TRANSITIONAL MASONRY FACADES

HIDDEN AND UNFORESEEN HAZARDS

PART 2

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ACI 2023 Fall Convention

AGENDA

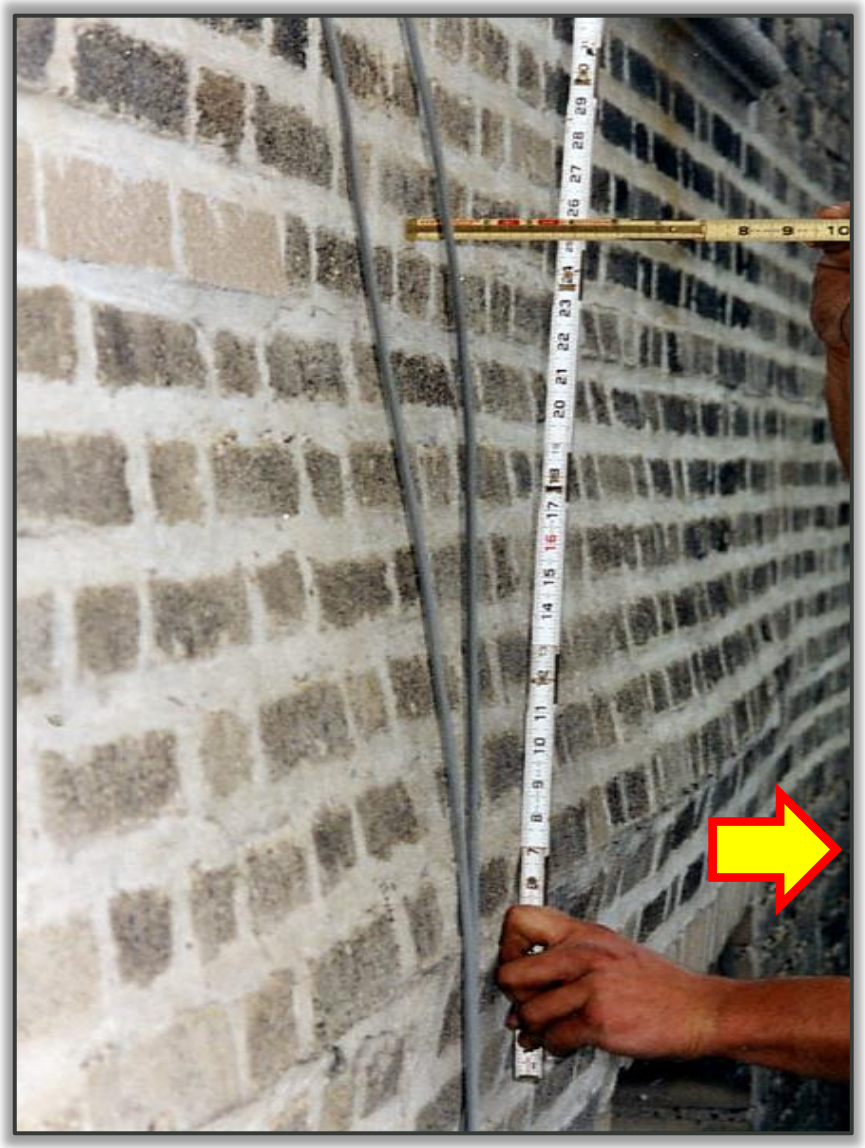
~~PART 1~~

- ~~Background on Transitional Masonry~~
- ~~Masonry and Structural Deterioration~~
- ~~Risk for Hazards~~

PART 2

- Inspection Methods
- Repairs and Protection Strategies

SUMMARY OF DETERIORATION – MASONRY FACADE



SUMMARY OF UNDERLYING DETERIORATION: STRUCTURE

Structural deterioration can compromise structural capacity

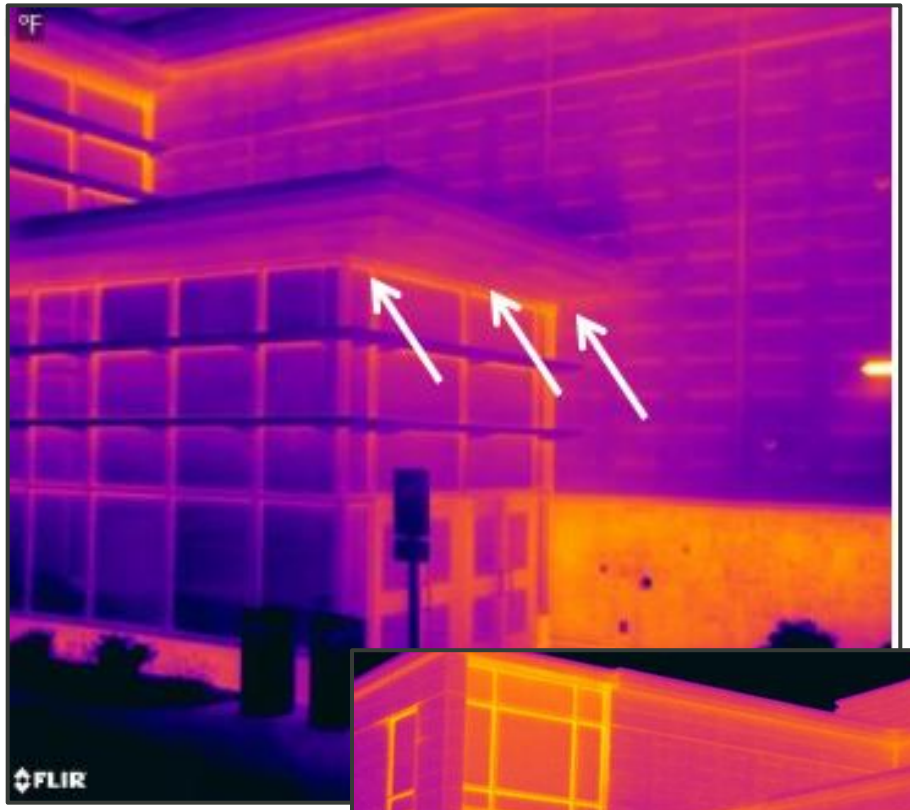
INSPECTION METHODS

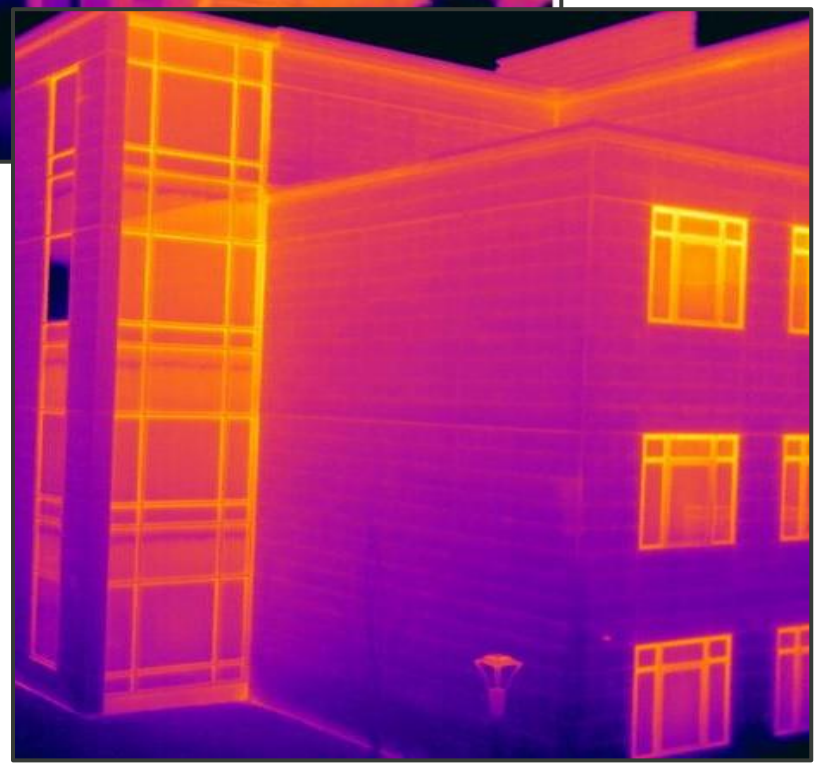
- **Visual Observations:**
  - Binoculars from ground level and adjacent roof surfaces
  - Unmanned aerial vehicles (UAVs): drones
- **Infrared Thermography:**
  - Identify locations with retained moisture
- **Reality Modeling:**
  - 3-D Imaging
- **Hands-on:**
  - Close-up observations from aerial lifts, suspended scaffolding or industrial rope access
  - Exploratory openings to observe condition of structural frame and masonry

Visual Observations

Infrared Thermography (IRT)

- Non-destructive technique with a thermal camera to capture images
  - Common for roofing surface leak detection and exterior wall thermal insulation discontinuities.
  - Potential for use in transitional masonry facade inspections
- Thermal cameras capture variations in surface temperatures
  - Surfaces that retain water will change temperature at a different rate.
  - Identify walls with and without absorbed water.
- In transitional masonry buildings, “wet” areas can indicate locations with hidden deterioration

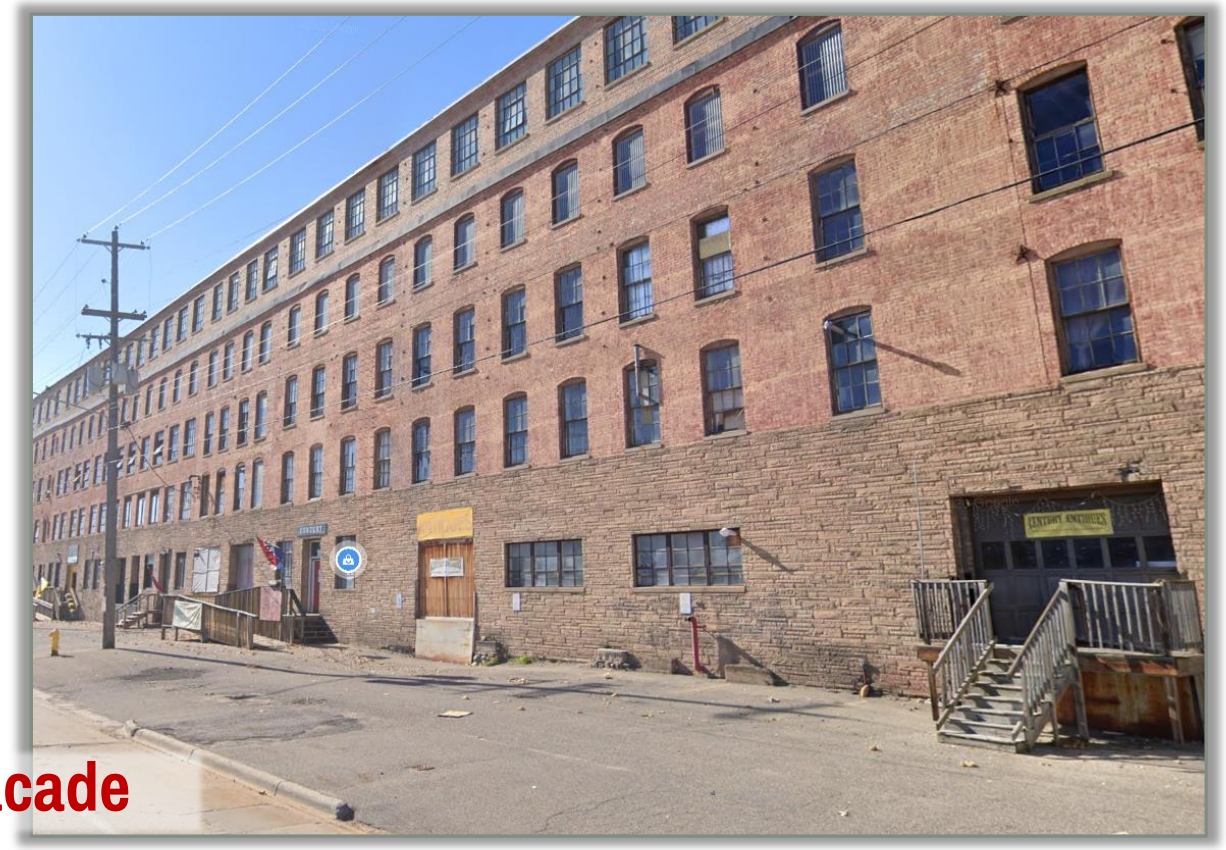




Reality Modeling

- Reality models provide actual context using aerial imagery
  - RM “constructs” a building in 3D using drones, laser scanners, and photogrammetry software

- Used to document existing conditions prior to up-close observations
- Model can be converted to BIM model
  - Basis model for the production of repair documents
- Document change in conditions with future imaging



View of masonry facade

Reality Modeling

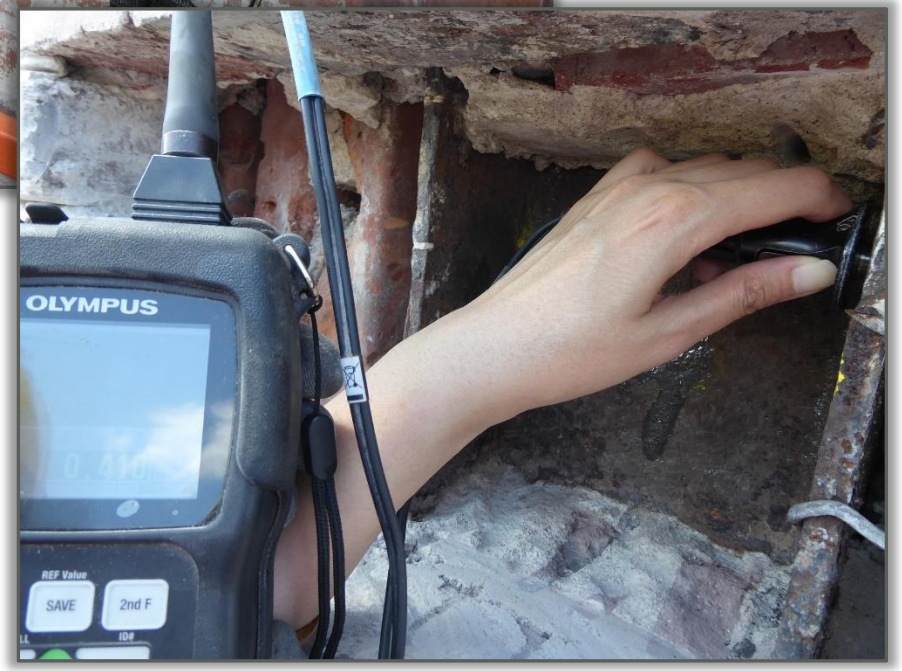
Credits: BIMstream

Overall view of model

Selected facade views

Hands-on Inspections

- Close-up assessment of conditions of masonry
- Exterior wall openings to document concealed structural elements
  - Correlate brick distress with structural deterioration
  - Inform the repair scope
- Gather information for structural analysis
  - Verify structural capacities
  - Design repairs/strengthening



REPAIR AND PROTECTION STRATEGY

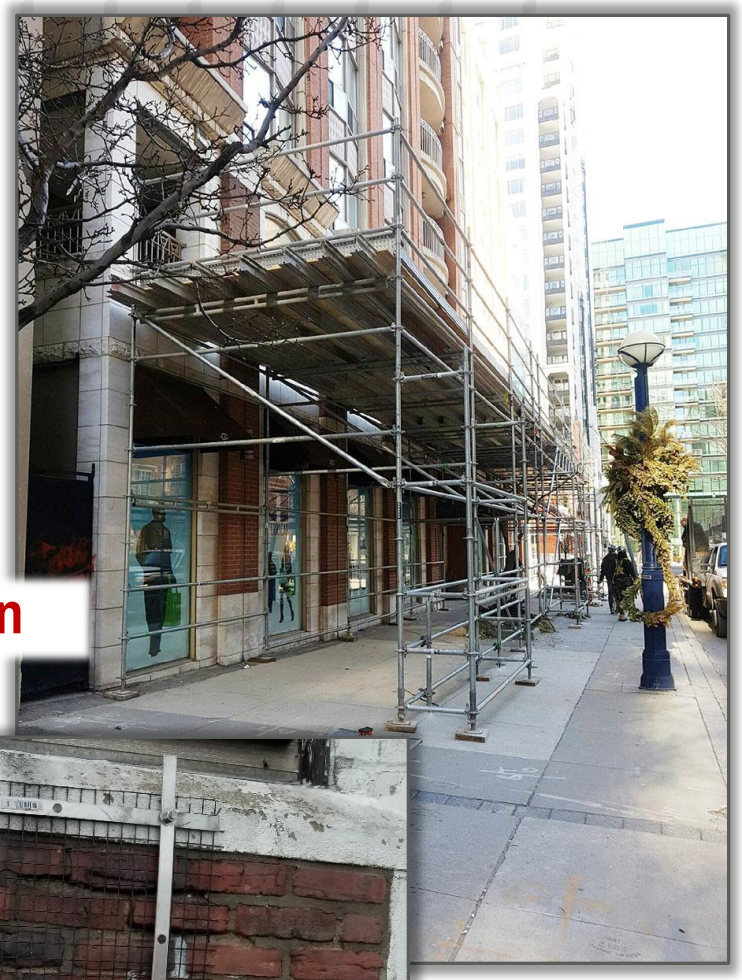
The remedial work generally falls into three categories:

1. **Make Safe:**
   - Remove loose material
   - Netting
   - Overhead sidewalk protection
   - Temporary stabilization
2. **Facade Repairs:**
   - Structural repairs to concrete/steel elements
   - Masonry repairs
3. **Corrosion Mitigation:**
   - Waterproofing
   - Specialty coatings
   - Impressed Current Cathodic Protection (ICCP)

“MAKE SAFE”

Public safety is paramount

Removal of loose material

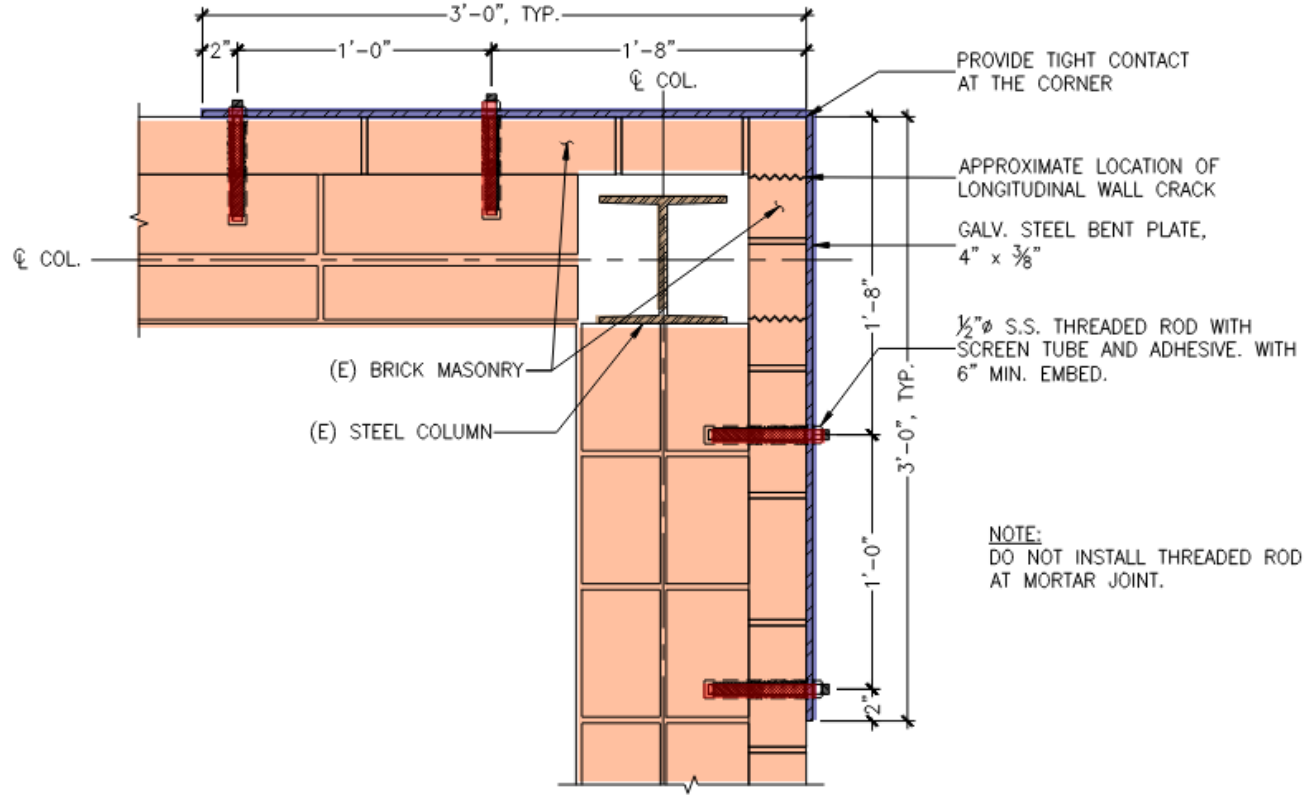


Overhead Protection

Netting

STABILIZATION

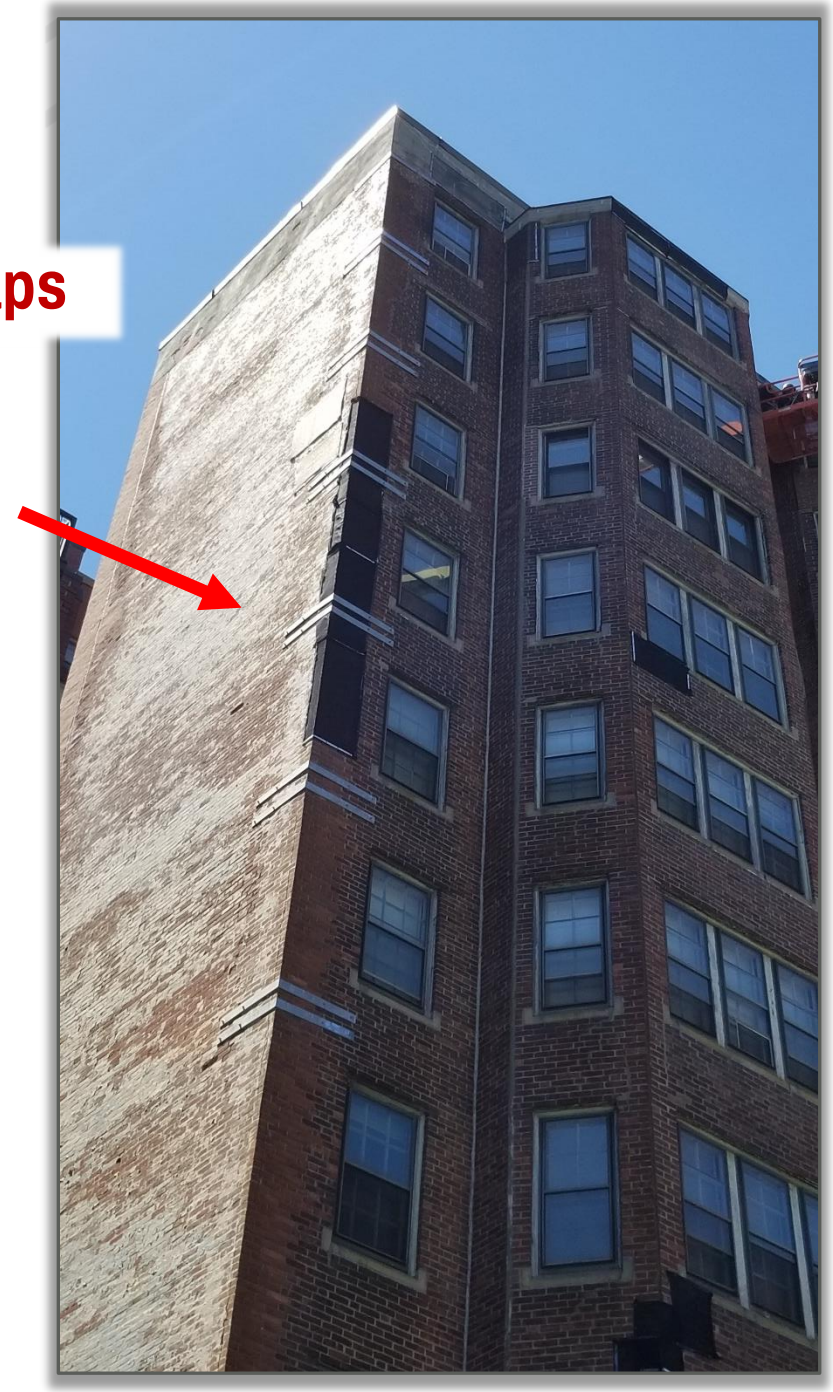
- Temporary measures to prevent fall hazards



1 STEEL STRAP INSTALLATION AT CORNER COLUMN – PLAN DETAIL

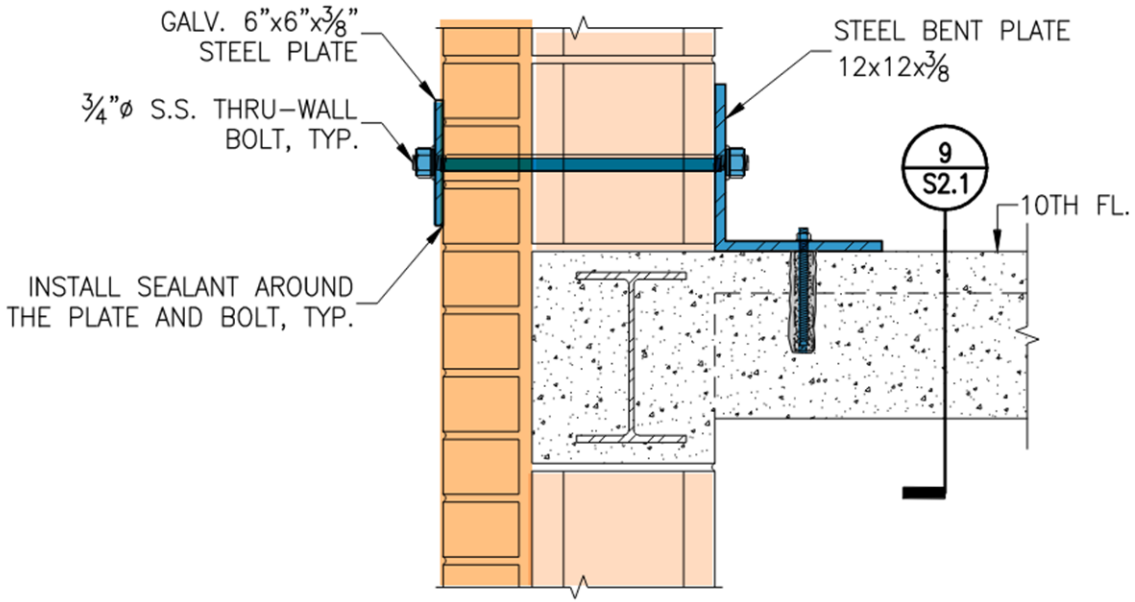
1 1/2" = 1'-0"

Steel Straps



STABILIZATION

Anchor Plates

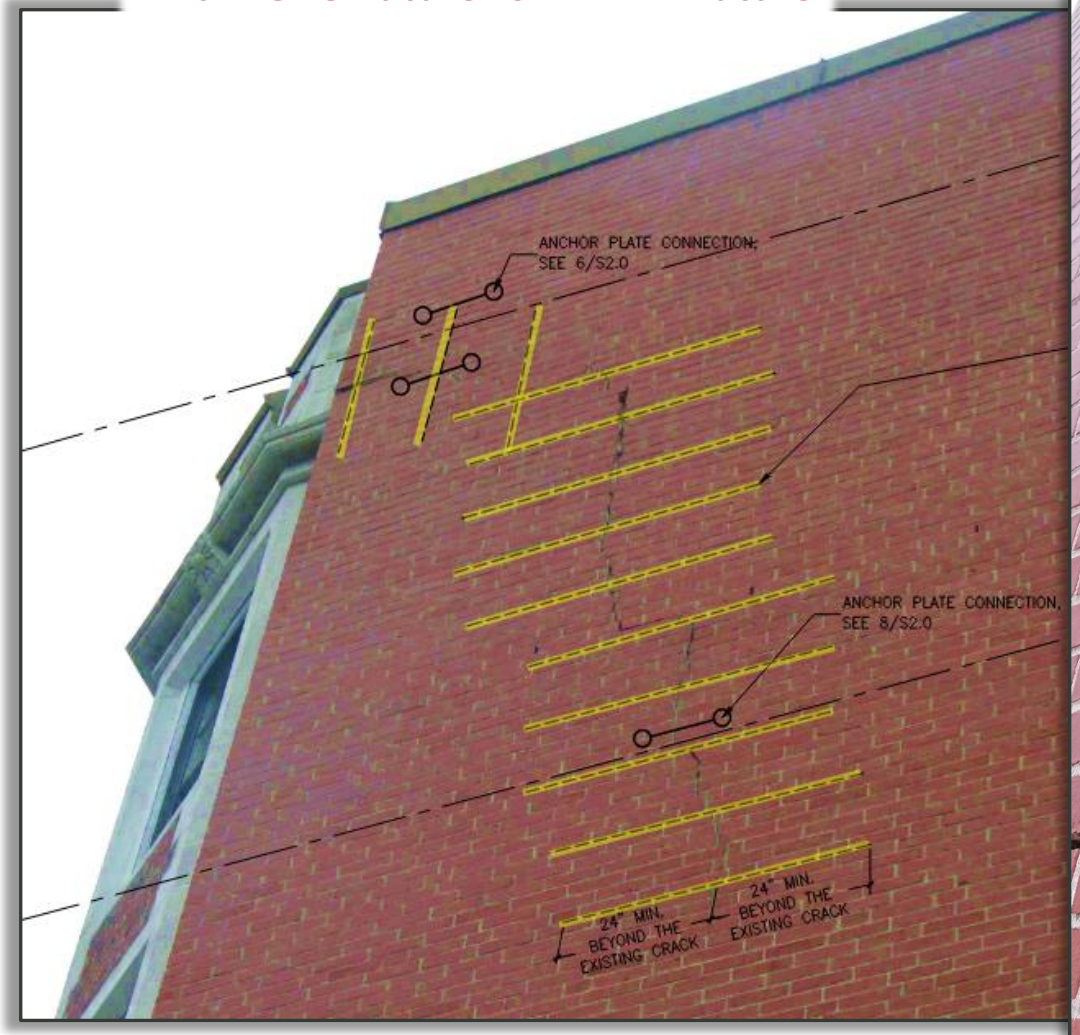


8 ANCHOR PLATE CONNECTION AT 10TH FLOOR

1 1/2" = 1'-0"

STABILIZATION

Crack “Stitching” with S.S bars or FRP bars



Supplemental Steel Elements with Netting

STRUCTURAL REPAIRS AND PROTECTION

Column with new reinforcement

Repaired column

Waterproofed column

STRUCTURAL REPAIRS AND PROTECTION

- Remove and Replace Steel Members
- Add supplemental elements to strengthen

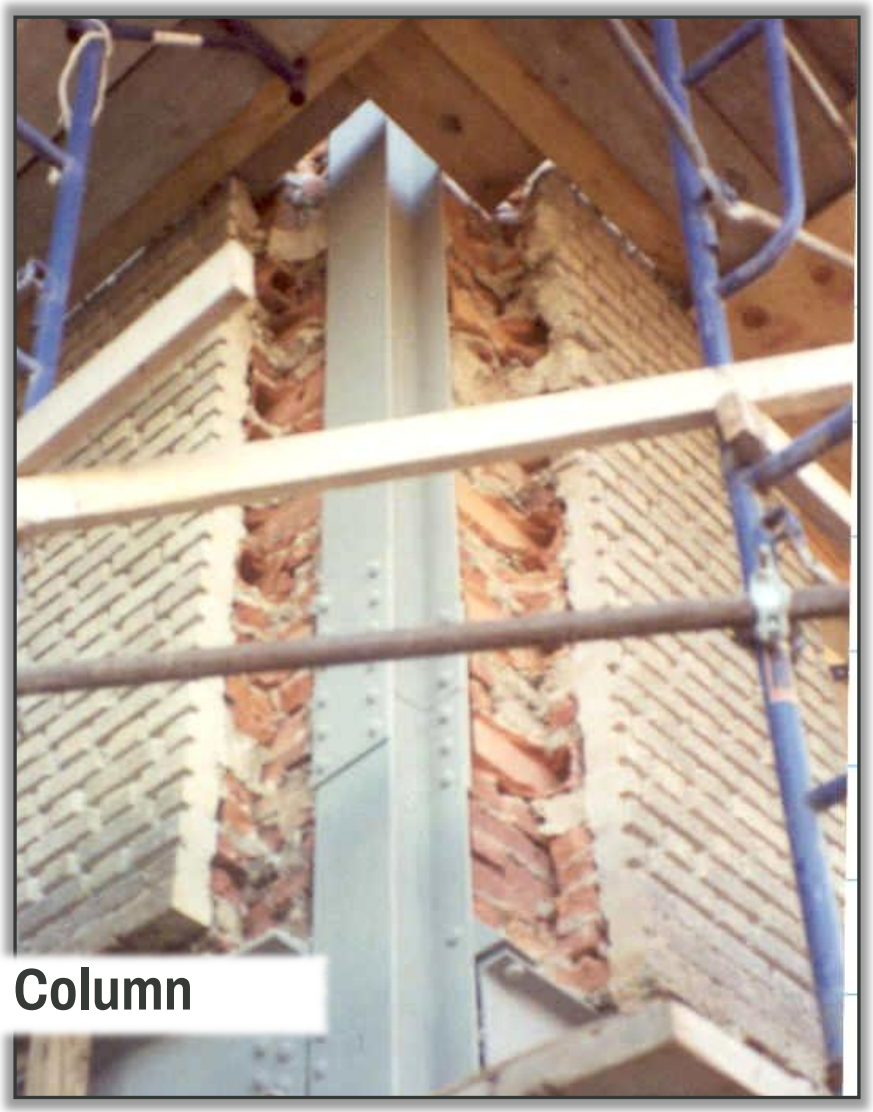
Corroded Steel Beam
(note shoring)

Supplemental Steel

Waterproofing

STEEL COATING

Corroded Steel Column



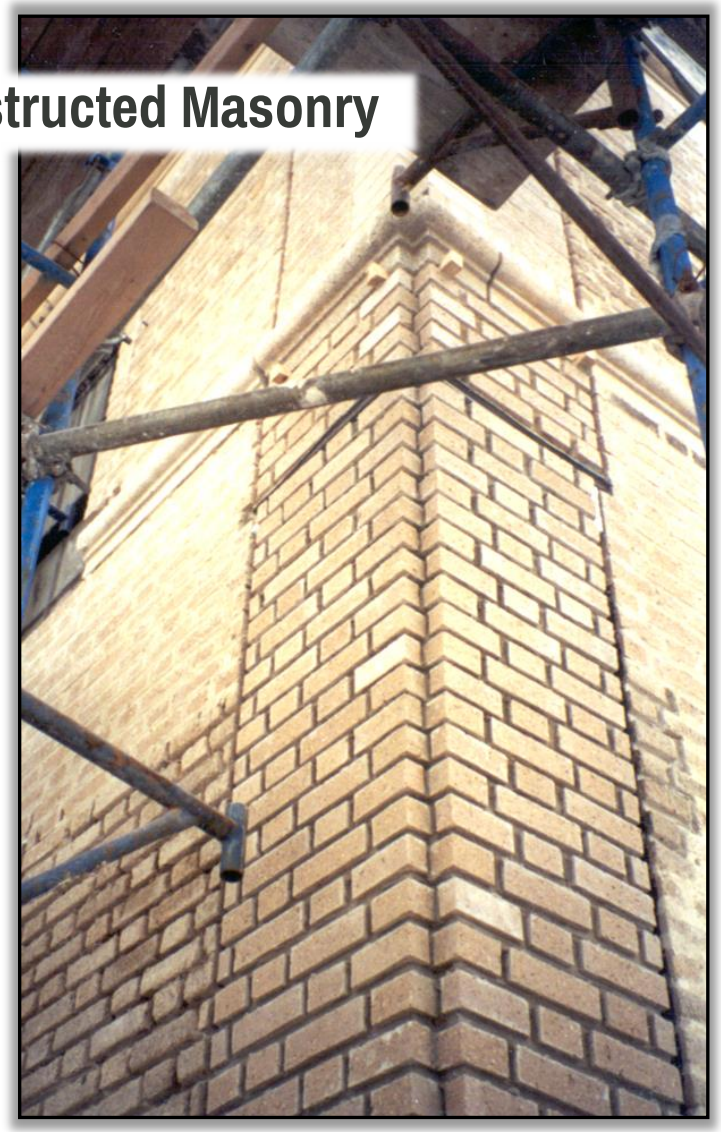
Coated Column

WATERPROOFING

SGH

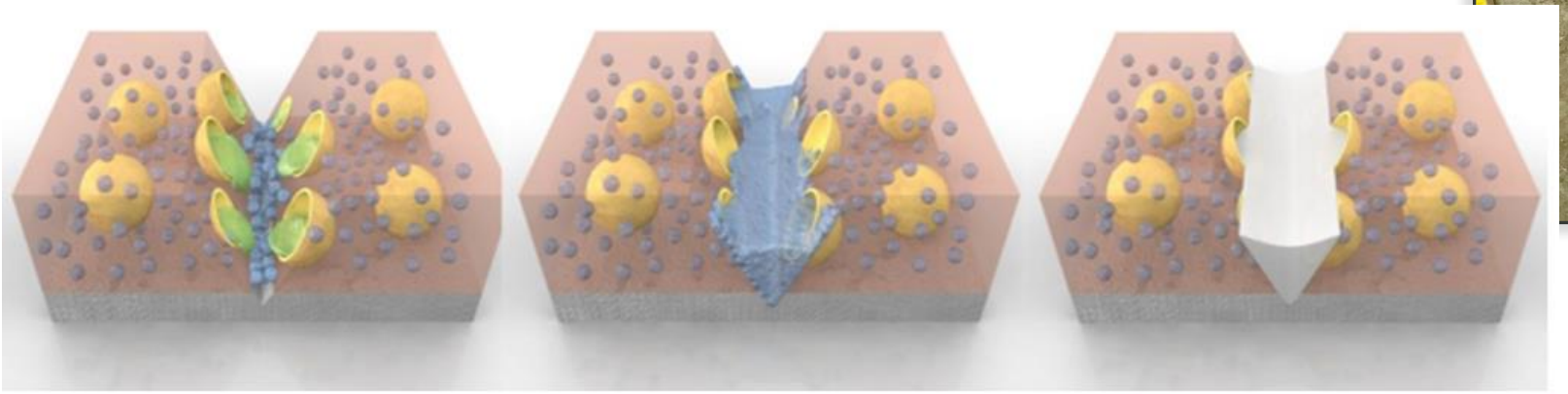
Waterproofed Column

Reconstructed Masonry



NEW COATING TECHNOLOGIES

- Self-healing coatings for steel
  - Autonomous healing mechanism to restore corrosion protection
  - Microencapsulated healing agents enable coatings to “heal” after damage
- Self-healing extends the service life of the underlying structure



Microcapsules ruptured by damage → Healing agent released to damage site → Healing agent polymerizes and heals damage.

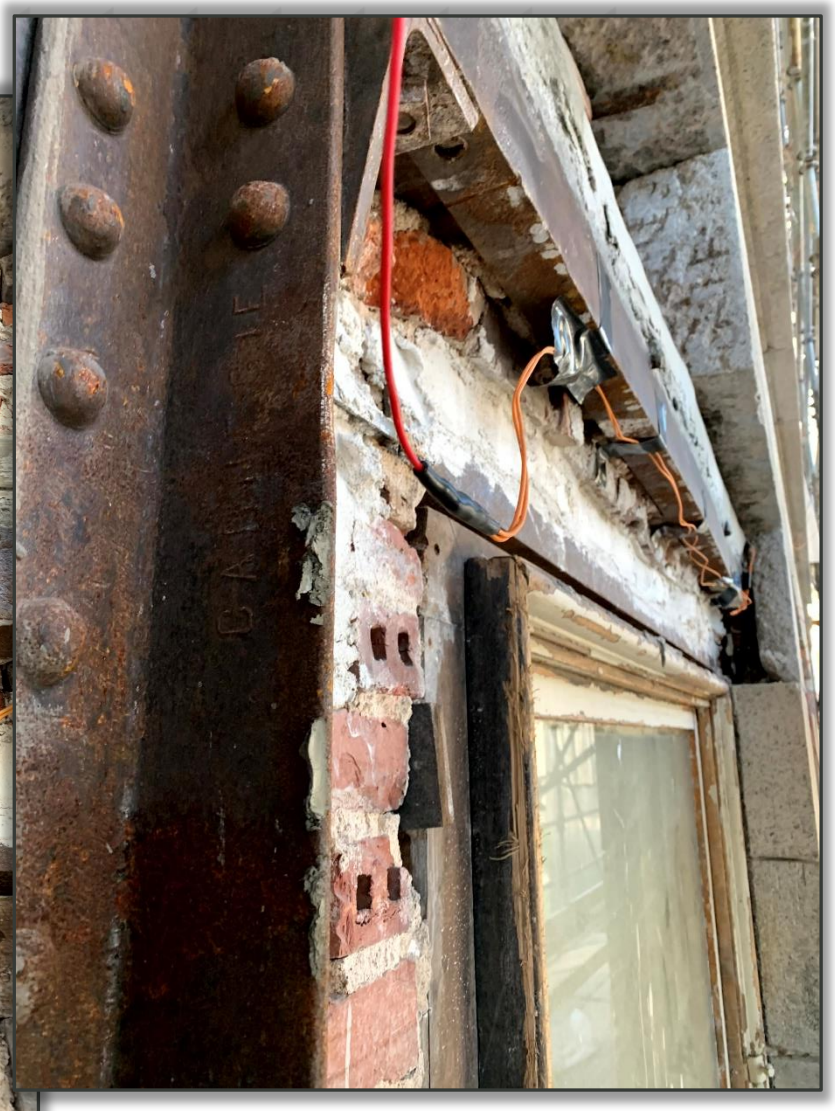
Credits:

DURABILITY, INC.
Corrosion Specialists

IMPRESSED CURRENT CATHODIC PROTECTION (ICCP)

- ICCP controls steel corrosion with impressed current
  - ICCP slows down or stop corrosion of the embedded steel
- ICCP requires anodes and cathodes – pass protection current from anodes to cathodes
  - Anodes are wired and inserted in masonry joints
  - Cathodes: steel frame elements or steel bars in concrete frames
- Monitoring and control through management server
  - Monitor specific locations for corrosion activity throughout life of the installed system

IMPRESSED CURRENT CATHODIC PROTECTION



FINAL REMARKS

- Conduct visual and hands on survey
- Supplement observations with NDT techniques
- Remove facade materials to make direct structure observations
- Develop repair approach
  - Make-Safe/Stabilization
  - Localized repairs
  - Full restoration with durability improvements
  - Consider waterproofing
    - Sheet waterproofing
    - Specialty coatings
    - Cathodic protection