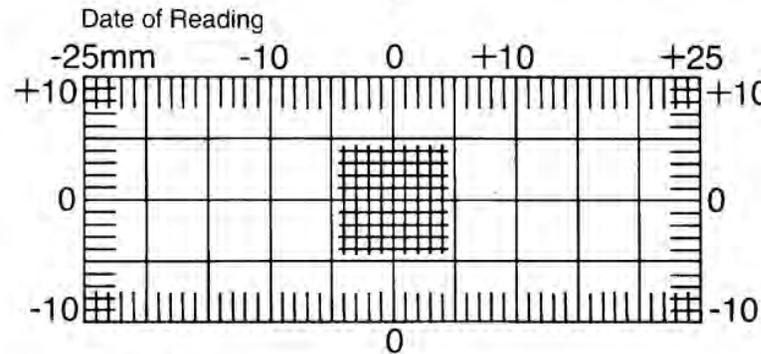
**+** represents **Crack Opening**                      **-** represents **Crack Closing**

Diagram Scales are Approximate!



Date of Reading  
8/7/2015

Distance between spigots
0



Date of Reading

Distance between spigots



# [Assessing Buildings with Infrared Thermography]

## *Information Yielded From Infrared Thermography:*

- Identify Areas of Active Water Intrusion
- Identify Areas Where Walls have been Previously Repaired
- Identify Air Infiltration
- Evaluate Areas of the Building Interior that are Inaccessible from the Ground
- Rapid Graphic Understanding of Surface Conditions



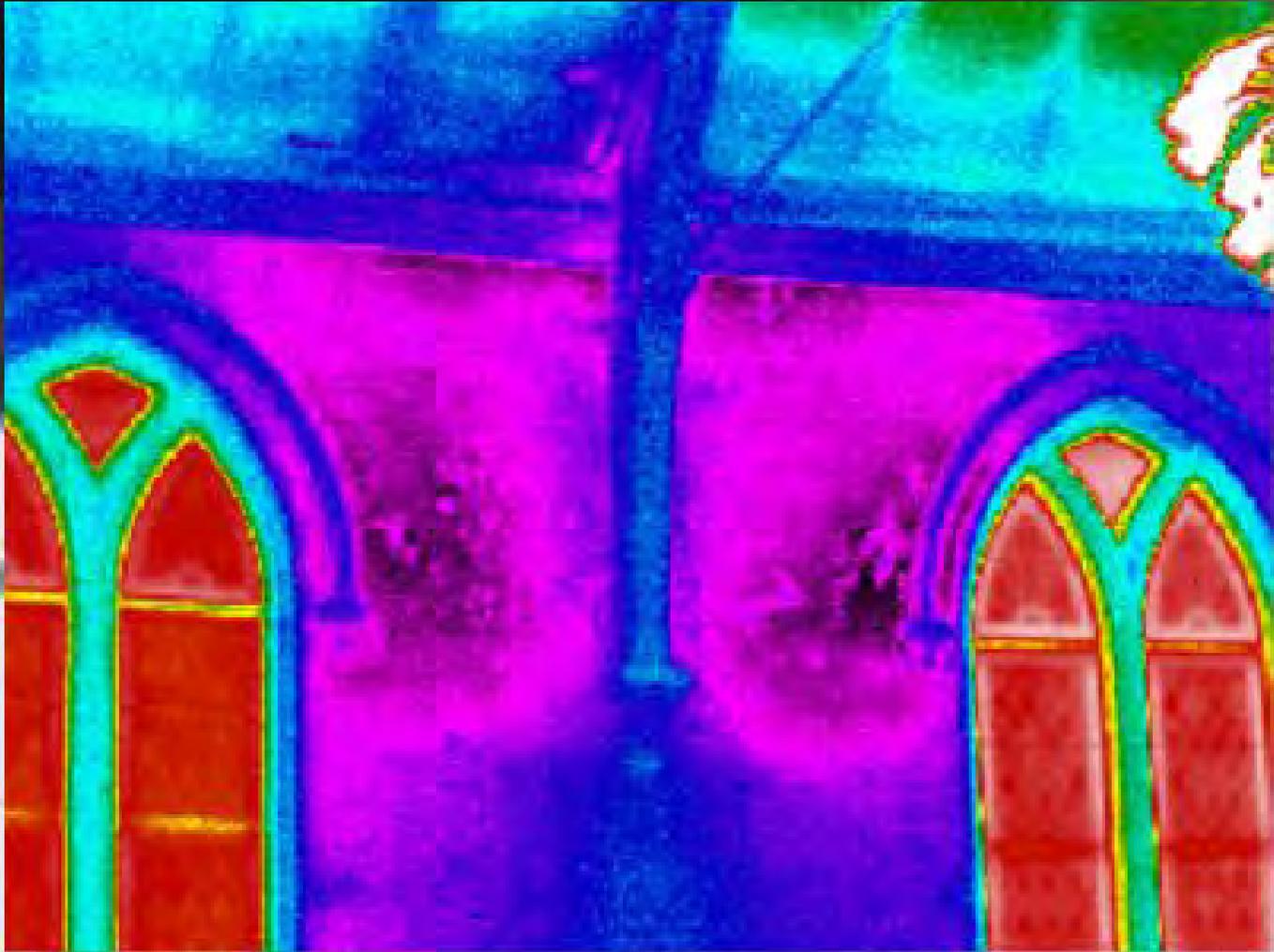


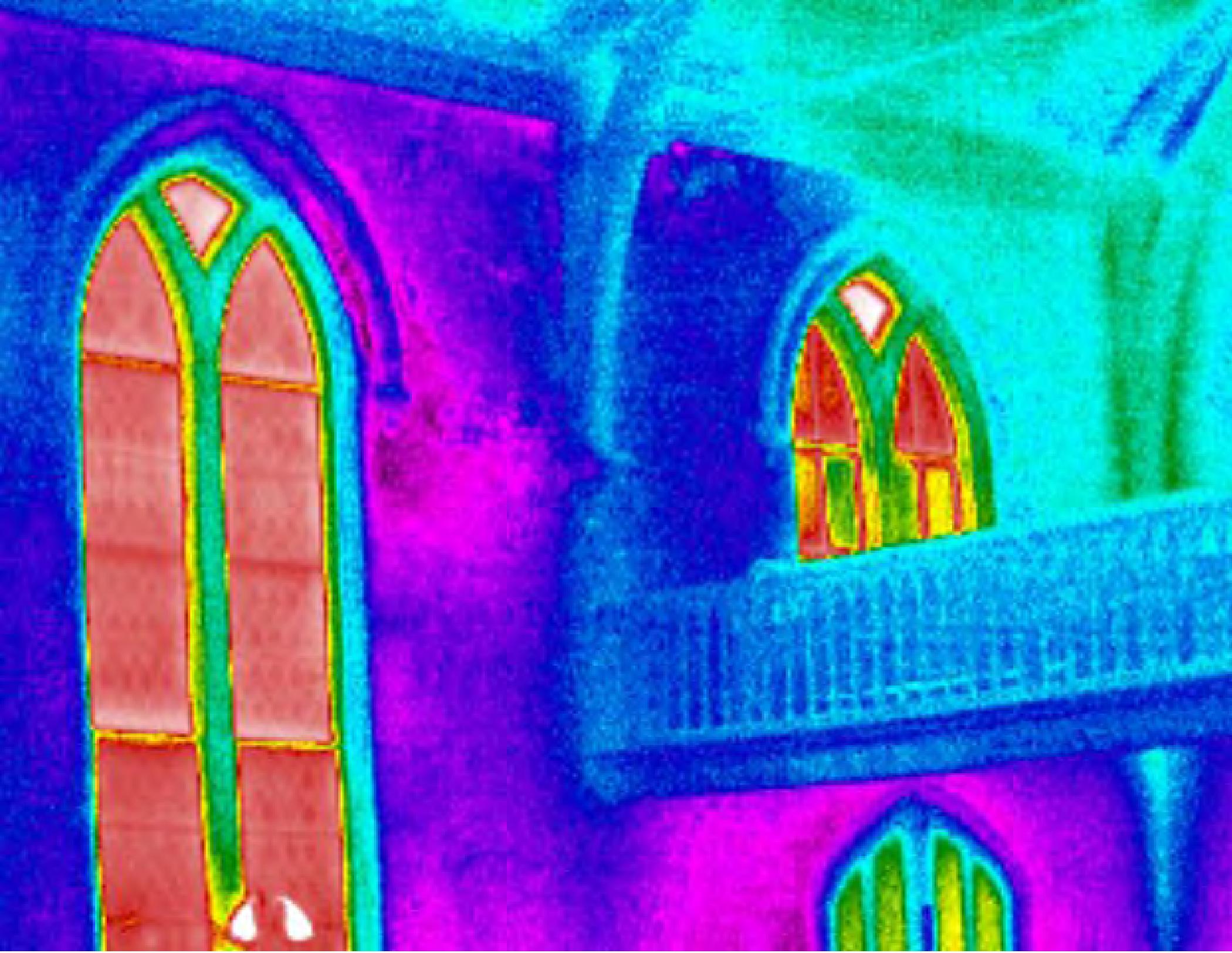


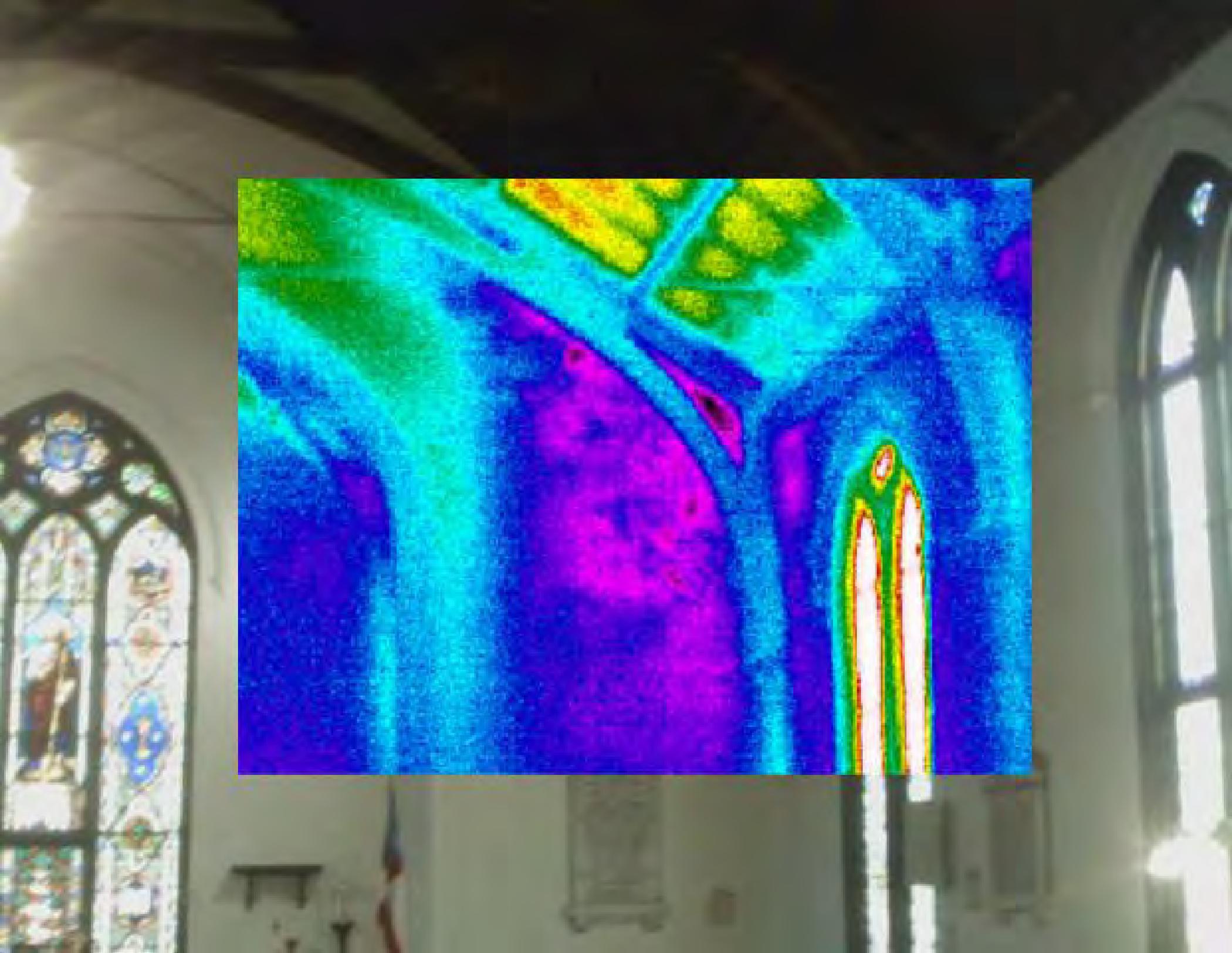


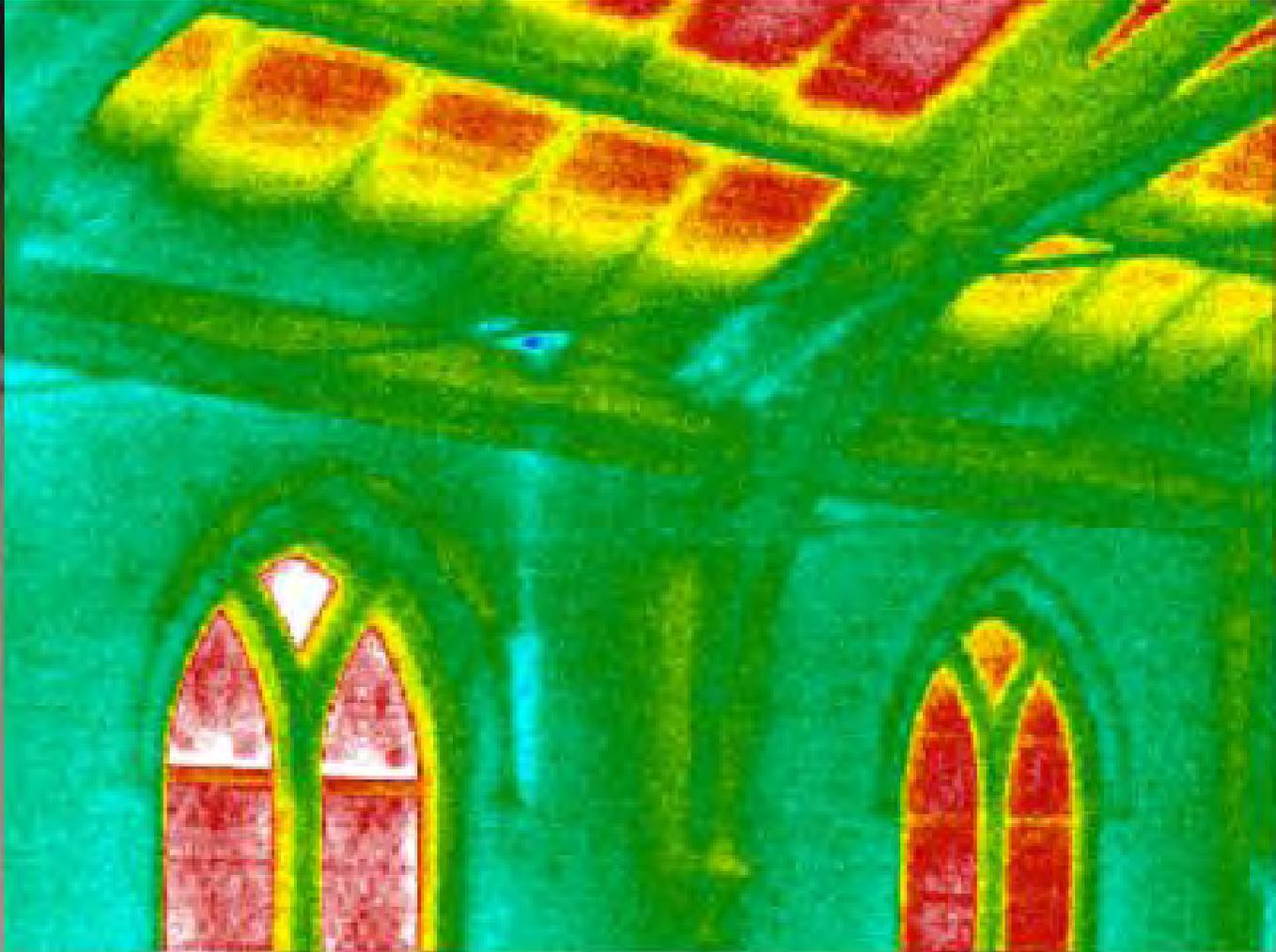


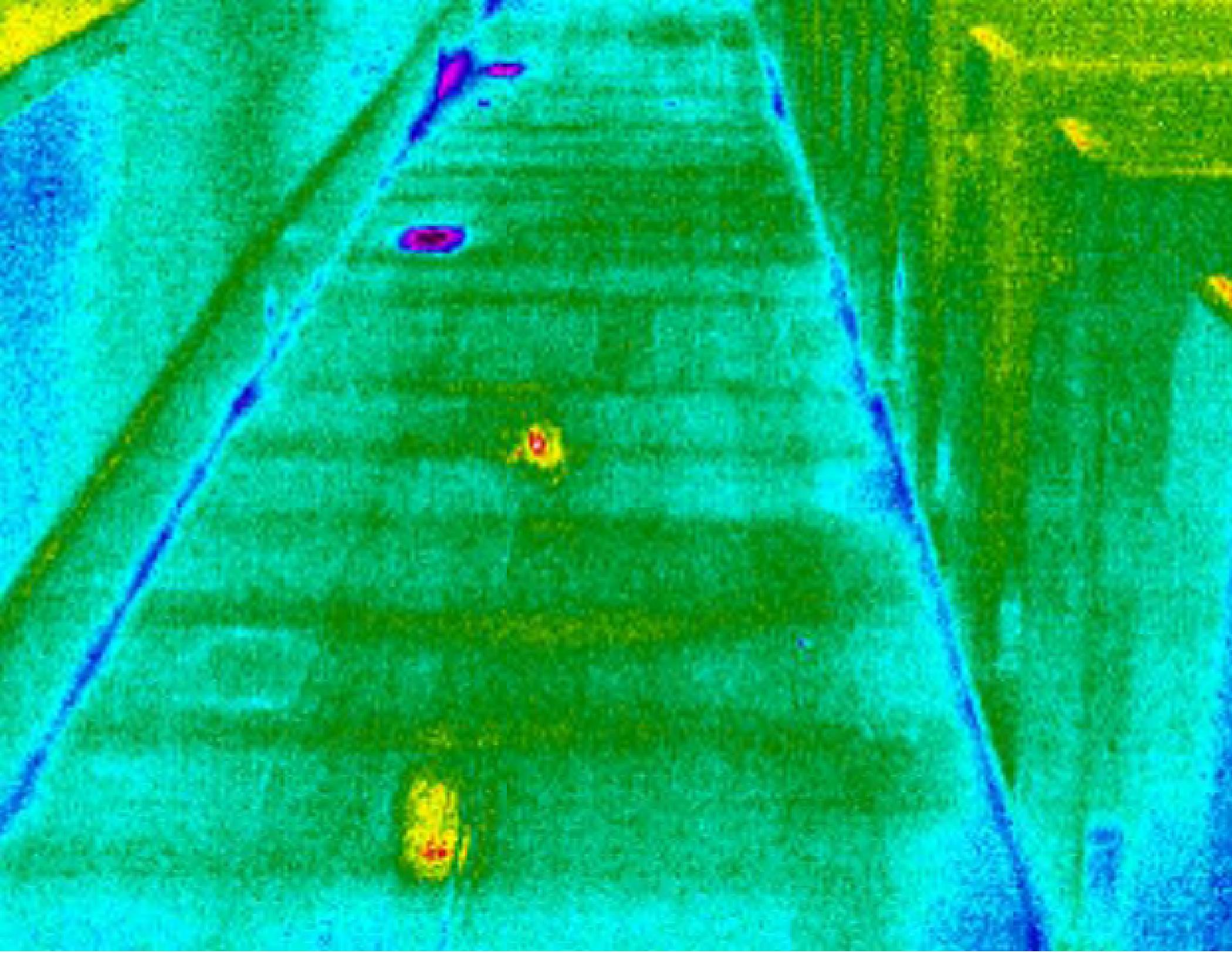








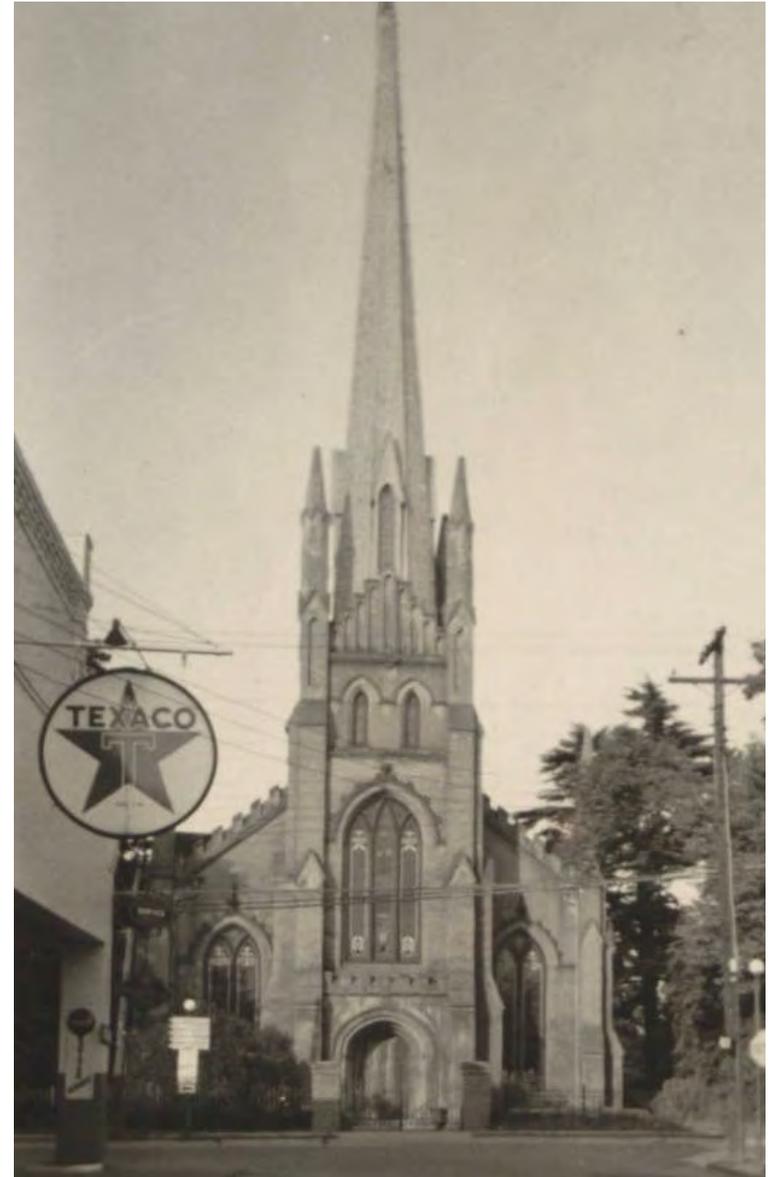




# [Assessing Buildings Through Materials Analysis]

## *Information Yielded From Materials Analysis:*

- Identify Building Materials
- Understand from a Microscopic Level Why Deterioration is Occurring
- Understand Why Delamination and Material Failure is Occurring
- Understand Original Appearance of the Building
- Establish baseline to Specify Compatible Materials



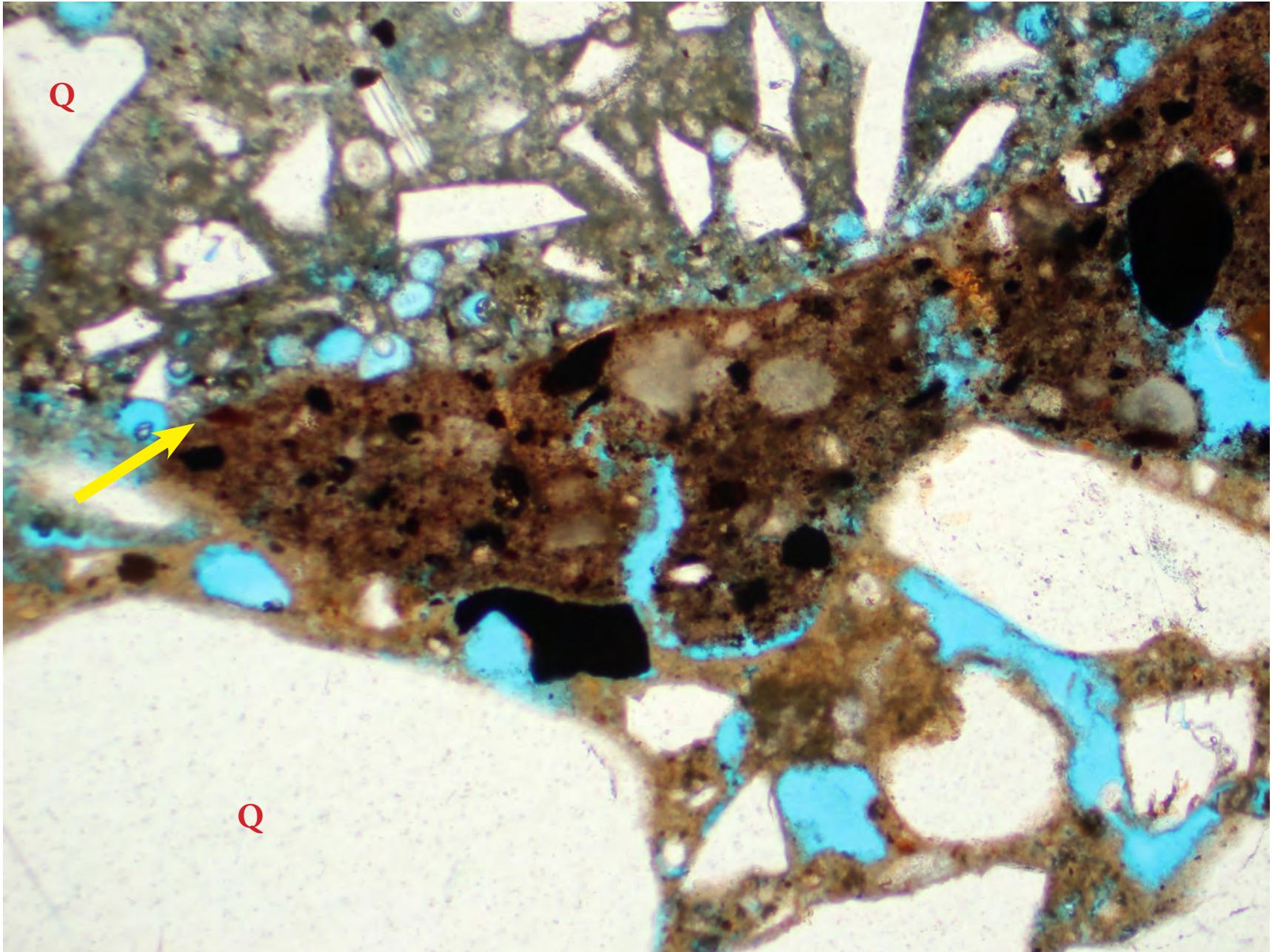
# [Materials Analysis: Stucco]



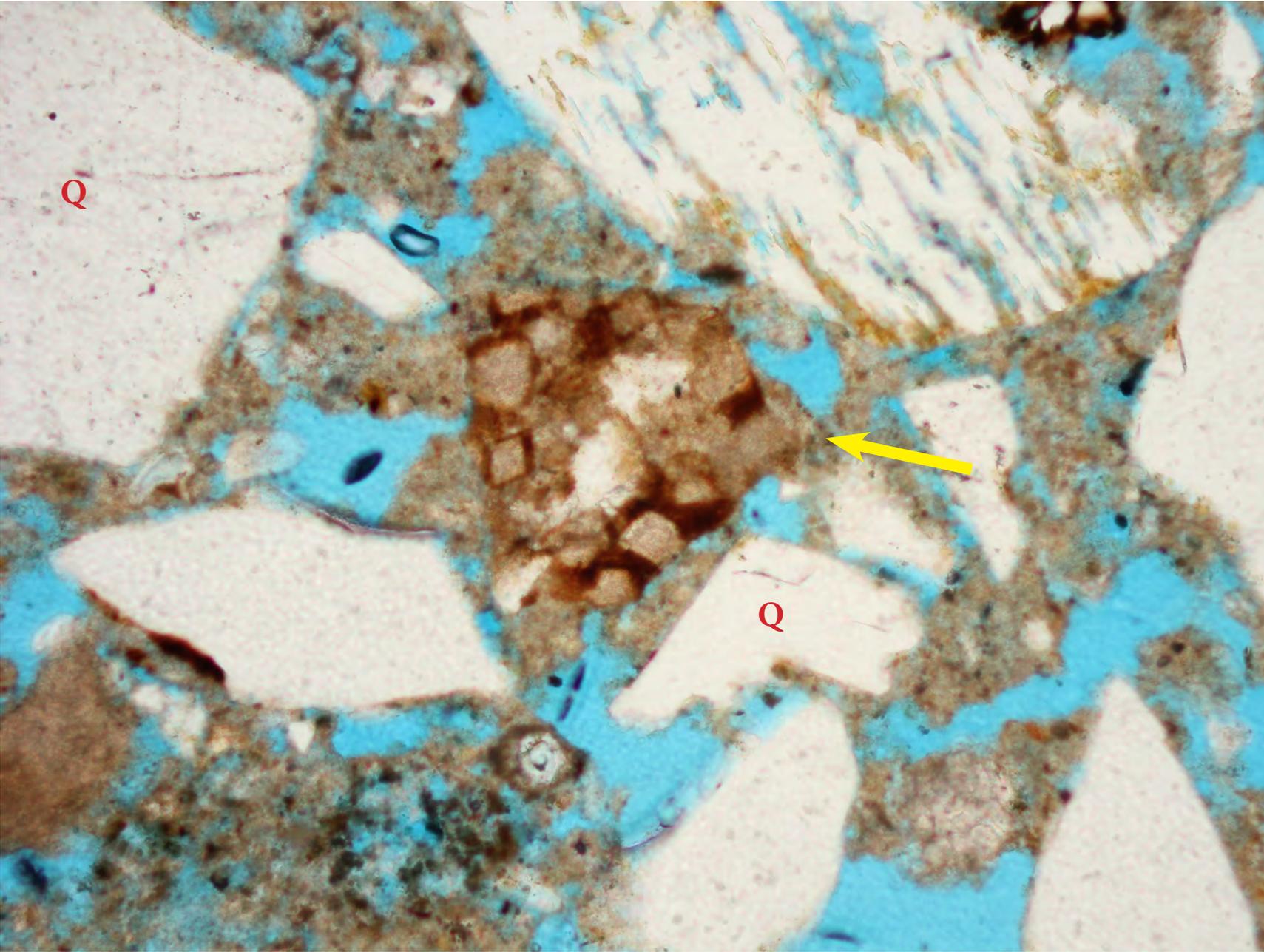
# [Materials Analysis: Portland Cement Skim Coat]



# [Petrographic Analysis: Portland Skim Coat]



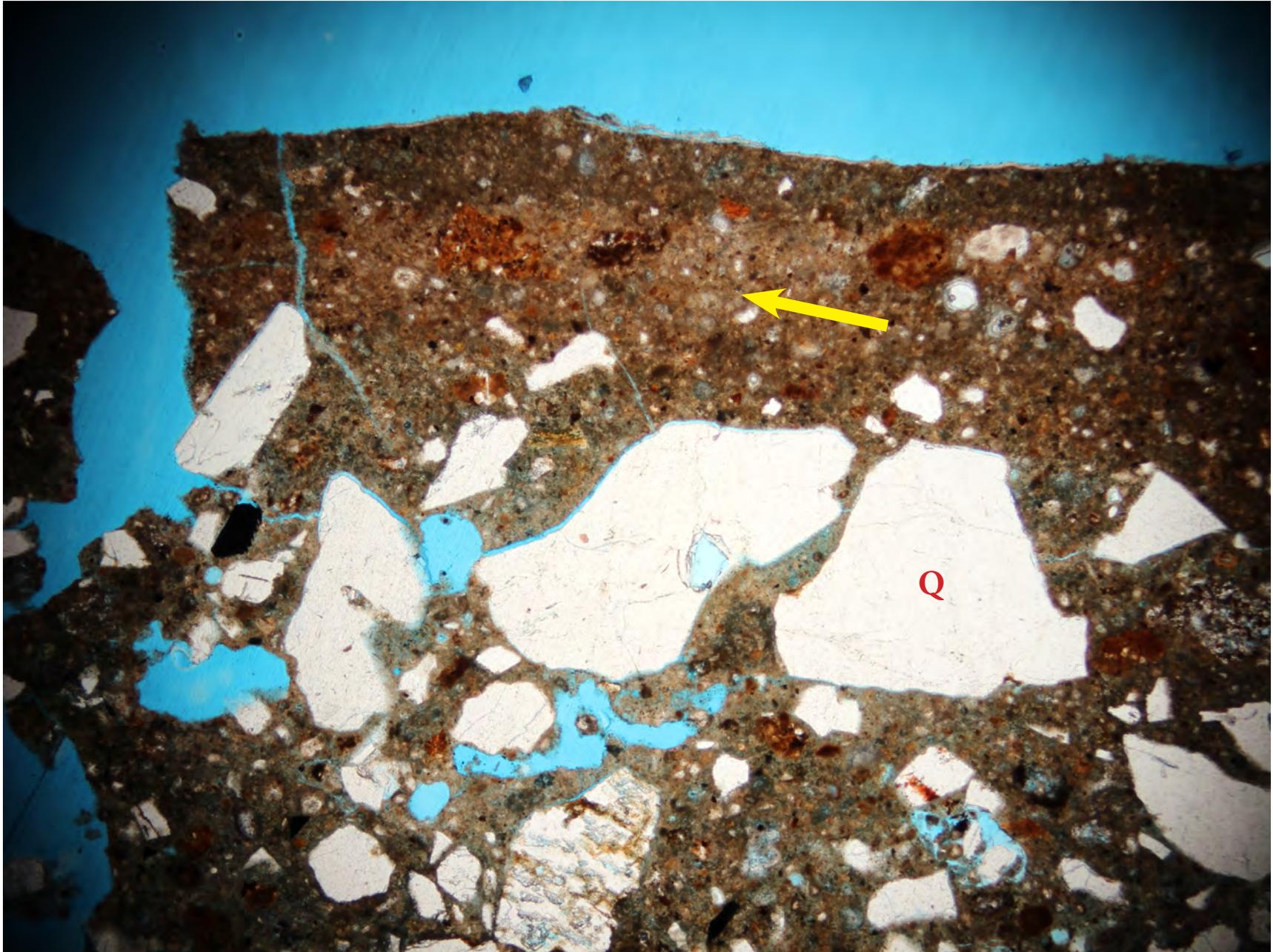
# [Petrographic Analysis: Stucco Condition & Material ID]



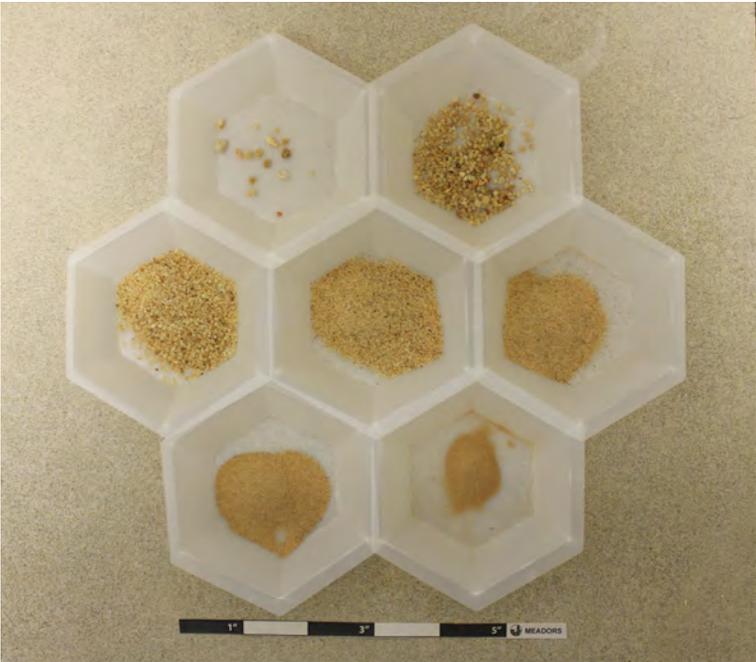
# [Materials Analysis: Porosity of Natural Cement]



# [Petrographic Analysis: Porosity of Natural Cement]



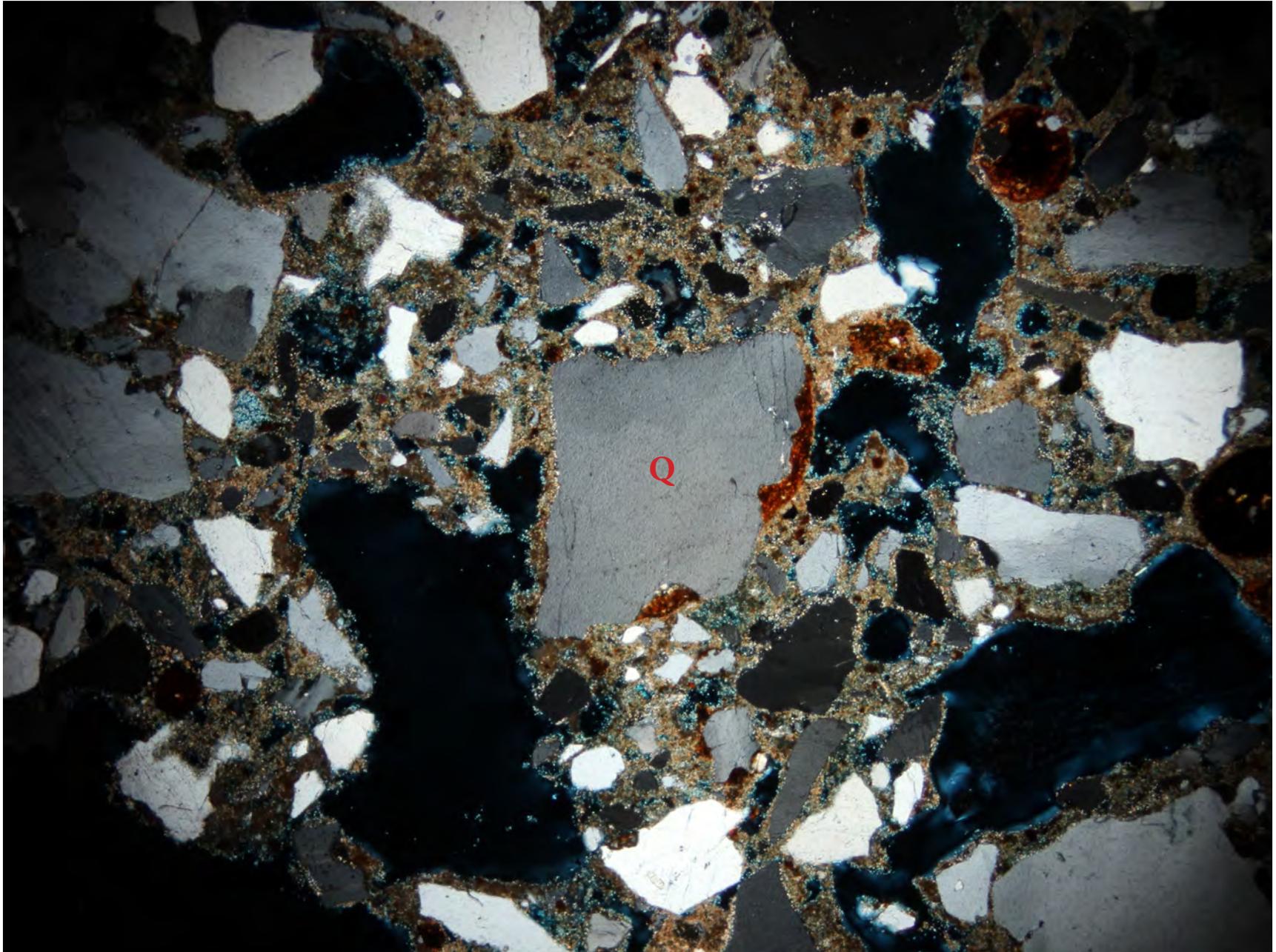
# [Materials Analysis: Mortar with Brick Pozzolan Additive]



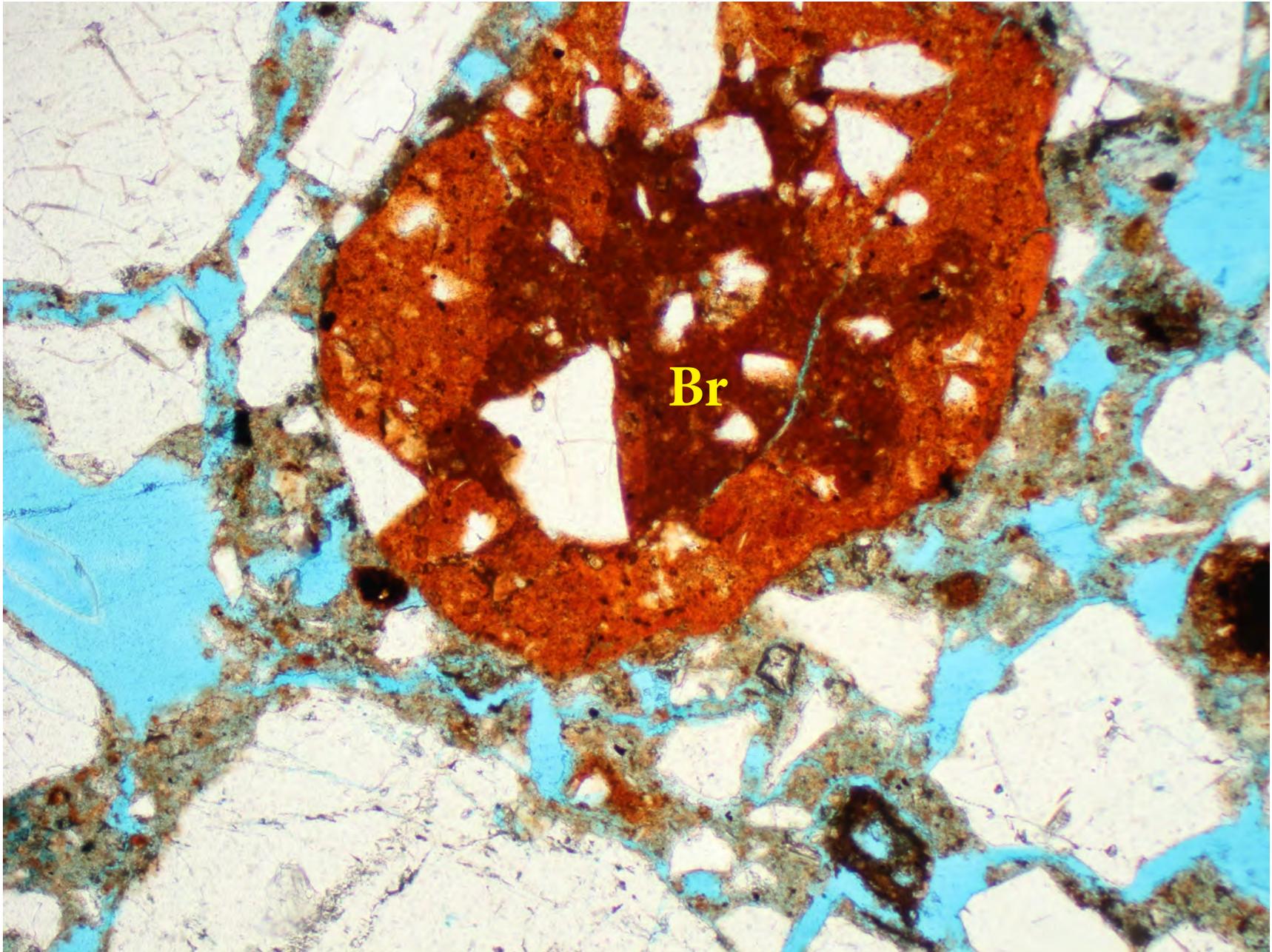
# [Petrographic Analysis: Mortar ID]



# [Materials Analysis: Mortar ID]



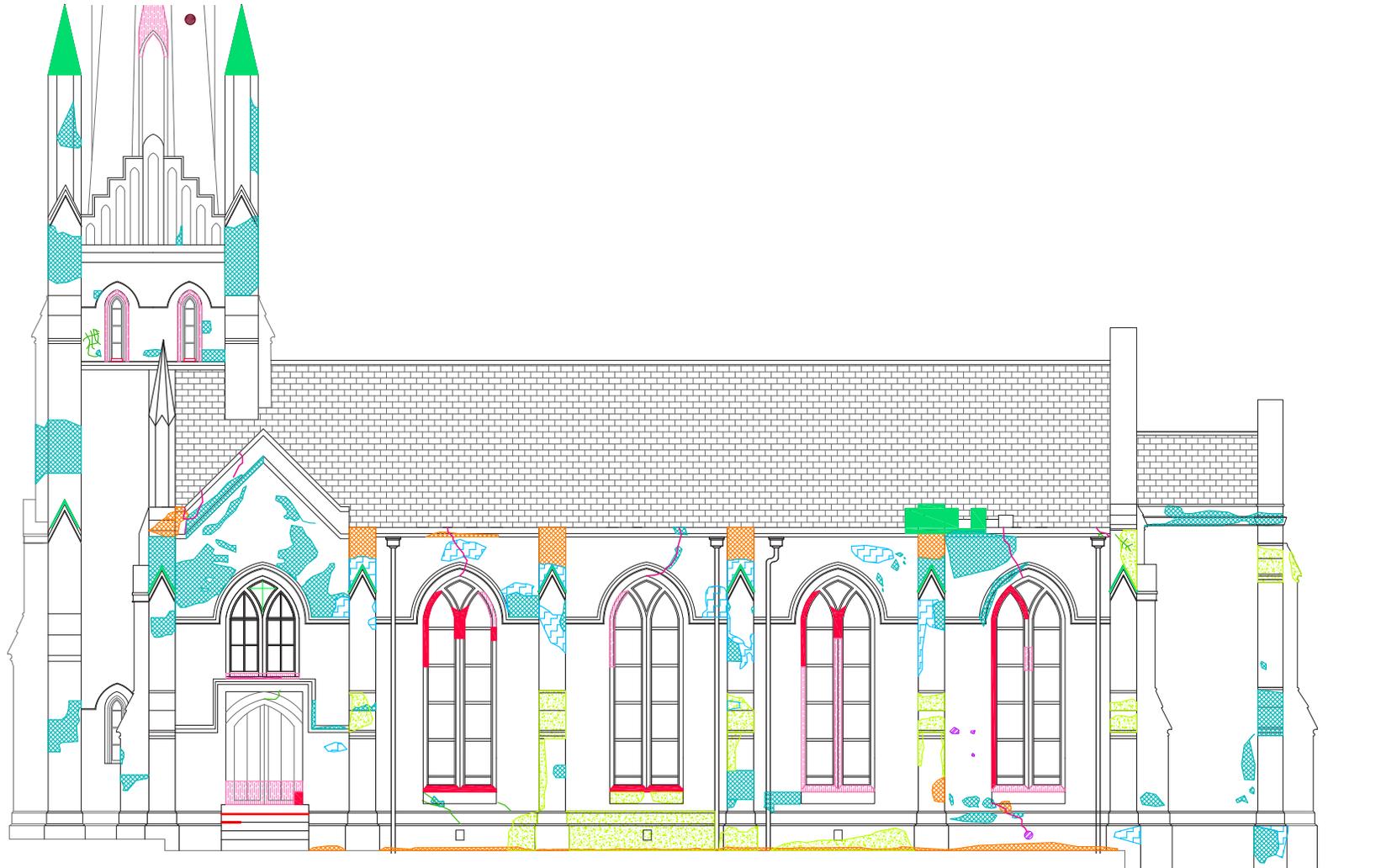
# [Petrographic Analysis: Mortar Additives]



**[How Do We Convey the Information We've Gathered?]**



# [Conditions Drawings: Findings]



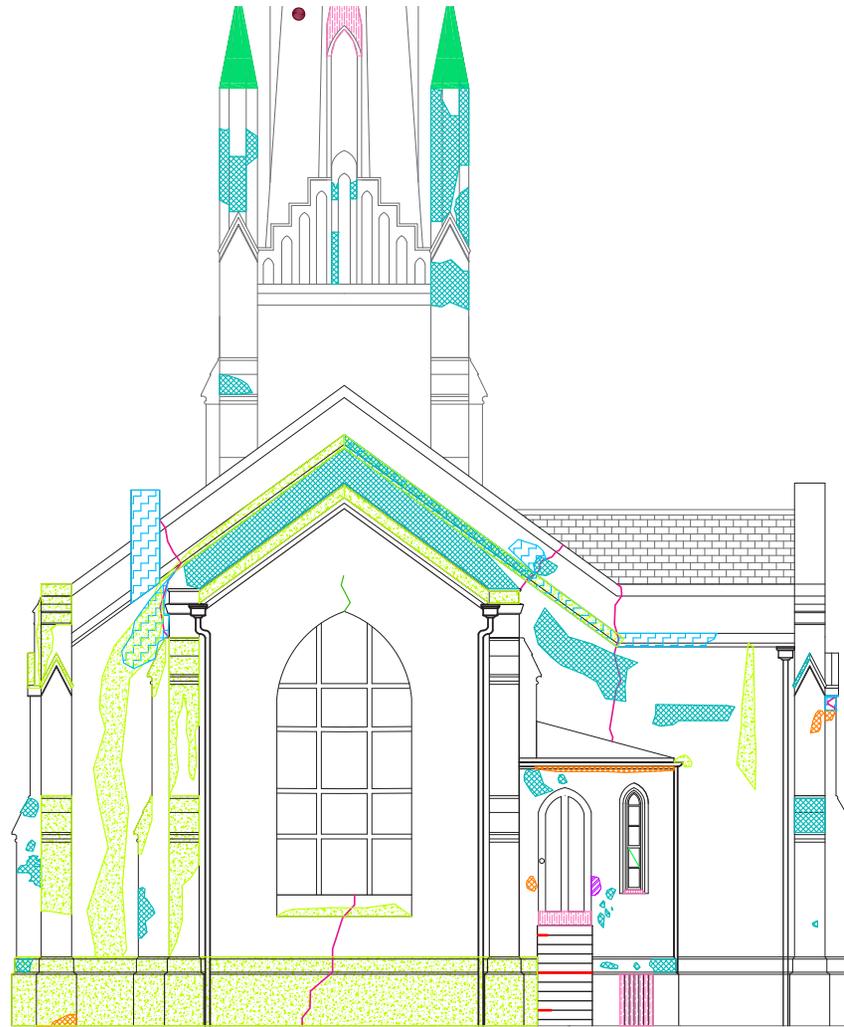
NORTH ELEVATION

1/8" = 1'-0"

- |                        |                   |                          |                            |                                   |                         |
|------------------------|-------------------|--------------------------|----------------------------|-----------------------------------|-------------------------|
| Displaced Cracking     | Detached Stucco   | Stucco Loss of Skim Coat | Inappropriate Stucco Patch | Wood Decay                        | Cracked/Dislodged Glass |
| Non-Displaced Cracking | Total Stucco Loss | Unpainted Stucco         | Void Space                 | Weathered/Damaged Wooden Elements | Microflora              |



# [Conditions Drawings: Findings]



WEST ELEVATION

1/8" = 1'-0"

- |                          |                     |                            |                              |                                     |                           |
|--------------------------|---------------------|----------------------------|------------------------------|-------------------------------------|---------------------------|
| — Displaced Cracking     | ■ Detached Stucco   | ■ Stucco Loss of Skim Coat | ■ Inappropriate Stucco Patch | ■ Wood Decay                        | — Cracked/Dislodged Glass |
| — Non-Displaced Cracking | ■ Total Stucco Loss | ■ Unpainted Stucco         | ■ Void Space                 | ■ Weathered/Damaged Wooden Elements | ■ Microflora              |



# [Conditions Drawings: Findings]



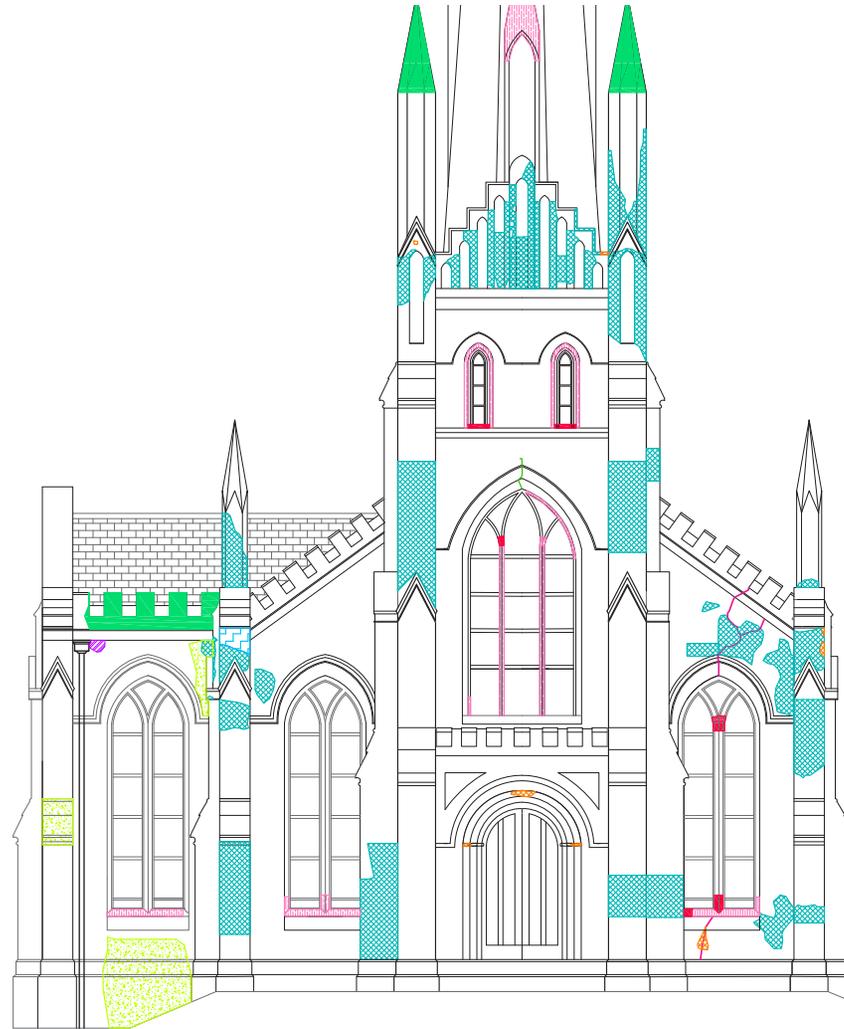
SOUTH ELEVATION

1/8" = 1'-0"

- |                        |                   |                          |                            |                                   |                         |
|------------------------|-------------------|--------------------------|----------------------------|-----------------------------------|-------------------------|
| Displaced Cracking     | Detached Stucco   | Stucco Loss of Skim Coat | Inappropriate Stucco Patch | Wood Decay                        | Cracked/Dislodged Glass |
| Non-Displaced Cracking | Total Stucco Loss | Unpainted Stucco         | Void Space                 | Weathered/Damaged Wooden Elements | Microflora              |



# [Conditions Drawings: Findings]



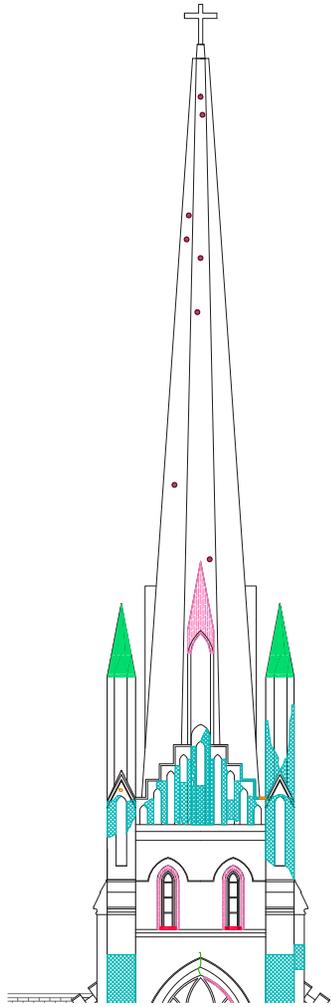
EAST ELEVATION

1/8" = 1'-0"

- |  |   |  |  |   |   |
|--|---|--|--|---|---|
|  Displaced Cracking     |  Detached Stucco   |  Stucco Loss of Skim Coat |  Inappropriate Stucco Patch |  Wood Decay                        |  Cracked/Dislodged Glass |
|  Non-Displaced Cracking |  Total Stucco Loss |  Unpainted Stucco         |  Void Space                 |  Weathered/Damaged Wooden Elements |  Microflora              |

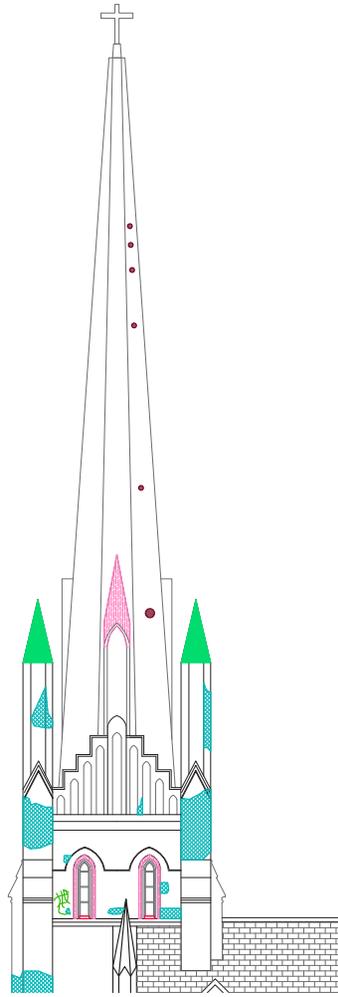


# [Conditions Drawings: Findings]



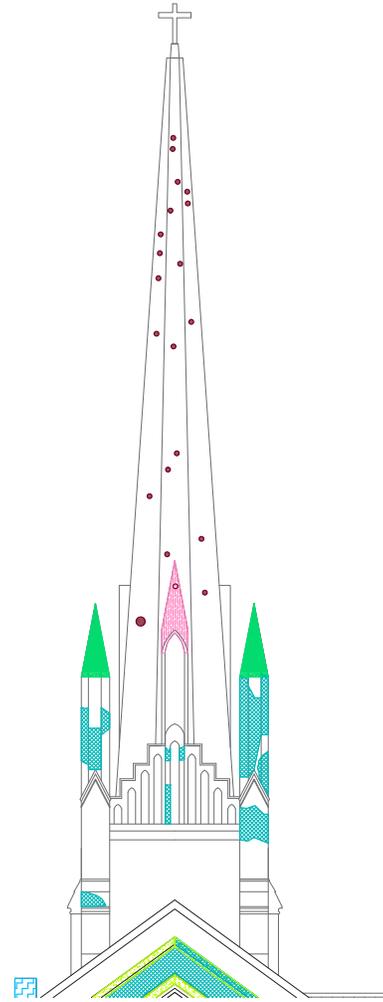
EAST ELEVATION

3/32" = 1'-0"



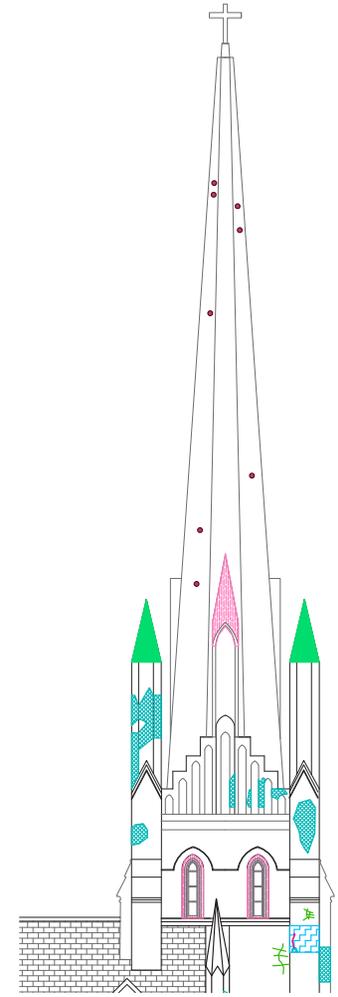
NORTH ELEVATION

3/32" = 1'-0"



WEST ELEVATION

3/32" = 1'-0"



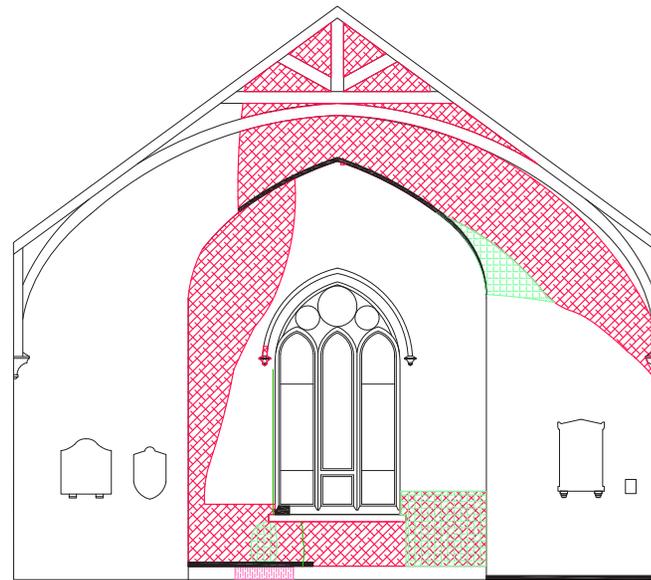
SOUTH ELEVATION

3/32" = 1'-0"

- |                        |                   |                          |                            |                                   |                         |
|------------------------|-------------------|--------------------------|----------------------------|-----------------------------------|-------------------------|
| Displaced Cracking     | Detached Stucco   | Stucco Loss of Skim Coat | Inappropriate Stucco Patch | Wood Decay                        | Cracked/Dislodged Glass |
| Non-Displaced Cracking | Total Stucco Loss | Unpainted Stucco         | Void Space                 | Weathered/Damaged Wooden Elements | Microflora              |



# [Conditions Drawings: Findings]



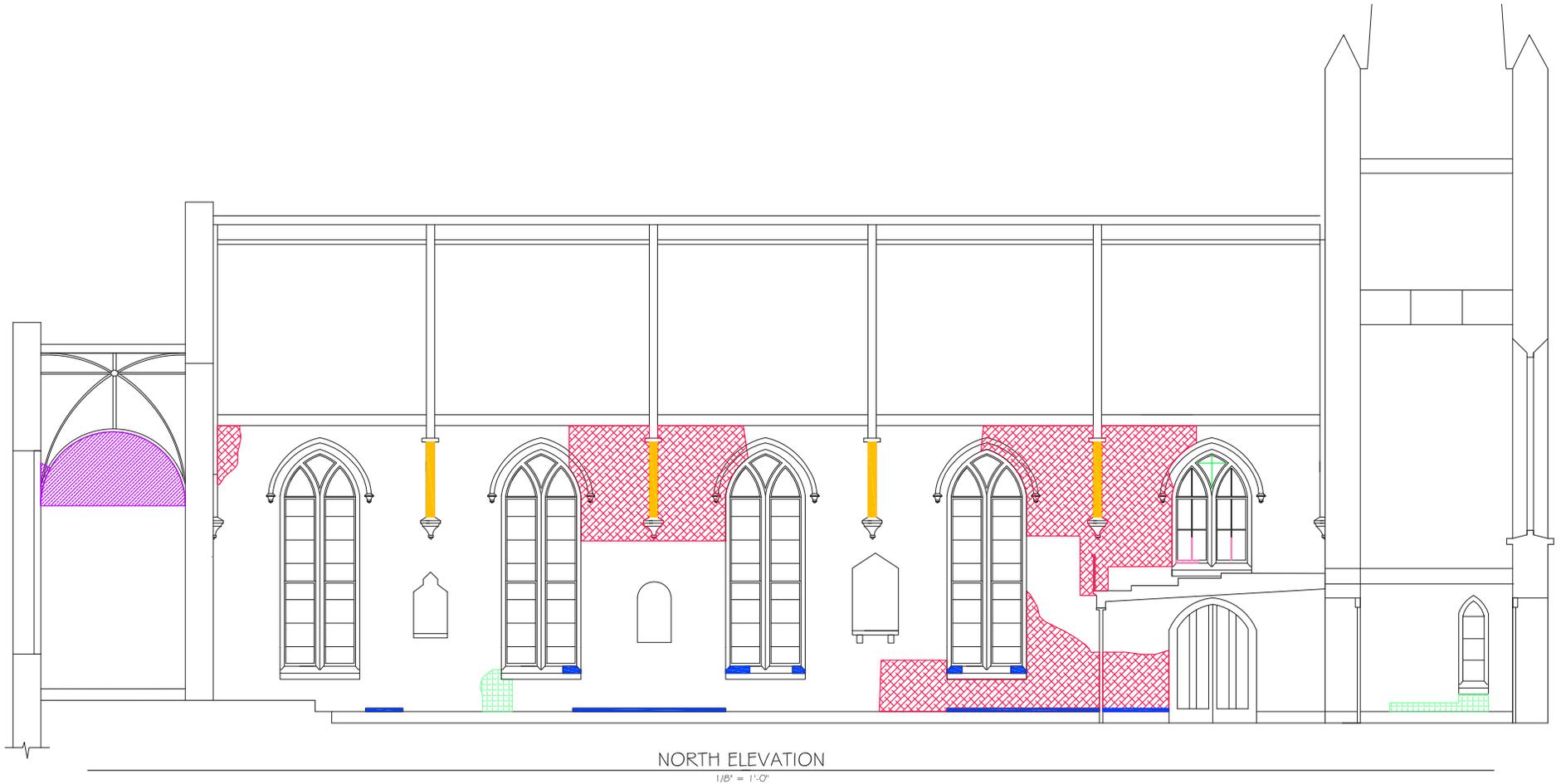
WEST ELEVATION

1/8" = 1'-0"

- |                          |                       |                                |                                  |                           |
|--------------------------|-----------------------|--------------------------------|----------------------------------|---------------------------|
| — Displaced Cracking     | ⊠ Gypsum Dissolution  | ■ Plaster Debris               | ■ Separation of Woodwork/Checked | — Cracked/Dislodged Glass |
| — Non-Displaced Cracking | ⊠ Plaster Chips/Gouge | ■ Detached Plaster             | ■ Damaged Wooden Elements        |                           |
|                          | ⊠ Paint Flaking       | ■ Inappropriate Plaster Repair |                                  |                           |



# [Conditions Drawings: Findings]



- |  |   |  |  |   |
|--|---|--|--|---|
|  Displaced Cracking     |  Gypsum Dissolution  |  Plaster Debris               |  Separation of Woodwork/Checked |  Cracked/Dislodged Glass |
|  Non-Displaced Cracking |  Plaster Chips/Gouge |  Detached Plaster             |  Damaged Wooden Elements        |   |
|  |  Paint Flaking       |  Inappropriate Plaster Repair |  |   |

# [Conditions Drawings: Findings]



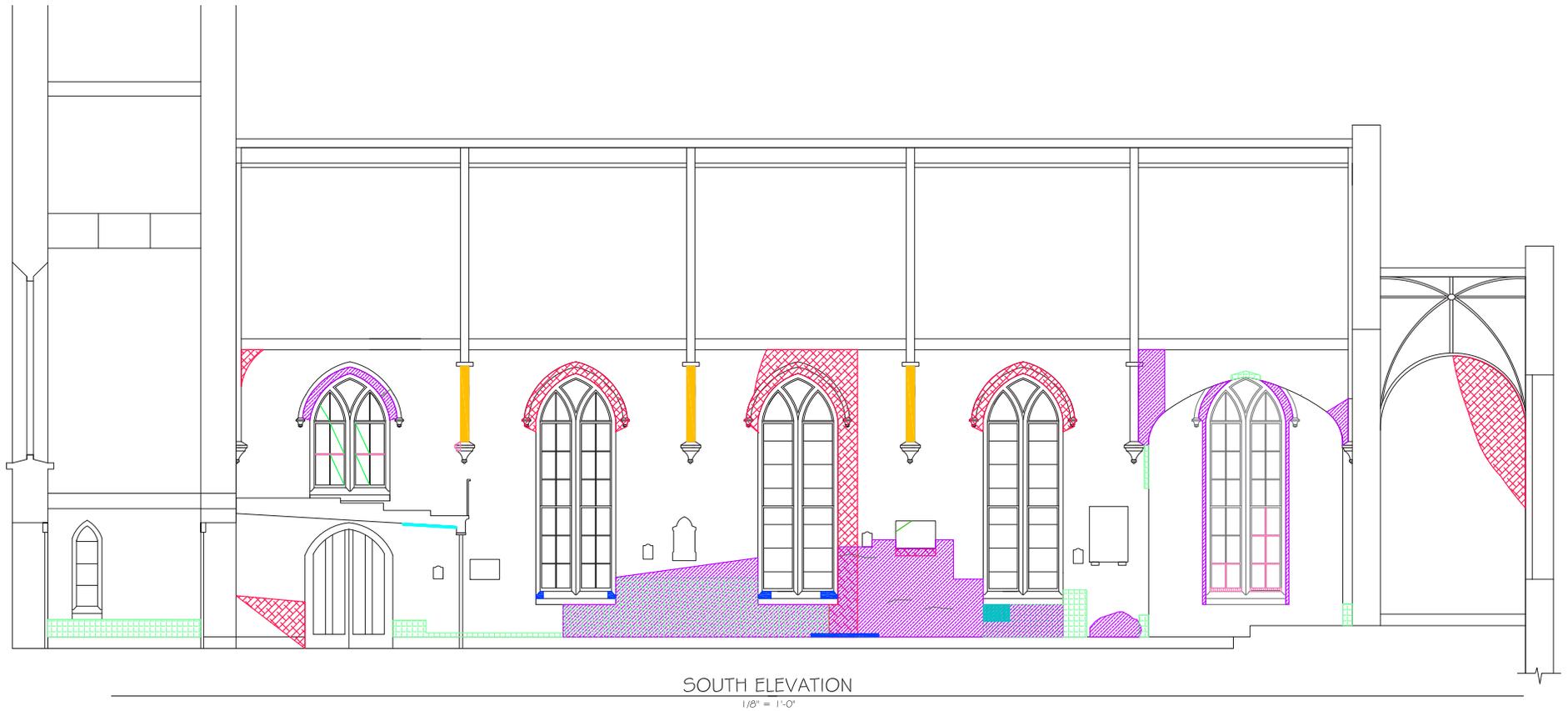
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- |                          |                       |                                |                                  |                           |
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| — Displaced Cracking     | ▣ Gypsum Dissolution  | ▣ Plaster Debris               | ▣ Separation of Woodwork/Checked | — Cracked/Dislodged Glass |
| — Non-Displaced Cracking | ▣ Plaster Chips/Gouge | ▣ Detached Plaster             | ▣ Damaged Wooden Elements        |                           |
|                          | ▣ Paint Flaking       | ▣ Inappropriate Plaster Repair |                                  |                           |



# [Conditions Drawings: Findings]



- |                        |                     |                              |                                |                         |
|------------------------|---------------------|------------------------------|--------------------------------|-------------------------|
| Displaced Cracking     | Gypsum Dissolution  | Plaster Debris               | Separation of Woodwork/Checked | Cracked/Dislodged Glass |
| Non-Displaced Cracking | Plaster Chips/Gouge | Detached Plaster             | Damaged Wooden Elements        |                         |
|                        | Paint Flaking       | Inappropriate Plaster Repair |                                |                         |



**[Where Do We Go From Here?]**



# [Recommendations: Immediate, Short-Term, & Long-Term]

PROJECT PHASE	ITEM	RECOMMENDATIONS	COST
IMMEDIATE PRIORITY (10 MONTHS TO COMPLETE)	Architectural	<ul style="list-style-type: none"> <li>Develop complete construction bid set based off of assessment findings with all necessary architectural and engineering details prior to the commencement of any work.</li> <li>Construction administration during course of work.</li> </ul>	\$49,902.50
	Scaffolding (East, Steeple, North)	<ul style="list-style-type: none"> <li>Labor to Erect</li> <li>Labor to Dismantle</li> <li>Rental fee per 28 days (\$7,580)</li> </ul>	\$157,773.00
	General Conditions	<ul style="list-style-type: none"> <li>Mobilization</li> <li>Temporary facilities</li> <li>Site protection</li> <li>Equipment rental</li> <li>Debris removal</li> <li>Site supervision</li> </ul>	\$112,073.40
	Foundation & Wall Structural Repairs	<ul style="list-style-type: none"> <li>Install helical piles to underpin the existing foundation by a specialized contractor licensed to perform underpinning.</li> <li>Further evaluate the condition of the horizontal tie rod anchors. Repair bolts as necessary with stainless steel bolts of a similar dimension.</li> </ul>	\$30,085.12
	Exterior Stucco	<ul style="list-style-type: none"> <li>Removal of loose portland cement stucco on east elevation, north elevation, and bell tower to address life safety hazards.</li> <li>Restoration and stabilization of existing historic stucco on the east elevation, north elevation, and steeple. Repair historic stucco using a natural cement stucco.</li> <li>Reinstall decorative elements on all finials</li> <li>Continual monitoring of crack monitors throughout the building.</li> <li>Paint new and restored stucco with desired finish.</li> </ul>	\$703,075.27
	Gutters & Downspouts	<ul style="list-style-type: none"> <li>Replace existing membrane gutters with welded stainless steel.</li> <li>Replace membrane roof at bell tower with welded stainless steel.</li> <li>Investigate below grade drainage to verify runoff is being directed away from the structure.</li> <li>Remove leaves and debris from half round gutters on west elevation.</li> </ul>	\$72,737.60
	Steeple & Bell Tower	<ul style="list-style-type: none"> <li>As detailed in structural repairs, shore up first floor beneath scaffolding in vestibule with additional stabilization.</li> <li>Install scaffolding to safely access bell tower in order to fully assess the framing and masonry.</li> <li>Perform structural repairs as necessary.</li> <li>Restore wooden elements on steeple.</li> <li>Installation of new hatch and ladder to safely access steeple and bell tower.</li> <li>Restoration of bell tower ceiling at balcony level.</li> <li>Perform structural repairs to the spire and bell tower framing as necessary (Allowance of \$100,000 of work).</li> </ul>	\$194,685.97
	Spire & Roof	<ul style="list-style-type: none"> <li>Replace existing shingle roof in kind with a 30 year shingle roof.</li> <li>Replace any damaged sheathing uncovered during roof replacement. Flashing should also be reevaluated at this time.</li> <li>Reshingle spire and repair flashing in kind.</li> </ul>	\$38,137.50
	Windows	<ul style="list-style-type: none"> <li>Remove lower panels in protective coverings on windows #12, 16, &amp; 17 to address ventilation issues.</li> </ul>	\$339.00

PROJECT PHASE	ITEM	RECOMMENDATIONS	COST	
SHORT TERM (4 MONTHS TO COMPLETE)	Architectural	<ul style="list-style-type: none"> <li>Follow annual treatment plan as determined by architectural documents during Phase 1 for items restored in immediate priority section.</li> <li>Construction administration during course of work.</li> </ul>	\$8,125.00	
	Scaffolding (West, South)	<ul style="list-style-type: none"> <li>Labor to Erect</li> <li>Labor to Dismantle</li> <li>Rental fee per 28 days (\$6,324)</li> </ul>	\$74,767.58	
	General Conditions	<ul style="list-style-type: none"> <li>Mobilization</li> <li>Temporary facilities</li> <li>Lift rental</li> <li>Debris removal</li> <li>Site supervision</li> </ul>	\$51,189.00	
	Exterior Stucco	<ul style="list-style-type: none"> <li>Removal of loose portland cement stucco on west and east elevations to address life safety hazards and in preparation for repairs.</li> <li>Restoration and stabilization of existing historic stucco on the east elevation and steeple. Repair historic stucco using a natural cement stucco.</li> <li>Reconstruction of missing crenellations</li> <li>Repair and painting of modern portland cement crenellations.</li> <li>Perform masonry repairs as necessary.</li> <li>Paint new and repaired stucco with desired finish.</li> </ul>	\$338,594.90	
	Gutters & Downspouts	<ul style="list-style-type: none"> <li>Repair broken leader heads throughout building.</li> </ul>	\$919.54	
	Windows	<ul style="list-style-type: none"> <li>Restore all stained glass and plate glass windows.</li> <li>Replace protective window coverings with modern windows that promote ventilation between the historic and modern windows.</li> </ul>	\$214,418.63	
	Doors	<ul style="list-style-type: none"> <li>Restore and repaint all doors as necessary.</li> <li>Rehang Door #05 to function properly.</li> </ul>	\$9,808.40	
	Crawlspace	<ul style="list-style-type: none"> <li>Promote ventilation within the crawlspace to prevent moisture or infestation within this space.</li> </ul>	\$5,650.00	
	Interior	<ul style="list-style-type: none"> <li>Install interior scaffolding.</li> <li>Repair deteriorated plaster and woodwork on interior of the church.</li> </ul>	\$161,245.35	
	Termite & Insect Control	<ul style="list-style-type: none"> <li>Annually inspect building with a licensed pest control operator and apply treatment as necessary</li> <li>Annually apply a biocide to the exterior woodwork to limit the growth of organic material.</li> <li>Annually remove insect nests on all windows and woodwork.</li> </ul>	\$0.00	
	Maintenance	<ul style="list-style-type: none"> <li>Follow annual maintenance plan established during Phase 1.</li> </ul>	N/A	
	<b>Total Estimated Budget for Short Term Repairs</b>			<b>\$864,718.39</b>

PROJECT PHASE	ITEM	RECOMMENDATIONS	COST	
LONG TERM (6 WEEKS TO COMPLETE)	Architectural	<ul style="list-style-type: none"> <li>Construction administration during course of work.</li> </ul>	\$4,062.50	
	General Conditions	<ul style="list-style-type: none"> <li>Mobilization</li> <li>Temporary facilities</li> <li>Lift rental</li> <li>Debris removal</li> <li>Site supervision</li> </ul>	\$22,854.25	
	Steeple & Bell Tower	<ul style="list-style-type: none"> <li>Address any issues discovered with historic cast iron bell (Allowance of \$10,000 worth of work).</li> </ul>	\$11,300.00	
	Windows	<ul style="list-style-type: none"> <li>Restore and reinstall decorative elements above windows #01 &amp; #03.</li> </ul>	\$1,130.00	
	Interior Balcony	<ul style="list-style-type: none"> <li>Repair missing railing strap on middle section of balcony.</li> <li>Restore floors as necessary.</li> <li>Remove debris.</li> </ul>	\$20,905.00	
	Iron Gate	<ul style="list-style-type: none"> <li>Treat areas of corrosion with a rust inhibitor and repaint</li> </ul>	\$2,486.00	
	Termite & Insect Control	<ul style="list-style-type: none"> <li>Annually inspect building with a licensed pest control operator and apply treatment as necessary</li> <li>Annually apply a biocide to the exterior woodwork to limit the growth of organic material.</li> <li>Annually remove insect nests on all windows and woodwork.</li> </ul>	\$6,147.20	
	Maintenance	<ul style="list-style-type: none"> <li>Follow annual maintenance plan established during Phase 1.</li> </ul>	N/A	
	<b>Total Estimated Budget for Long Term Repairs</b>			<b>\$68,884.95</b>
	<b>Total Estimated Budget for All Repairs in One Phase</b>			<b>\$2,331,938.06</b>



# [Recommendations: Primary Issues]

- **Stop Water Intrusion and Stabilize the Building Envelope**
  1. Install New Built-In Gutters, Flashing, & Roof Over the Sanctuary
  2. Install New Wood Shingle Roof on the Spire
  3. Install New Metal Roof at Bell Tower
  4. Restoration and Stabilization of Historic Stucco
- **Address All Life-Safety Issues (remove loose Portland cement stucco)**
- **Assess Bell Tower and Develop Prioritized List of Repairs**
- **Install Helical Piles at Base of North Wall**
- **Remove Lower Panels in Protective Stain Glass Window Coverings to Address Ventilation Issues**





[Next Steps]

