September 20, 2016

Grand Lodge of Free & Accepted Masons of California

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ATTN: Tom Boyer

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Subject: Existing Masonic Temple Building at 106 W J St., Benicia CA
Evaluation of the Stucco Cracks on North Elevation (Facing J Street)
Phase 1, Preliminary Field Investigation
ESE Project 16120

Dear Mr. Boyer,

In accordance with our proposal, we are pleased to submit this report for the subject project.

Background

The existing Masonic building at 106 West J Street in Benicia California is an unreinforced masonry building (UMB) built in late 1800s. It is located at the south-west corner of the First and J Streets in Benicia, and is comprised of a partially accessible unoccupied basement, and two tall stories above the basement. Street level has occupied commercial tenants, and the upper level is comprised of meeting halls and ancillary rooms that are presently unoccupied but were used for meetings and social gatherings in the past.

There are no existing drawings or previous reports available for this building for our review and evaluation. We also checked at the city building department, and except for some non-technical record of previous permit applications, we did not find any drawings or technical or historical reports for this building. However, based on our field observations and search on Internet, the building appears to be about 70' x 70' in plan dimensions and about 40 feet high from the street level to top of parapet. The accessible areas of the basement were about 8 feet floor to floor high. All the existing walls appear to be constructed of unreinforced brick, typically with no or very few openings for the south and west walls, and a few openings for the north wall along J Street. The wall along the First Street is all open at lower level where Iron columns support upper level wall and its three sets of double windows. The upper level is mainly solid masonry constructions with few tall and narrow openings. The first level space is divided mainly into three longitudinal segments in the east-west directions, separated by interior walls. The upper

level has two large meeting rooms at the east end, and the kitchen and few service rooms at west end.

The two exterior walls on the south and west sides have exposed brick finish and the remaining two walls on the north and east sides have stucco finish over brick. There are some cracks in the stucco finish of the north and east walls. The cracks appear to be mainly vertical in orientation. The building owner, Grand Lodge of F&AM of California intends to repair the stucco cracks, and before doing this they have engaged ESE Consulting Engineers, Inc. (ESE) to investigate the nature of the crack in the stucco and if the repair can be limited to the stucco or if the repair should include underlying brick wall.

Scope of Present Investigation

The scope of the present phase 1 evaluation is to visually measure at a few representative locations the width and depth of the cracks and based on that information evaluate the structural significance of the cracks in the stucco to see if they are "cosmetic" in nature or if they are structural in nature and therefore more significant. If the cracks are found to be structurally significant, then a future phase 2 project will address the underlying cause and how to repair the building. This report summarizes the findings of our present phase 1 investigation.

Site Investigations

I visited the site on August 5, August 25, August 31, and September 8 of 2016. You and Dale Vigil of Grand Lodge of F&AM of California were present on August 5 and 31 site visits. Dale Vigil was present on September 8 visit. And on August 25, Todd Ramos, Ned Ramos, and Juan Castillo of TimCo Construction of Sacramento (TimCo) were present.

I looked at the building upper level meeting rooms and street level walls on August 5; Looked from the street level at the exterior of the building on August 31; Climbed on a scissor lift and looked at the cracks of the J Street and First Street walls from close on August 25; and entered the partial basement on September 8.

During August 25 site visit I along with the contractor from TimCo Company used a scissor lift to look at the wall cracks at different elevations. The lift assisted us to reach to cracks up to about 10 feet from top of parapet. We looked at two locations along J Street and at one location along First Street. I measured the depth of the cracks at few locations and the contractor removed part of the stucco layer at few locations. This was done to check the quality and thickness of the stucco and its bonding to the brick and this also allowed us to get clear view of the shape and depth of the crack in the brick strata.

Summary of Findings

1. The stucco is a directly bonded to brick, it is 3/8" to ½" thick, reinforced with a layer of welded wire mesh of 2"x2" modules apparently made with W31 wires. The mesh has been placed in horizontal rolls of about 3' width that show as bands of horizontal white lines on elevations.
2. Except at the vertical wall articulations and reveals that divide the north and east elevations in three segments, the stucco has very good bond with the underlying bricks and has not delaminated. In fact in few places where the stucco has separated from the wall, it is still often bonded to portions of the brick that have also broken with it, see enclosed figures.
3. The crack widths measured approximately from 1/16" at the streel level to 1/8" wide at bottom of upper level and increases to about ¼" below parapet. At the north-east corner, the crack width was ½" to ¾". See enclosed figures.
4. I could probe the cracks with card or paper in the stucco and the probe penetrated the cracks from 1 ¾" deep just below upper level to 2" to more than 3" deep above upper level windows, to about 10" deep and more at the upper parts of the crack at the north-east corner of the building. See enclosed figures.
5. The crack width and depth in general increased as we moved up the wall in elevation. Also it is noted that the crack width and depth were much larger on the north-east corner compared to the remainder of the north and east walls.
6. Since the brick and mortar debris as well as rough and irregular crack surfaces would not allow easy penetration of the probe into the crack, it is reasonable to assume that the actual cracks are deeper than the depth measured by the probes.
7. The bottom of the iron column on the north-east corner has indication of vertical settlement as manifested by the settlement of the building relative to sidewalk at this location as well as vertical cracks between column and the adjacent brick window sill. This is an indication of possible foundation settlement at this location. The partial basement that I visited provides access to western part of the building only and the eastern portions are closed off by brick walls in the basement and therefore foundation at this location could not be observed. Probably the basement in this area is only an unexcavated crawl space of varying height.
8. At few locations where we removed the stucco, the mortar joint between bricks had deteriorated and had become soft. I could not ascertain if the mortar deterioration was limited only to the areas adjacent to cracks and exposed to air and moisture or the deterioration extended to other areas.
9. I should also add that due to absence of any existing drawings or reports regarding the existing construction especially for regions that are hidden by interior ceiling and wall finish, in addition to inaccessible portions of basement and attic, we do not know the detail of the wall to floor and roof connections and condition of those connections and any damage to any of these connections and resulting reduction to their structural capacity from forces and movements that have resulted in the visible cracks in the walls.

10. We do not know if there are any embedded iron plates, angles, rods and members in the walls, other than the visible part of the iron columns and part of their cap plates. Therefore, we do not know if any of the cracks could be due to corrosion and accompanying expansion of any embedded iron shapes due to moisture.

Conclusions

1. The most important conclusion is that the cracks are not limited to stucco layer and hence they are not "cosmetic" cracks, but that they are deep and wide and extend into the structural brick layers.
2. The second important conclusion that follows directly from 1 above is that the building strength and structural integrity has suffered a loss due to the cracks, and we now have a higher probability for part of the brick walls falling down on the sidewalk and street in an earthquake, especially the wall segments at the north-east corner.
3. We could not for certain pinpoint the cause of the cracks. Probably it has multiple causes, with varying degrees of contribution from each cause. Below I summarize the possible causes:

    3.1. Typical brick walls with openings are recommended to have vertical expansion joints at 20' horizontal spacing or less, and at wall corners and intersections. Moreover, bearing walls are required to have both horizontal and vertical reinforcing. This wall does not have either vertical expansion joints or wall reinforcing. Therefore, when subjected to thermal, moisture, creep, and elastic deformations due forces and/or support settlements, it will initiate and propagate cracks to accommodate these deformations.

    3.2. Absence of vertical expansion joints in UMB, especially at wall corners could result in vertical cracks when two perpendicular walls expand toward the corner and the internal stresses are generated. This is more likely for the wall along the First Street, since due to continuous glass window at the street level, the upper level wall is not restrained in the wall plane by any lower level wall or foundation wall and as such is free to expand and damage the perpendicular walls at its ends.

    3.3. We note that there are some vertical cracks in the south wall at First Street corner. The width and height of these cracks are smaller than the cracks on the north wall, but that may be at partly due to shape of the wall, especially the articulated exterior "pilaster" at north east corner and the window at the street level of the north wall's eastern end, whereas the south wall has a flat uniform brick wall from the roof to the street level and foundation.

    3.4. It should be noted that due to absence of any north-south lateral force resisting elements at lower level along the First Street, the building has a soft story weakness and vulnerability at this location that exacerbates the negative effects of the cracks. It is also possible that the soft story weakness at this location has contributed to the formation and/or extent and size of cracks at this location.

3.5. As discussed previously, potential foundation settlement at the north-east corner might have also contributed to the formation and/or extent and size of cracks at this location.

4. Unreinforced Masonry Buildings (UMB), especially UMB with soft story are potentially hazardous in an earthquake due to their high initial stiffness and low ductility, weakness, heavy mass and inadequate connections between the walls and between walls and floors and roof. UMB buildings, even if initially un-cracked, are expected to get damaged in an earthquake due to in-plane and out-of-plane forces on the walls and they are then expected to crack. The wall cracking will weaken and soften the walls further and if the earthquake's duration of strong shaking is long, it may result in walls' local failure (part of the wall falling down), or if there are sufficient number of local failures, result in overall failure and collapse of the building. This building has at present time very long, wide, and deep cracks before an earthquake has occurred and that makes this building that much more vulnerable in an earthquake.

5. The cracks discussed in this report have been formed for a few years, but what we do not know for sure is for how many years and if their length, width, and depth has been increasing and if yes at what rate.

Recommendations for Further Action

1. <u>Recommendations for Minimum Level of Work:</u>

1.1. We recommend that some temporary protection for the building occupants and pedestrians against falling brick hazards, especially along the First street, and J street be put in place until further investigation has been made and/or some minimum level of strengthening has taken place. We note that the "construction fence" presently placed there by TimCo contractors, though serves as a notice to warn the general public and also limits the number of people that can use this area of the sidewalk and adjacent street parking, it is not going to be adequate to prevent the building or part of its walls from falling down and if that happens, it will not have any strength to shield and protect anybody on the sidewalk or to protect the parked cars at adjacent street parking spaces. The cracks in the façade have been there and visible for at least a few years. Therefore, under normal conditions (no occurrence of very strong earthquake or very strong windstorm) we do not feel that the possibility of brick or other debris falling is imminent. However, we do feel that suitable protection should be put in place as soon as possible until minimum repairs are completed. In the meantime, the cracks width and length at few selected locations should be monitored periodically, to give us advance warning of any unforeseen additional deterioration of the building integrity.

1.2. We recommend that the large, deep, and wide cracks at the north-east corner be repaired and this corner to be strengthened such that the walls along the First and J Streets are tied well together to restore the building to its pre-cracked condition at this location. See Figures 8, 12, 14, 15.

1.3. We recommend that the vertical cracks along the east end of the south wall to be investigated further and repaired, if required. See Figure 20.

1.4. We recommend as a minimum that the present wide cracks (those wider than 1/8") or cracks deeper than stucco layer in the north and east walls to be repaired. See Figures 1, 2, 3, 4, 5, 6, 7, 11, 16, 17, 18.

1.5. We recommend that there should be further field investigation to find out about any damage to the building floor and roof diaphragm to wall connections and ascertain their construction and therefore estimate their capacity. If any damage to connections has taken place, we recommend as a minimum they be repaired to regain their original capacity and if desired provide new connections to add additional capacity.

1.6. We recommend providing new lateral force resisting elements, such as steel frames in the north-south direction at street level close to the First Street to remedy the soft story weakness at this area.

1.7. We recommend some minimum geotechnical investigation, especially at the north-east corner to be done to see if the column and foundation at this location have settled and if so, to evaluate the soil and foundation behavior for the future. See Figures 9, 10.

1.8. We recommend that minor cracks and the joints between window frames and walls be caulked and sealed to stop water penetration and deterioration of the brick and its mortar joints. See Figure 19.

2. Recommendations for Work Above the Minimum Level:

2.1. We recommend general seismic strengthening of the building.

If you have any questions or need clarifications, please do not hesitate to contact me.

Sincerely,

Amir Firouz, S.E. 2712

Vice President

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Enclosure (Annotated Figures)

ANNOTATED FIGURES

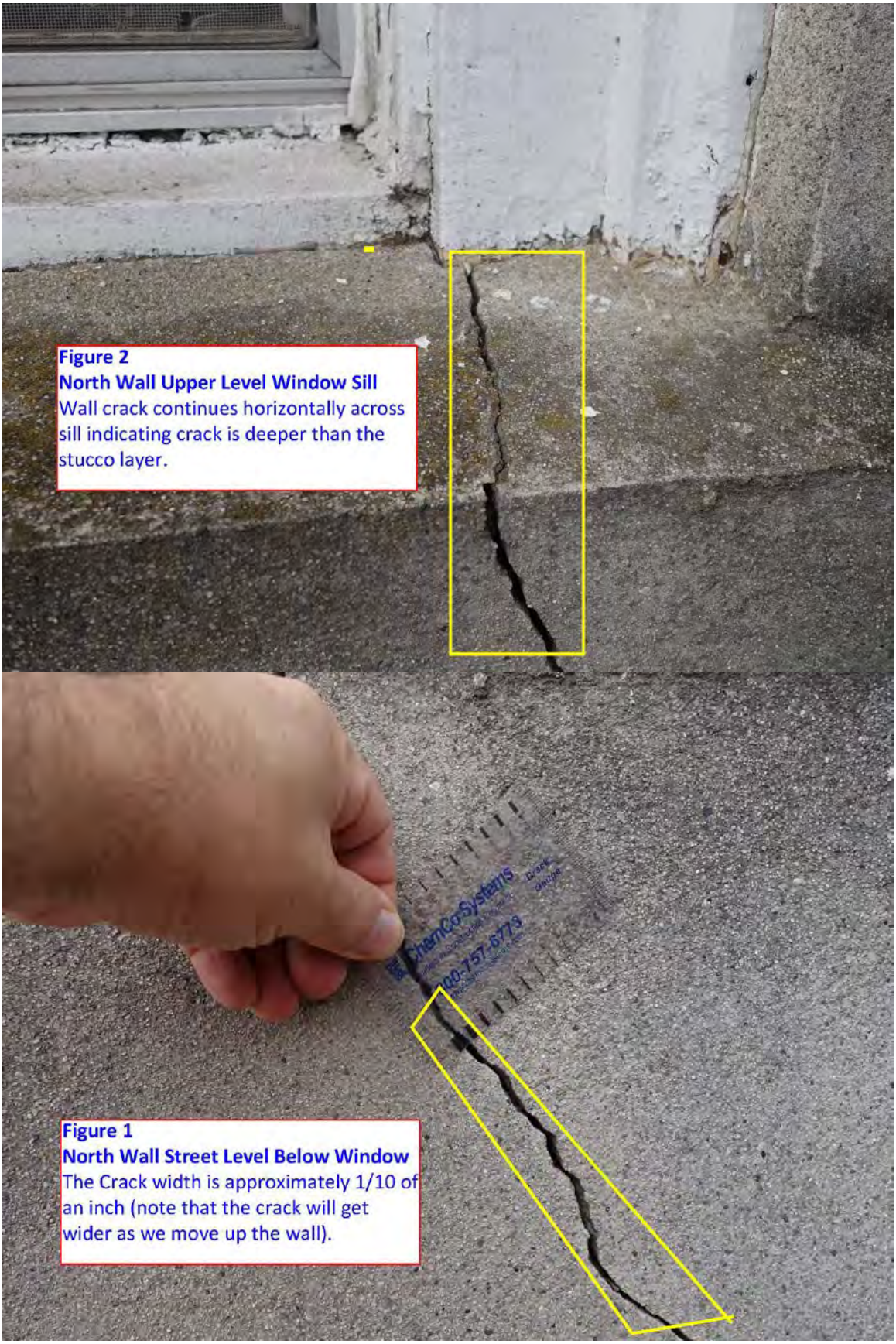

Figure 2
North Wall Upper Level Window Sill
Wall crack continues horizontally across sill indicating crack is deeper than the stucco layer.

Figure 1
North Wall Street Level Below Window
The Crack width is approximately 1/10 of an inch (note that the crack will get wider as we move up the wall).

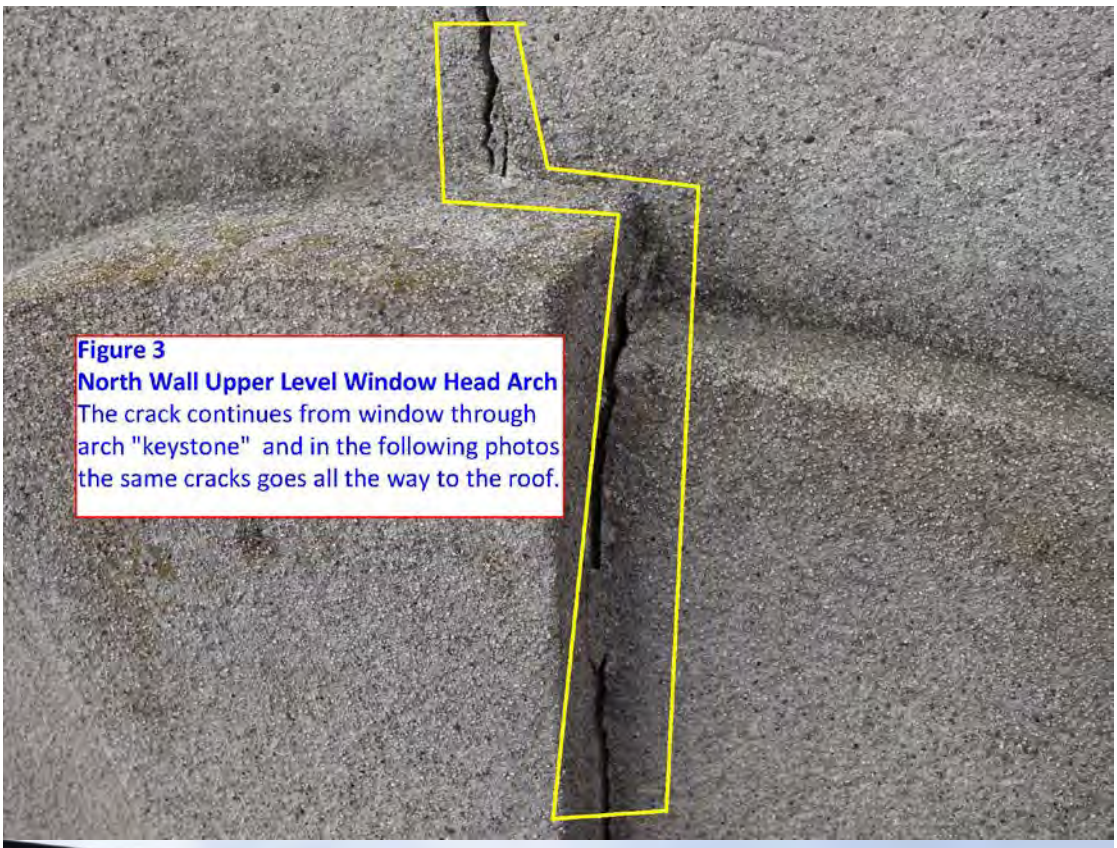

Figure 3
North Wall Upper Level Window Head Arch
The crack continues from window through arch "keystone" and in the following photos the same cracks goes all the way to the roof.

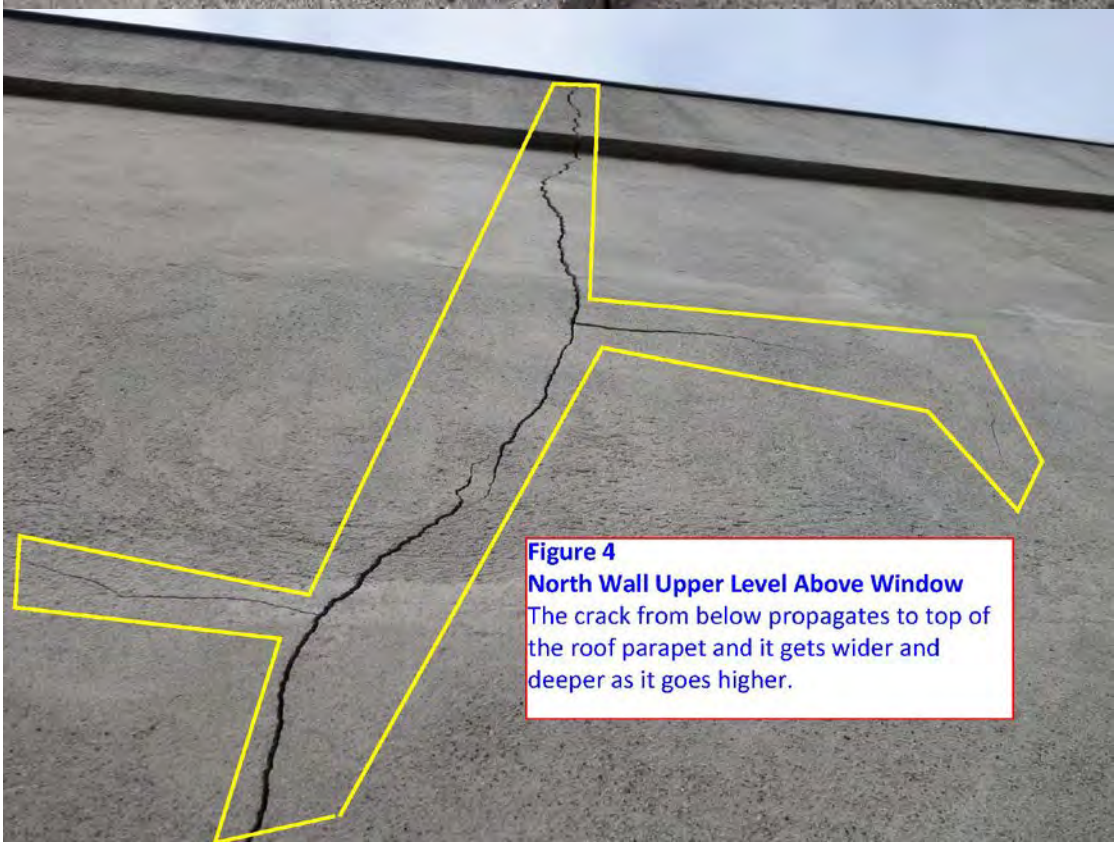

Figure 4
North Wall Upper Level Above Window
The crack from below propagates to top of the roof parapet and it gets wider and deeper as it goes higher.

Figure 5
North Wall Upper Level Above Window
Here the crack is at least 3 inches deep.

Figure6
North Wall Above Upper Window
Note the crack is at least 3" deep.

Figure 7
North Wall at Upper Window
Note pattern and extent of multiple vertical cracks.

Figure 8
North Wall at East Corner
Extent of major cracks. Also note the white band representing welded wire mesh in strucco.

Figure 9
Iron Column at North East Corner
Indications of vertical settlement from damage to the sidewalk and cracks at brick sill joint.

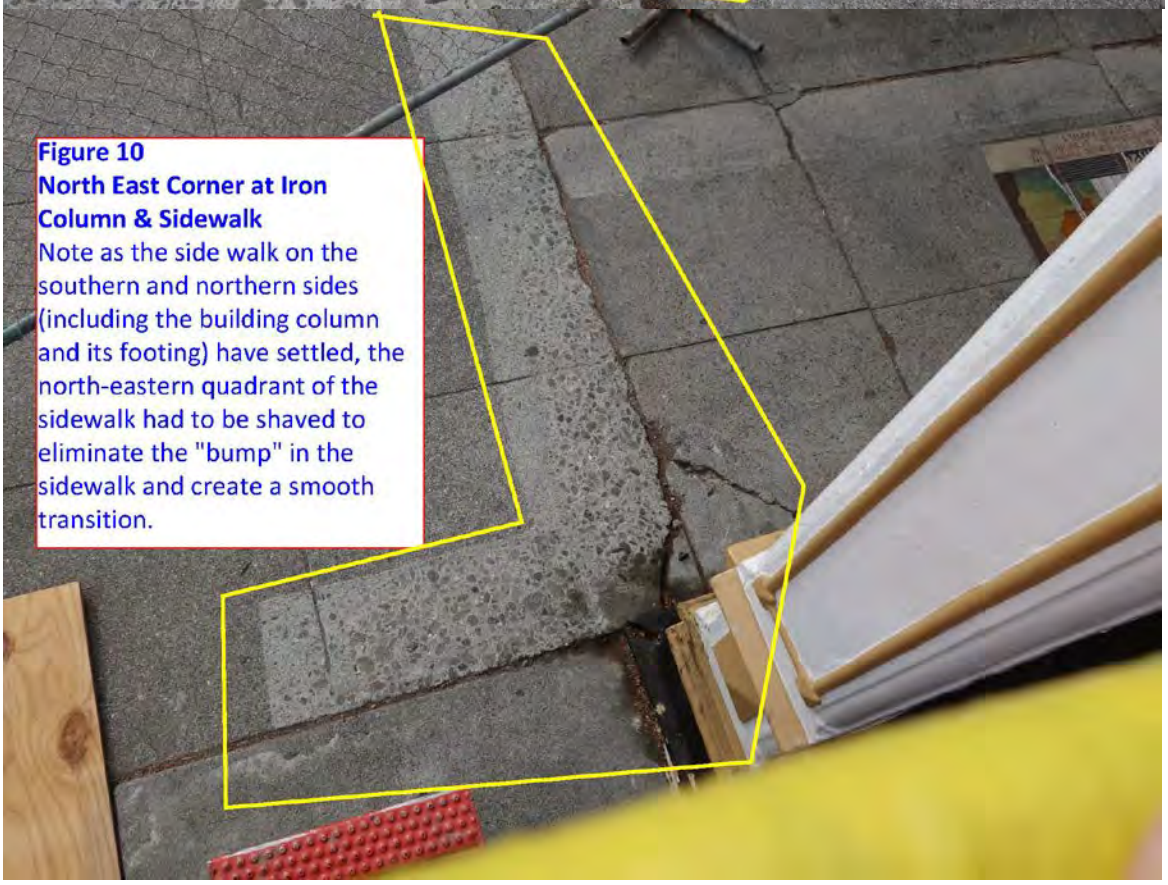

Figure 10
North East Corner at Iron Column & Sidewalk
Note as the side walk on the southern and northern sides (including the building column and its footing) have settled, the north-eastern quadrant of the sidewalk had to be shaved to eliminate the "bump" in the sidewalk and create a smooth transition.

Figure 11
North Wall Piece of Stucco and Brick.
Note very strong bond of stucco and brick.

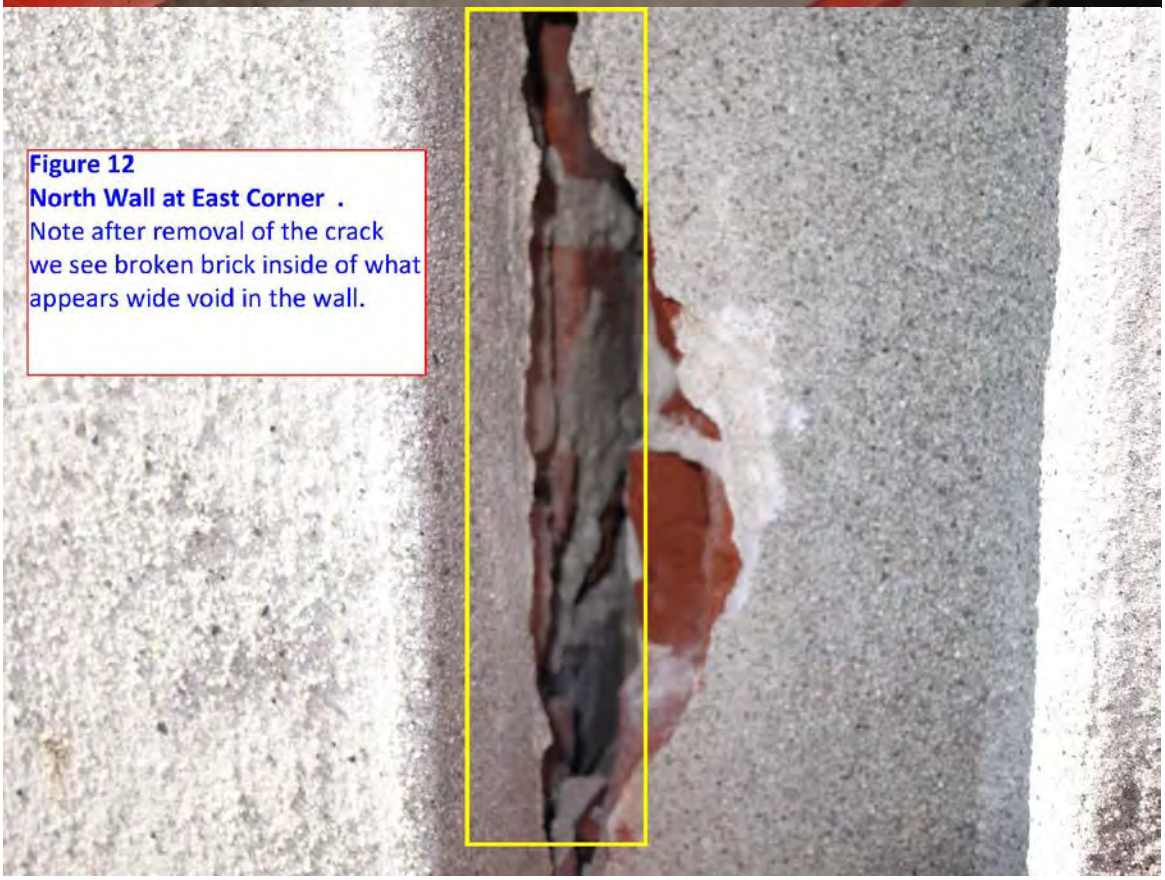

Figure 12
North Wall at East Corner .
Note after removal of the crack we see broken brick inside of what appears wide void in the wall.

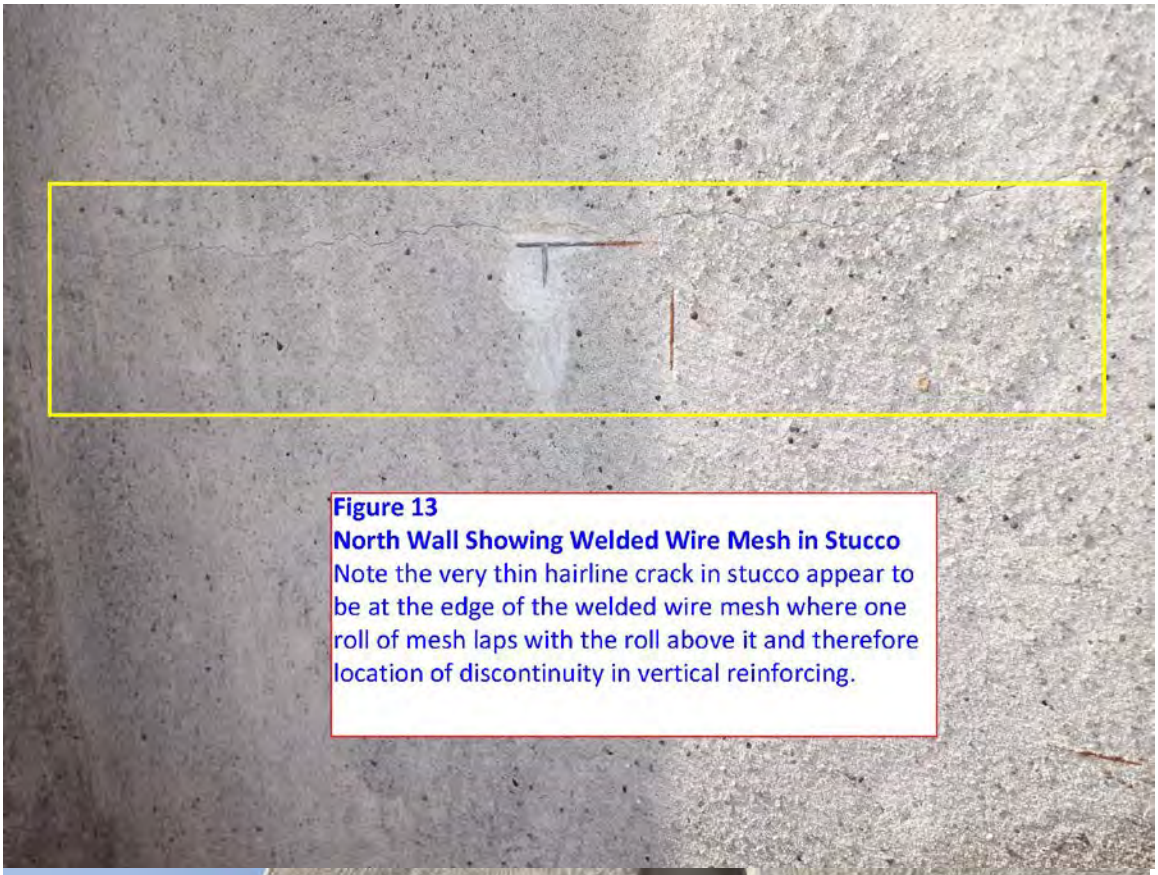

Figure 13
North Wall Showing Welded Wire Mesh in Stucco
Note the very thin hairline crack in stucco appear to be at the edge of the welded wire mesh where one roll of mesh laps with the roll above it and therefore location of discontinuity in vertical reinforcing.

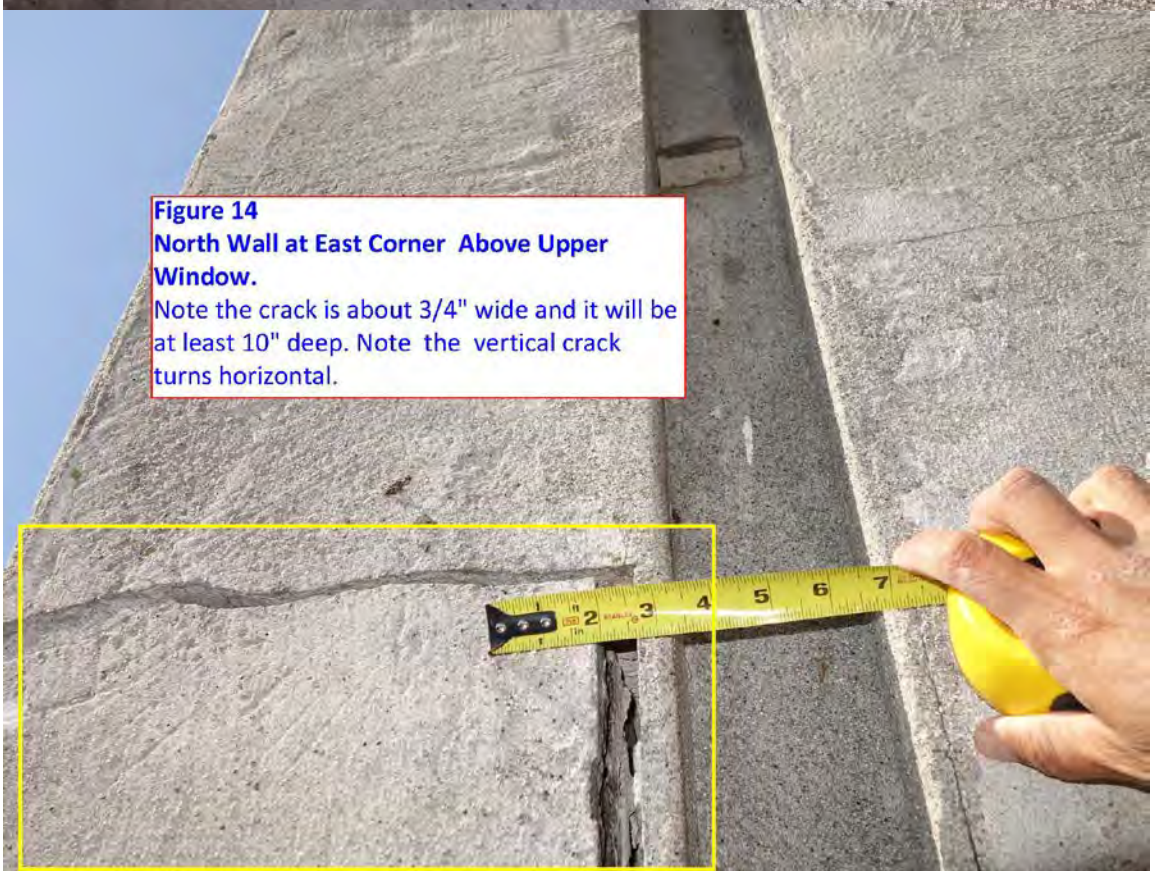

Figure 14
North Wall at East Corner Above Upper Window.
Note the crack is about 3/4" wide and it will be at least 10" deep. Note the vertical crack turns horizontal.

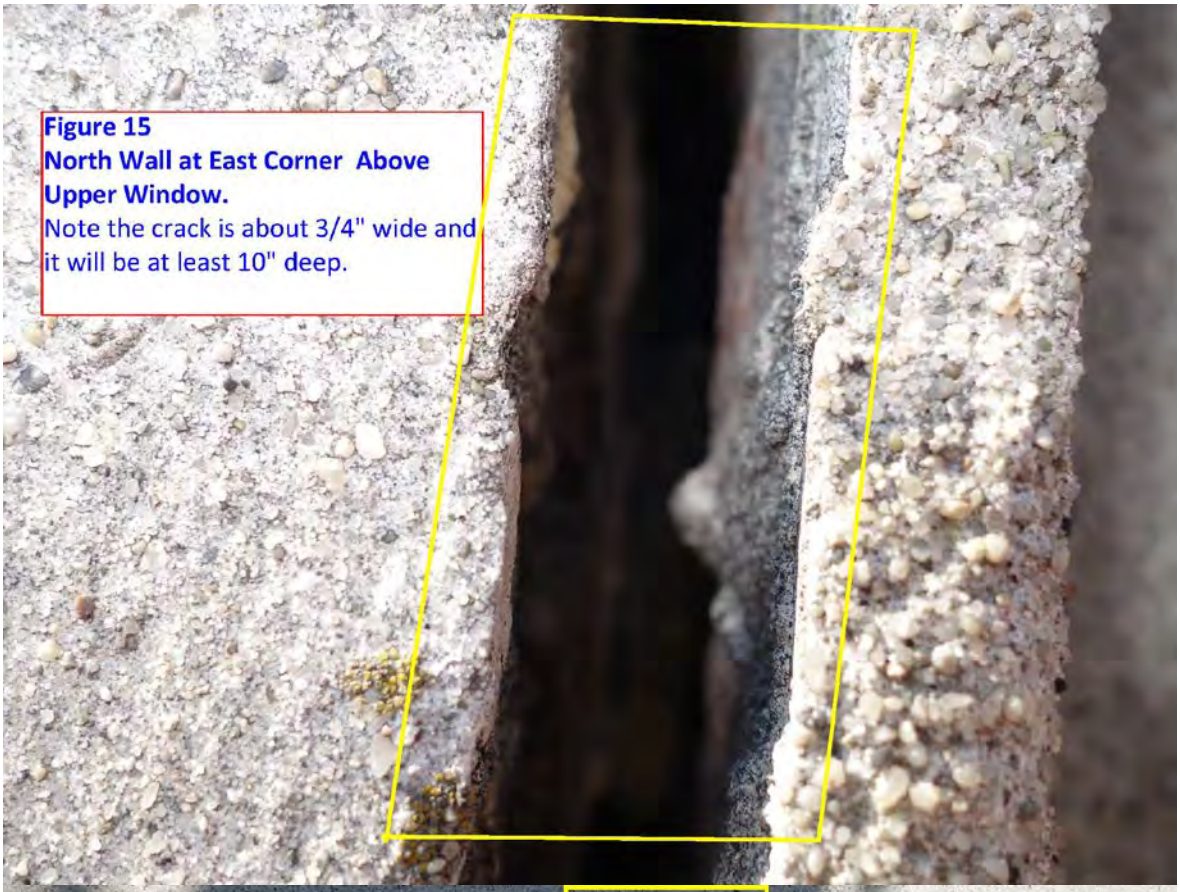

Figure 15
North Wall at East Corner Above Upper Window.
Note the crack is about 3/4" wide and it will be at least 10" deep.

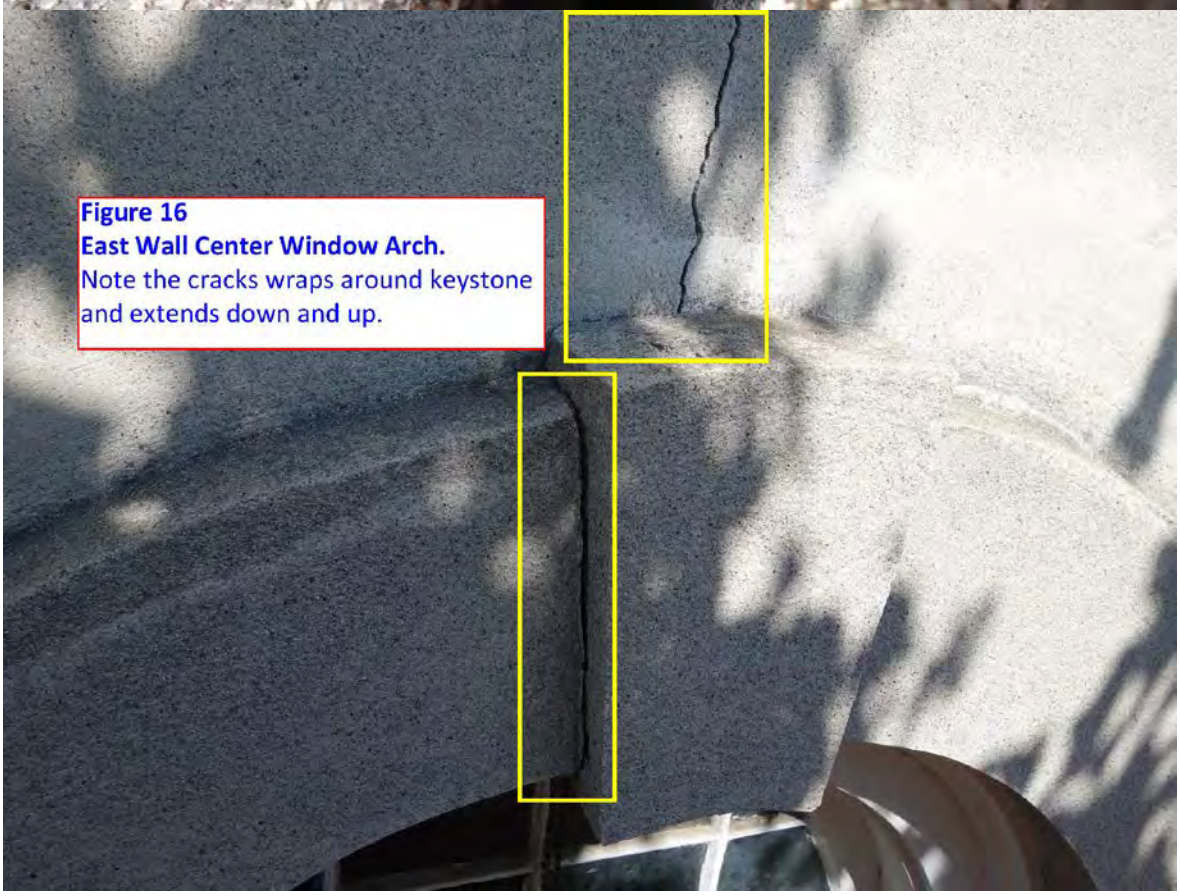

Figure 16
East Wall Center Window Arch.
Note the cracks wraps around keystone and extends down and up.

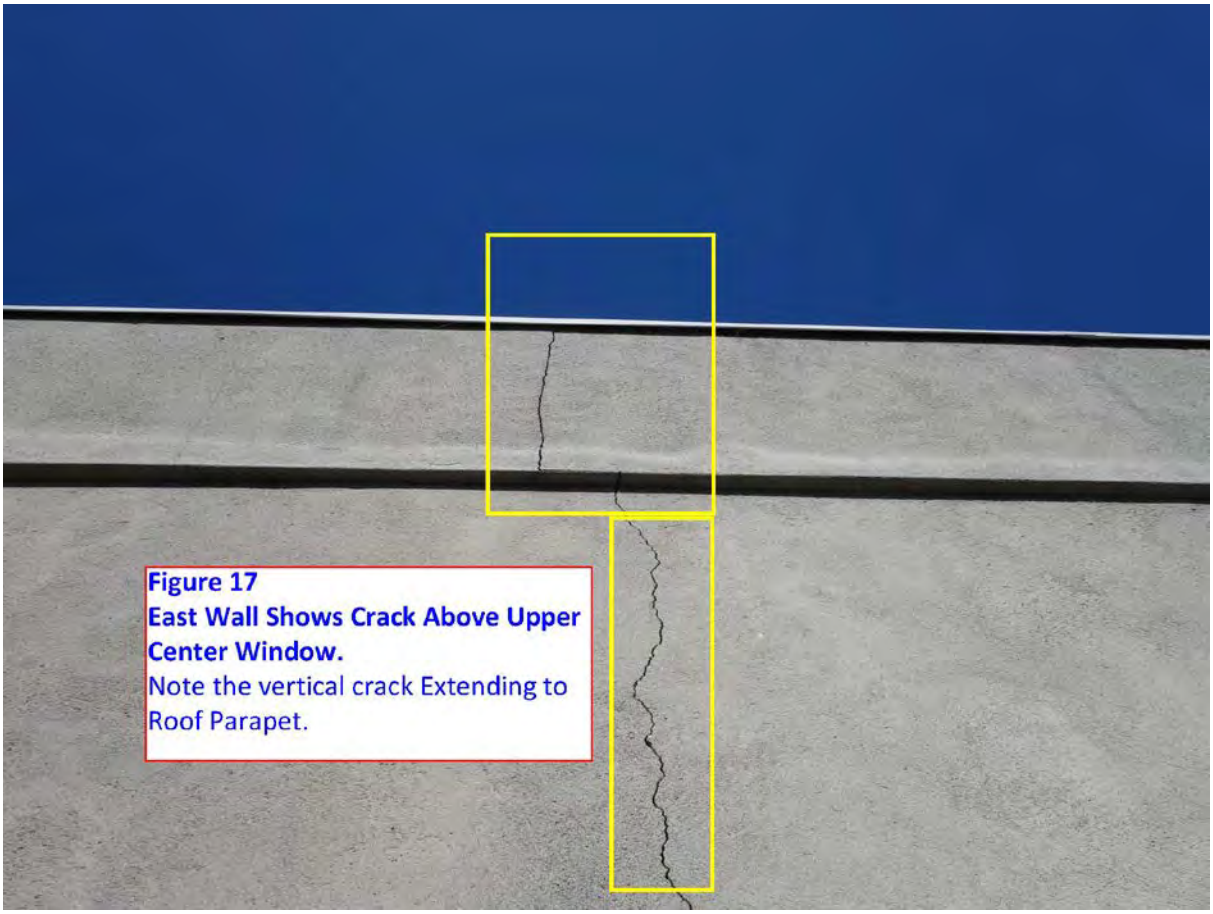

Figure 17
East Wall Shows Crack Above Upper Center Window.
Note the vertical crack Extending to Roof Parapet.

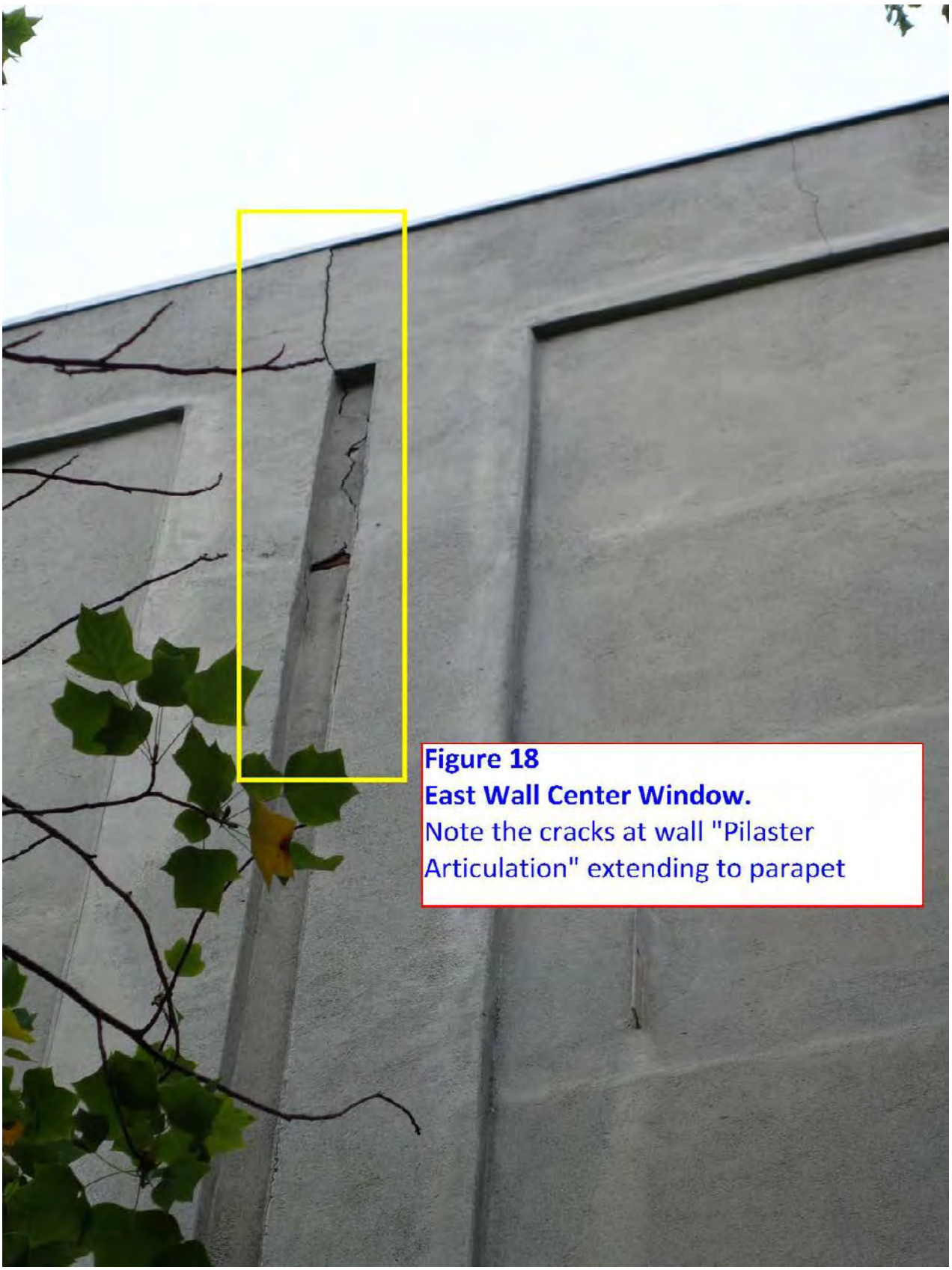

Figure 18
East Wall Center Window.
Note the cracks at wall "Pilaster Articulation" extending to parapet

Figure 19
East Wall Center Window.
Note the cracks at wood to wall
interface allowing moisture inside.

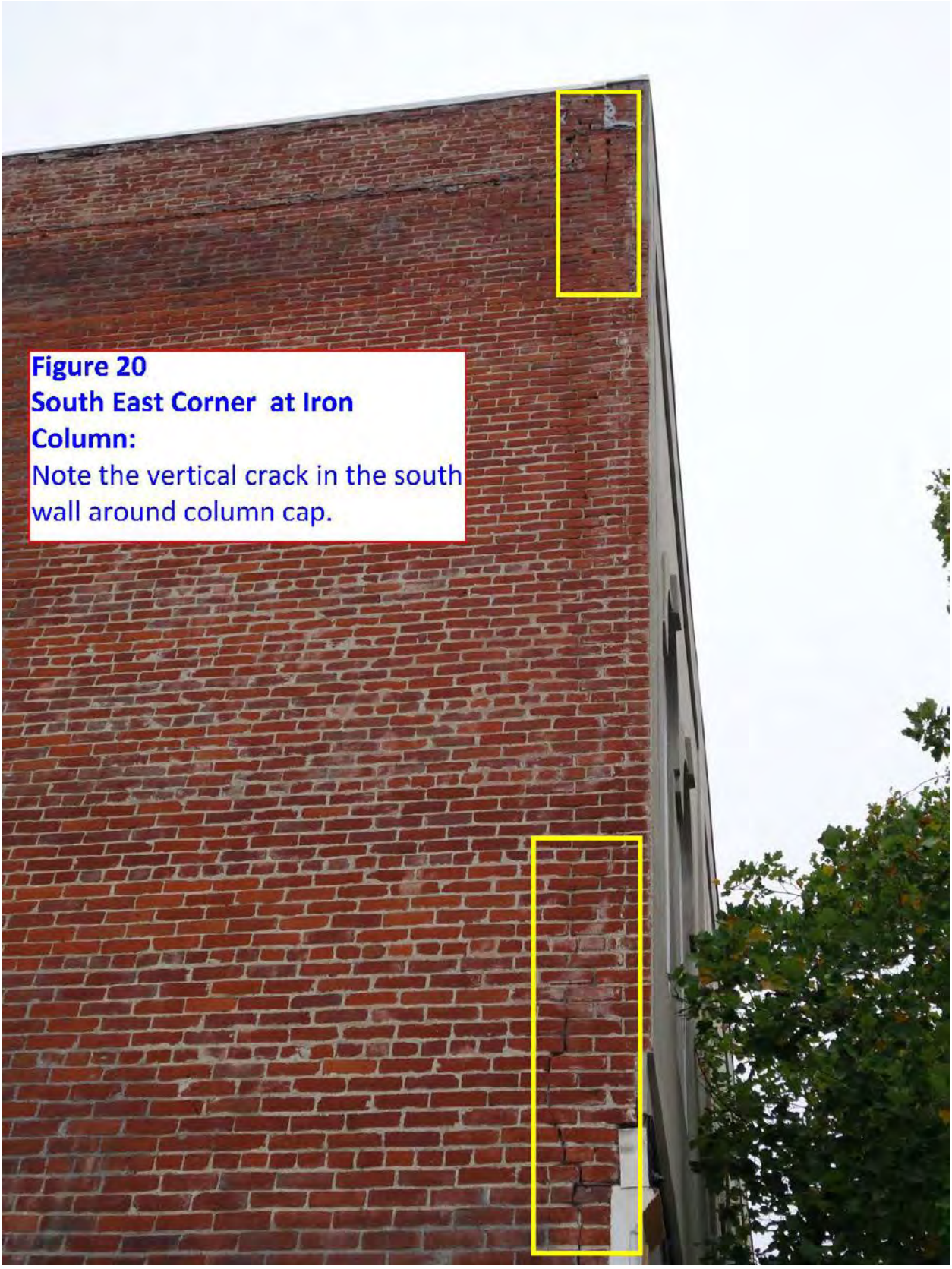

Figure 20
South East Corner at Iron Column:
Note the vertical crack in the south wall around column cap.

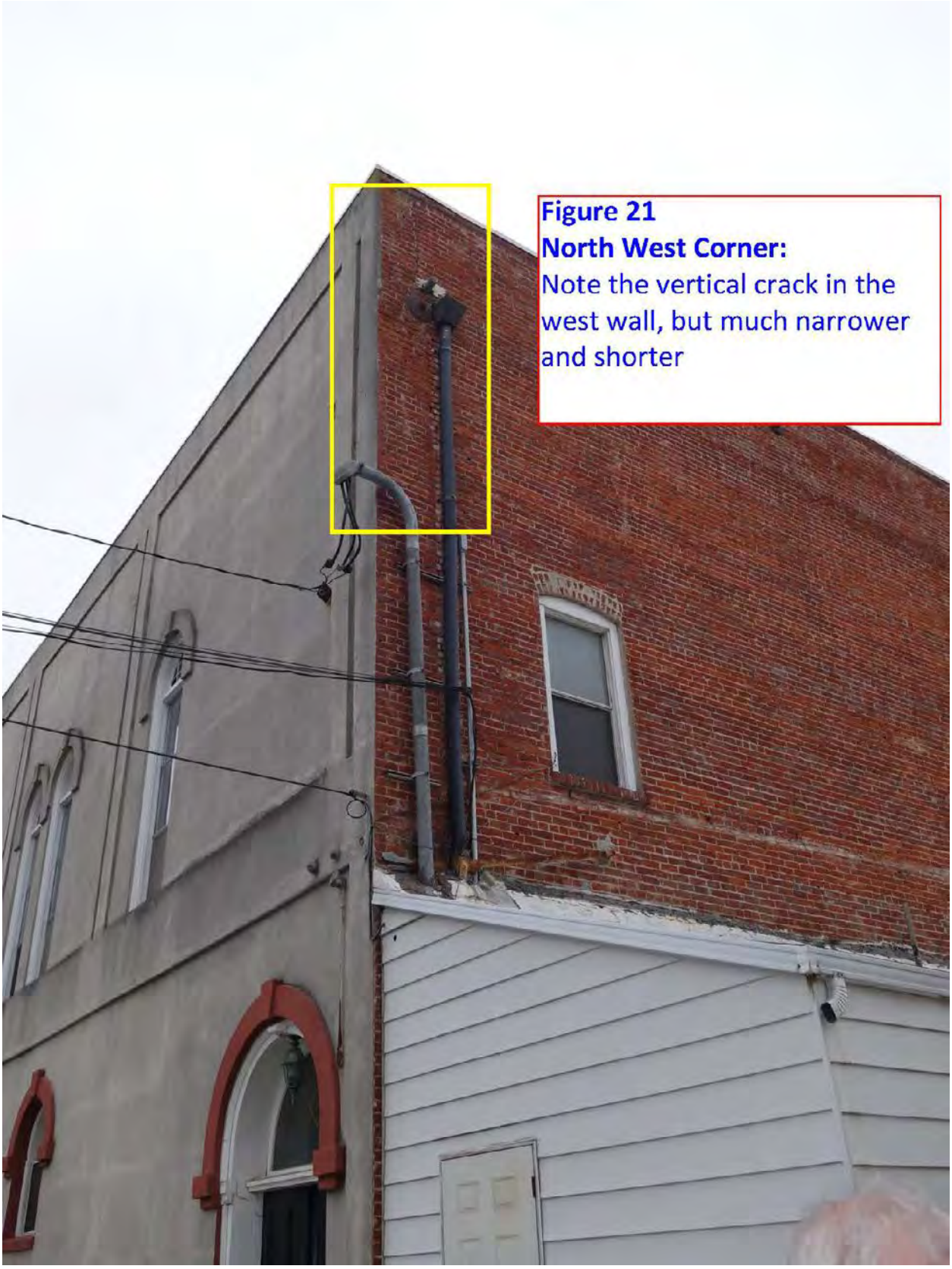
Figure 21
North West Corner:
Note the vertical crack in the west wall, but much narrower and shorter