How Masonry Fails and What to Do About It

South Carolina
Historic Preservation Conference

Tuesday, April 16, 2013
Columbia, SC

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Bennett PRESERVATION ENGINEERING PC

•Outline

- How masonry fails
- What not to do
- What to do about it
- Summary

•How masonry fails

- Water movement
- Inappropriate pointing mortars
- Freeze-Thaw
- Embedded metals
- Structural loads and settlement
- Mechanical damage

- How masonry fails
  - Water movement
    - Loss of mortar
    - Damage to brick
    - Internal delamination

06/27/2007

01/23/2007

01/23/2007

01/23/2007

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05/16/2005

07/05/20

11/02/2006

11/02/2006

11/02/2006

- How masonry fails
  - Inappropriate pointing mortars
    - Loss of face of brick

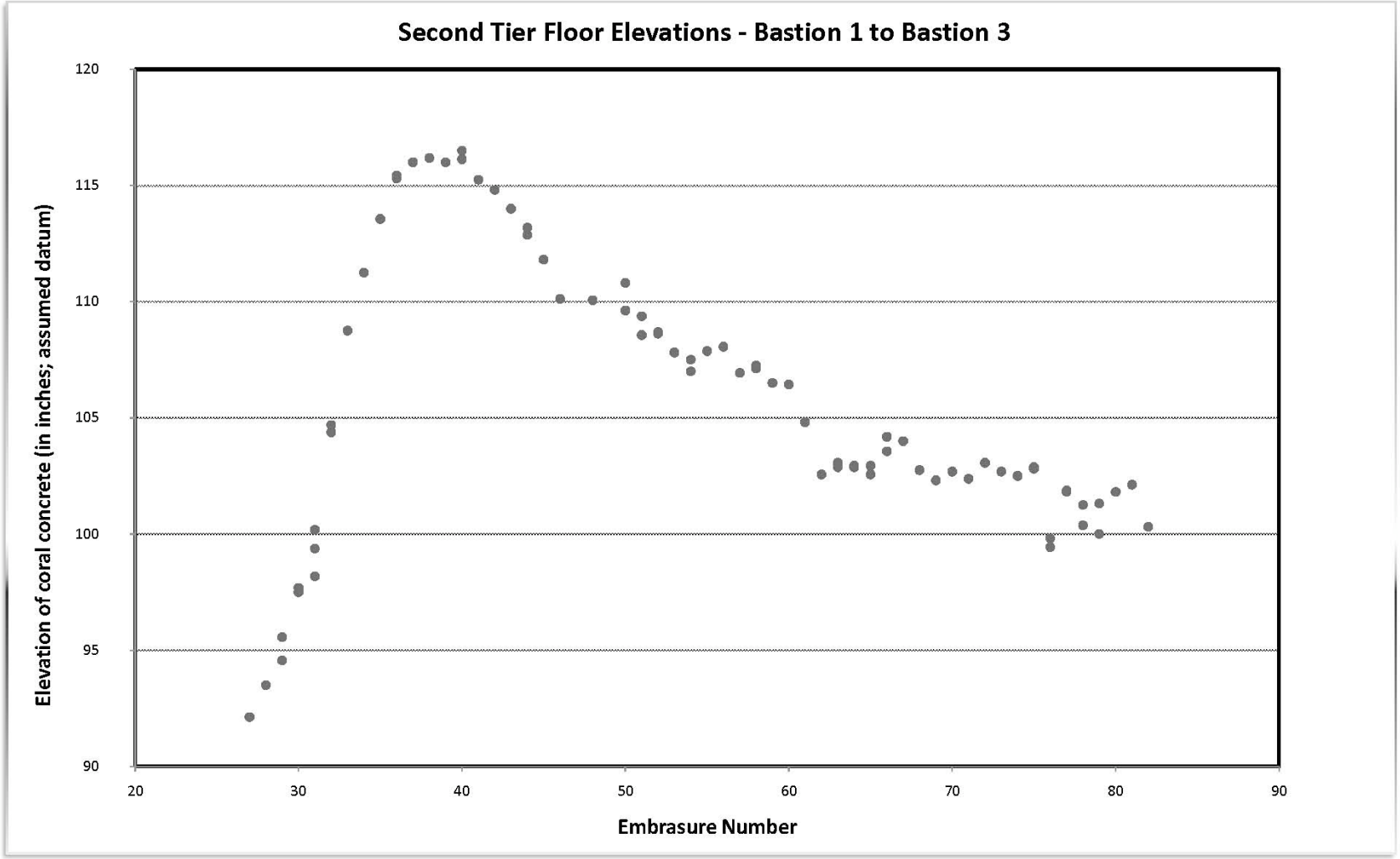
- How masonry fails
  - Freeze-Thaw
    - Loss of face of brick

- How masonry fails
  - Embedded metals
    - Corrosion and damage

11 12 2003

11 12 2003

- How masonry fails
  - Structural loads and settlement
    - Cracking
    - Internal delamination
    - Leaning


Second Tier Floor Elevations - Bastion 1 to Bastion 3
Elevation of coral concrete (in inches; assumed datum)
120
115
110
105
100
95
90
20
30
40
50
60
70
80
90
Embrasure Number

03/24/2005

- How masonry fails
  - Mechanical damage
    - Sandblasting
    - Automobiles

- What not to do
  - Don’t repoint with an impermeable Portland cement mortar
  - Don’t leave walls with internal tension
  - Don’t embed ferrous metals

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•What to do about it

- Preventative care
  - Keep water out of masonry and off of walls
  - Keep wall pointed with appropriate mortars
  - Deal with the cause of structural cracking
- Post damage repair
  - Cracks
  - Loss of mortar
  - Hard, impermeable pointing mortar
  - Embedded corroding iron or steel
  - Internal delamination
  - Leaning, bulging and out of plumb walls

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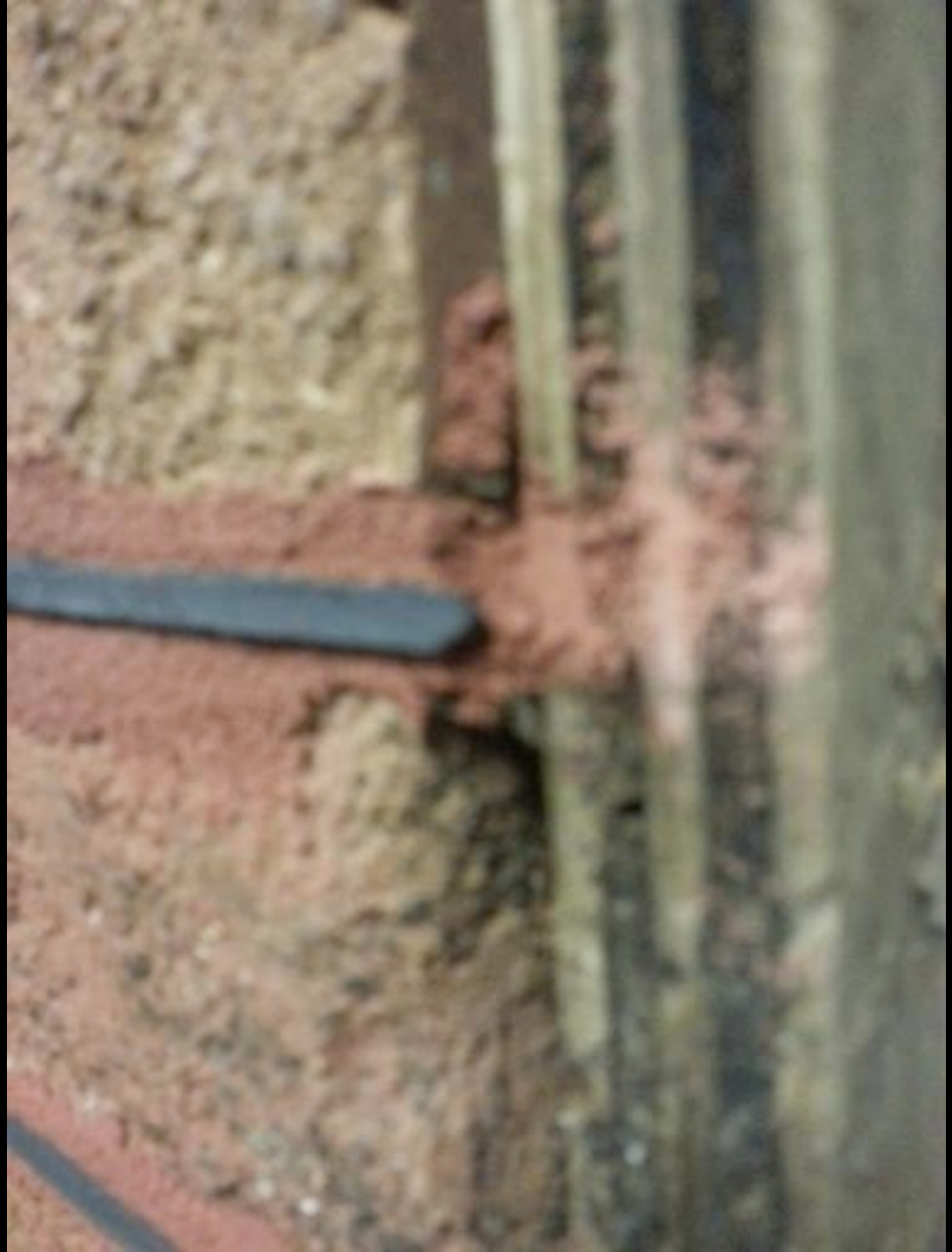
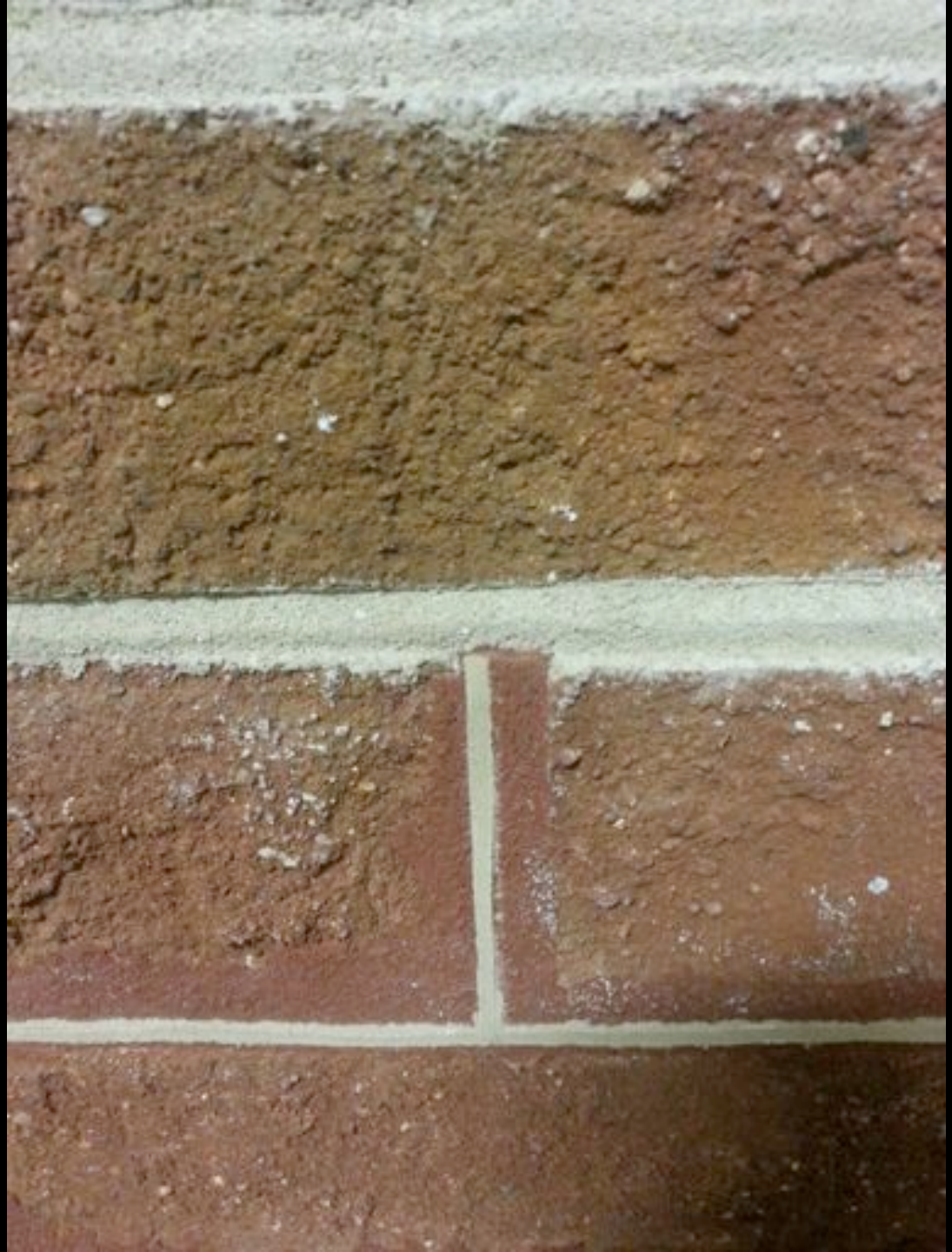
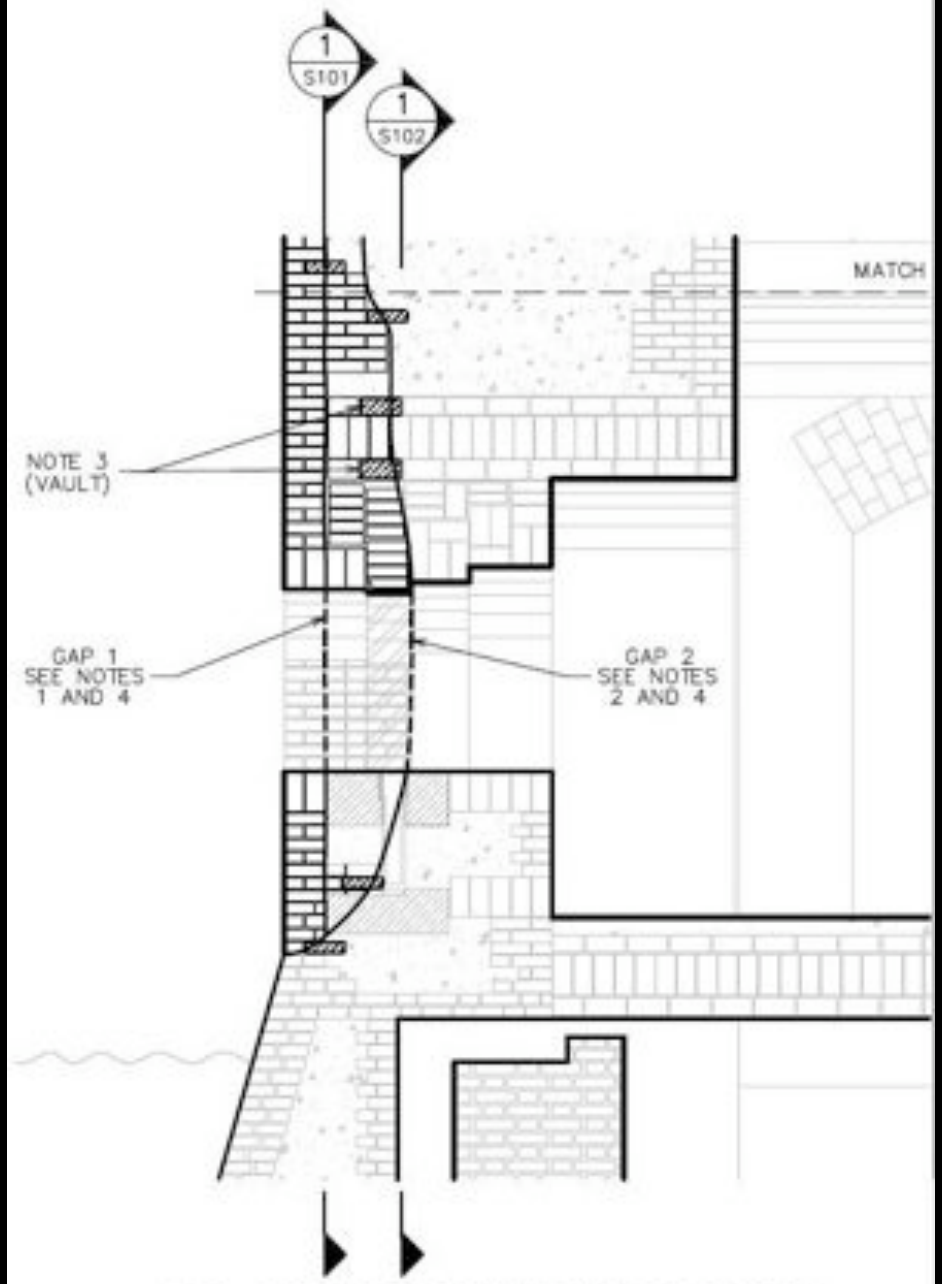




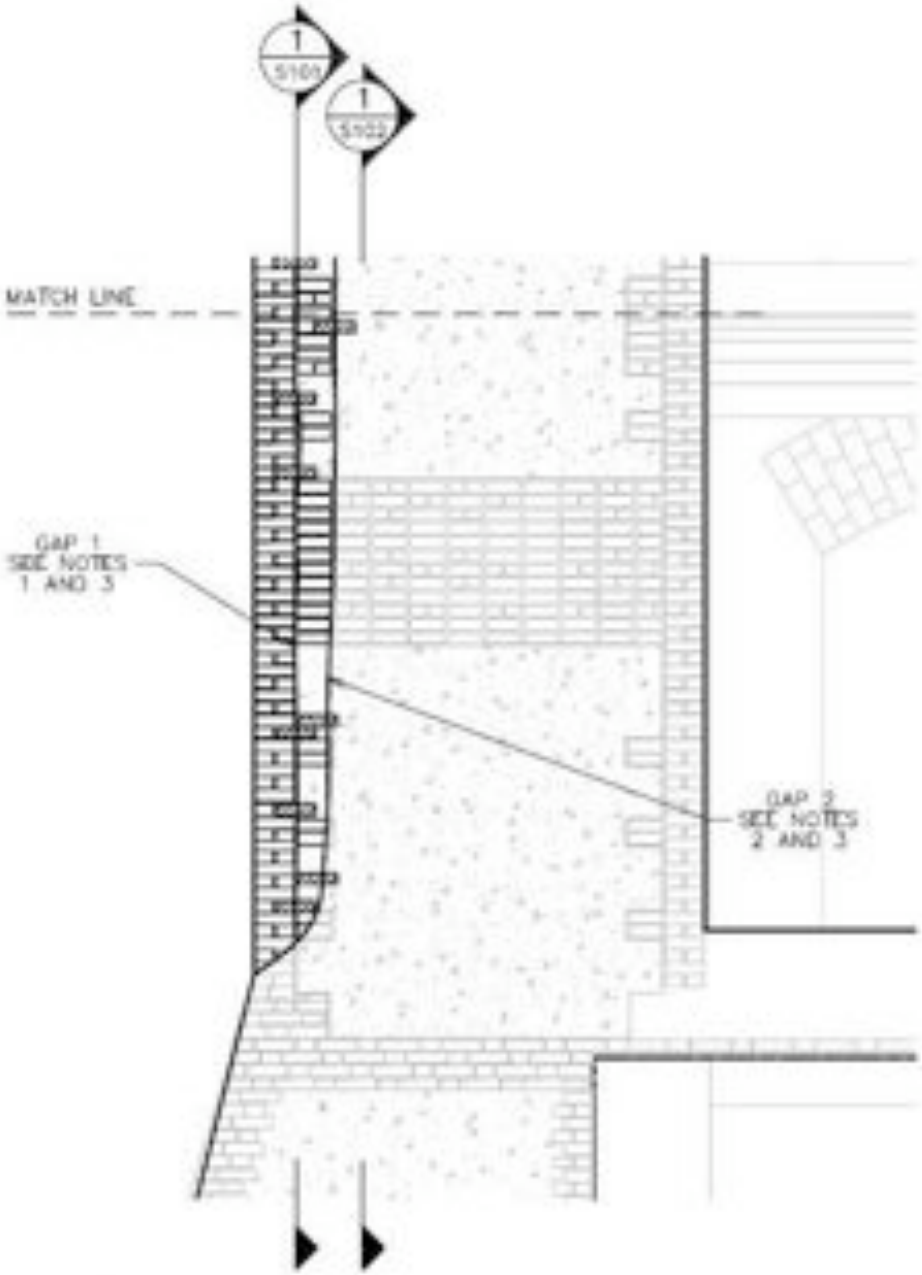
•What to do about it

- Post damage repair
  - Cracks
    - Relay bricks across cracks
    - Open joints, pull and clamp walls back together
    - Stitch across cracks with fiberglass, carbon fiber or stainless joint reinforcing
    - Reestablish the lost shear capacity



2 S103 LOWER EMBRASURE ENLARGED SECTION

SCALE B



2 / S104 LOWER EMBRASURE ENLARGED SECTION

SCALE (B)

#8

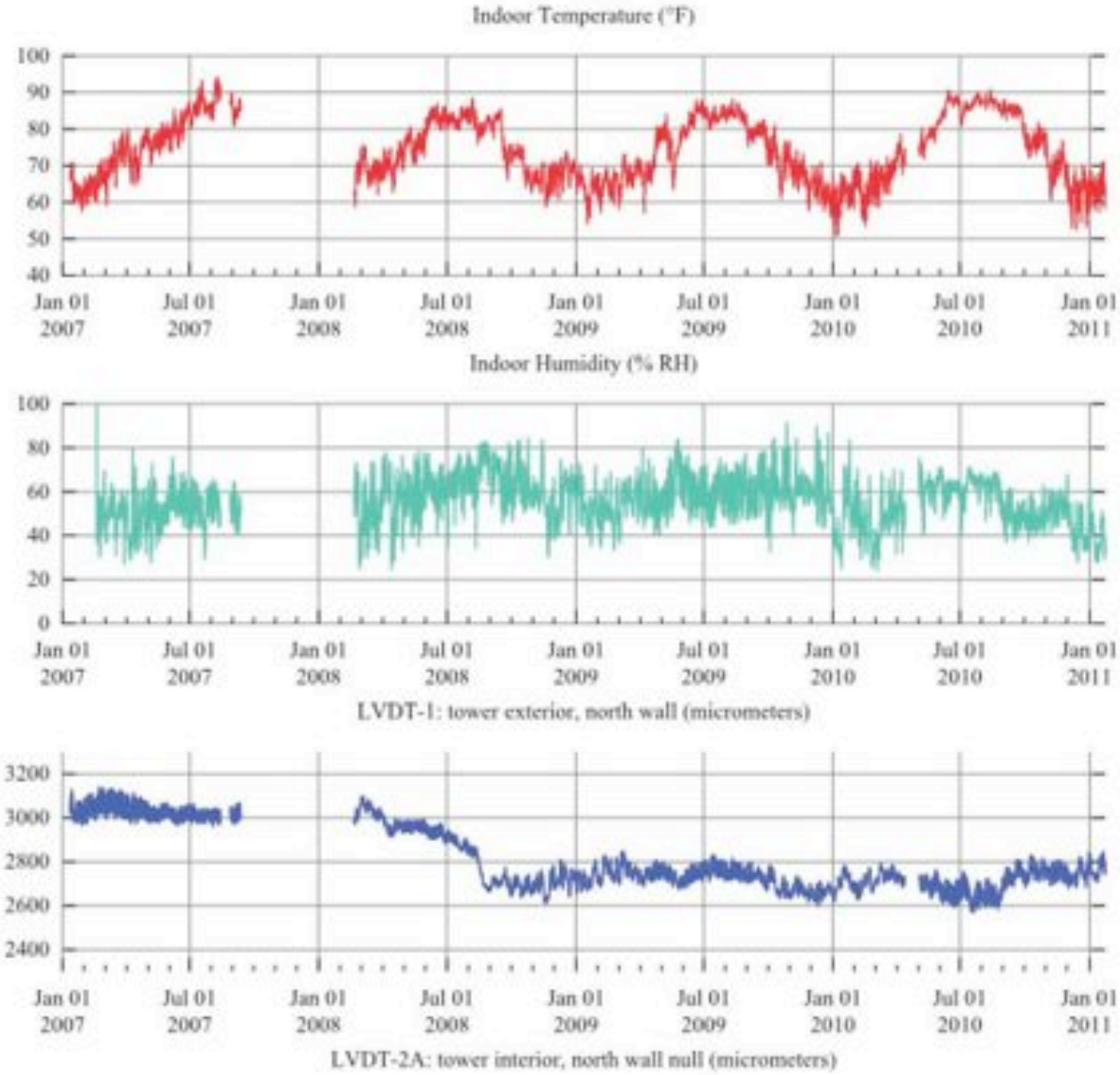
02/19/2008

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.



- What to do about it
  - Post damage repair
    - Loss of mortar
      - Repoint walls

ONLY
Sample
From
WellHouse

HOLE

ONLY
Sample
From
WellHouse

What to do about it

- Post damage repair
  - Hard, impermeable pointing mortar
    - Remove Portland cement mortar or stucco
    - Flip bricks

06/23/2005

06/23/2005

06/23/2005

06/23/2005

06/23/2005

06/23/2005

06/23/2005

06/23/2005

360
06/23/2005

360
06/23/2005

06/23/2005

06/23/2005

06/23/2005

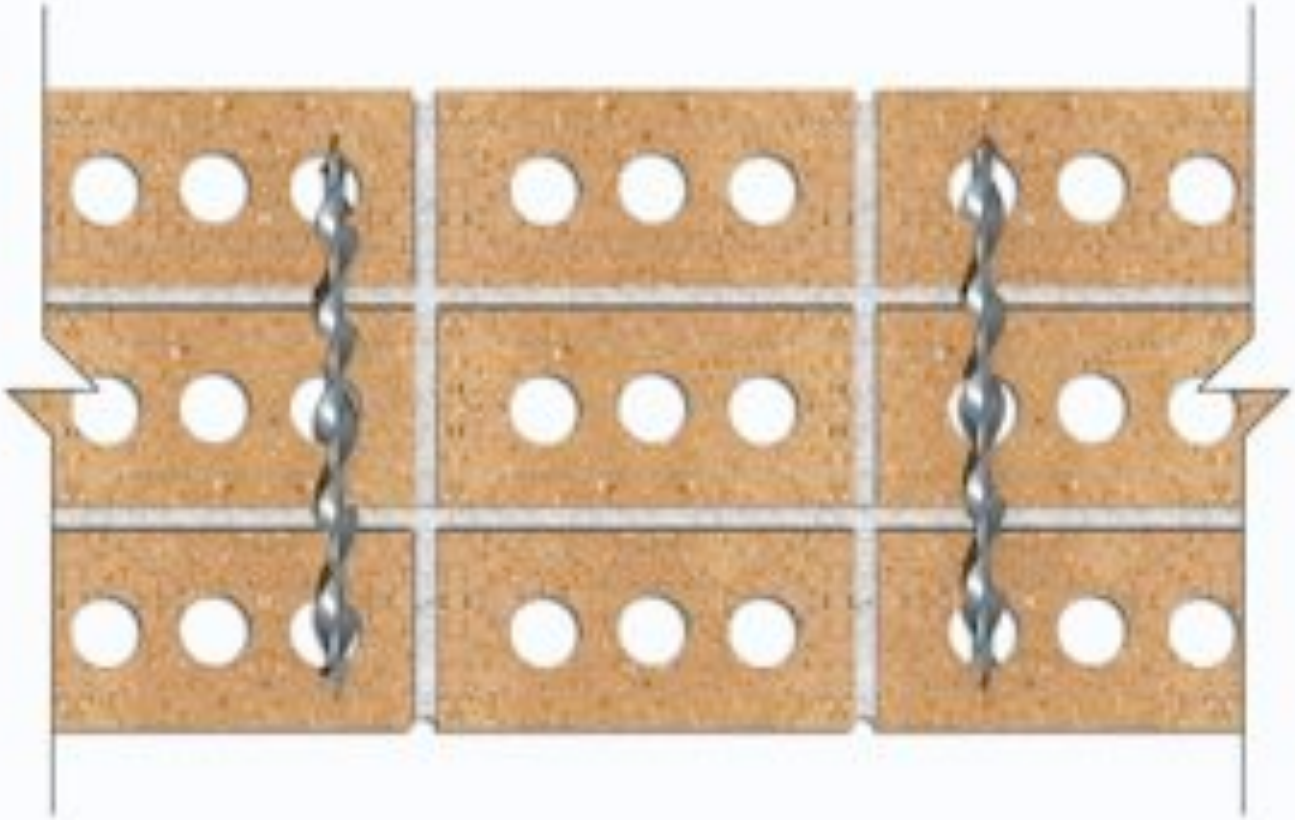
06/23/2005

•What to do about it

- Post damage repair
  - Embedded corroding iron or steel
    - Remove the ferrous metal,
      replace if necessary and reconstruct

What to do about it

- Post damage repair
  - Internal delamination
    - Stitching with helical or other ties or rods
    - Grout walls



What to do about it

- Post damage repair
  - Leaning, bulging and out of plumb walls
    - Straighten wall
    - Tie vertical walls back to the horizontal diaphragms

- Summary
  - Leave walls vertical, plumb, braced and tied, pointed and without excessive water movement

Thank you!

- Craig M. Bennett, Jr., PE

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