

DGM Consultants, P.A.

Structural Engineering and Masonry Consulting

November 24, 2009

Mr. Stan Hernly
Hernly Associates, Inc.
920 Massachusetts Street
Lawrence, Kansas 66044

Re: Historic Structures Report - Structural and Masonry
Sante Fe Station
413 East 7th Street
Lawrence, Kansas
DGM PN 2009014

Dear Mr. Hernly:

In response to your request we have completed our review of the referenced building and the original drawings. The following report summarizes our findings:

I. BACKGROUND

DGM Consultants, P.A. was retained by Hernly Associates, Inc. to assist with the historic structures report by reviewing the structural and masonry elements of the building and to recommend preliminary repair options. Donald McMican, PE visited the site on September 16, 2009 to observe the existing conditions at the Sante Fe Station. An additional survey was conducted by Mr. McMican on October 26, 2009 to obtain additional measurements and data to complete the survey.

II. PURPOSE

A. The purpose of this investigation was to assess the building's structural system and exterior masonry, and to recommend conceptual, structural renovations to restore any deficiencies noted during the survey. This information, in conjunction with the information gathered by Hernly Associates, Inc., will be used to define the overall scope of this preservation project.

III. DESCRIPTION OF STRUCTURE

A. **General:** The current facility consist of a single-story rectangular shaped building, approximately 128 feet by 41 feet, plus a canopy. The building is subdivided into the northwest waiting room and the southeast office/shipping area. These areas are separated by a low roof area over the vestibule/entrance corridor. A canopy surrounds over half the building.



- B. Type of Structure:** The building is constructed of masonry walls, steel roof joists, steel framing, and metal roof deck. The exterior masonry walls are composite masonry walls with brick and stone on the exterior and brick or concrete masonry units on the interior. The canopy that surrounds a portion of the building is supported by 19 double-pipe columns and the building.

IV. SCOPE OF INVESTIGATION

- A. Available Drawings:** The original drawings reviewed, dated January 1955, consist of 23 sheets and one rendering. One set is included in the appendix.

B. Survey

1. **Corroboration with Existing Drawings:** We compared the existing construction with the information contained in the available original drawings.
2. **Field Observation of Conditions:** A visual building survey of existing conditions and basic structural system was performed to identify any apparent deficiencies. Several areas were opened up near the foundation to better define the noted conditions.
3. **Records of Observations:** The deficiencies noted were documented with photographs. The 64 photographs, included in the body of the report represent a summary of the conditions recorded with 114 photographs.

C. Methods and Techniques:

1. **Photography:** Digital cameras
 - a. Canon Power Shot SD1000
 - b. Canon EOS 40D
2. **Measurements:** A laser level was used to compare relative elevations between various points that should have been constructed level to one another.

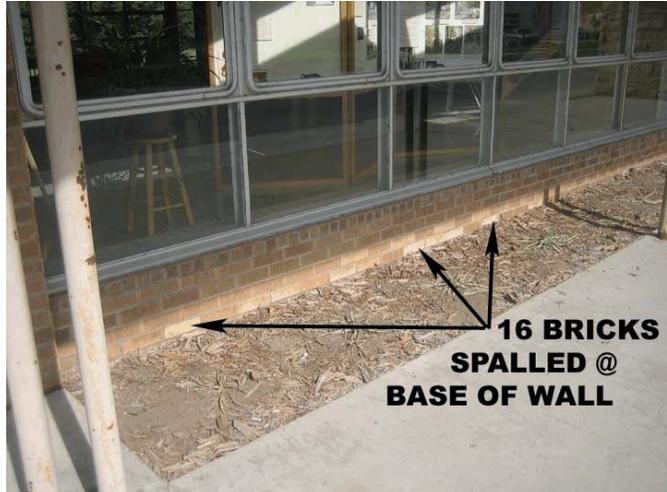
V. DISCUSSION OF FINDINGS

A. Waiting Room

1. The waiting room consist of an exterior wall on the northwest side and glass window walls on the front and back walls. A canopy surrounds the waiting room.



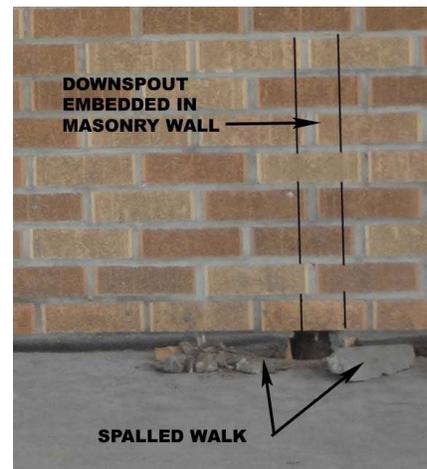
2. Along the front wall we noted 18 bricks that were spalled at the base of wall.



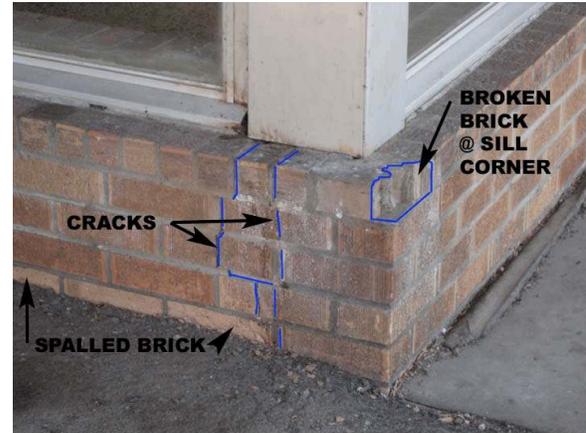
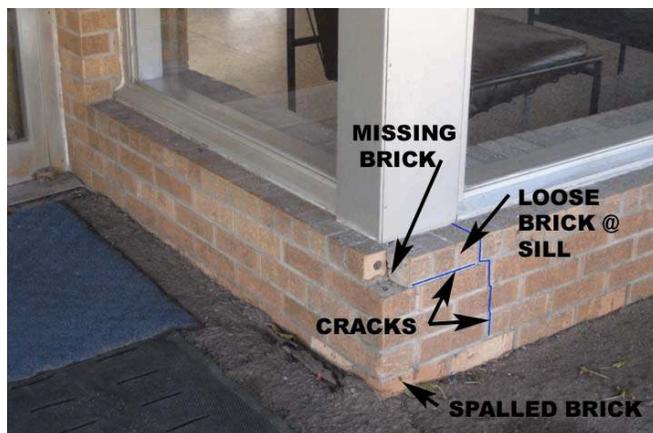
3. Northwest wall is a solid brick wall for most of the wall, except for the window at the north corner. We noted two spalled areas in the side walk and found them to be located at the two cast iron downspouts embedded in the wall. The cast



iron elbow had been turned out near the sidewalk surface and as the pipe corroded it spalled the concrete walk.

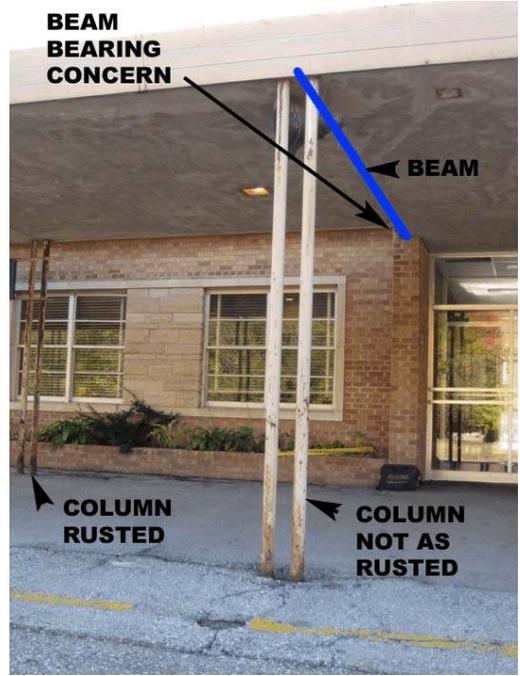


4. The northeast wall parallels the track and is all glass wall, except for the base of wall. We noted about 40 bricks that were missing, cracked, or spalled at the base. The cracking occurs near each corner where there is a steel column embedded in the window wall trim.



5. Canopy that wraps around the waiting room also extends another 42 feet northeast of the waiting room, parallel to the track.
- The columns for the canopy are constructed from two 2.5-inch diameter steel pipe.
 - The bases of these columns are embedded in the cementitious or asphaltic concrete walks.
 - The bases of some columns are severely corroded. Other columns are corroded the full length of the column or barely corroded at all.
 - Refer to the pictures on the following pages for the various conditions noted.

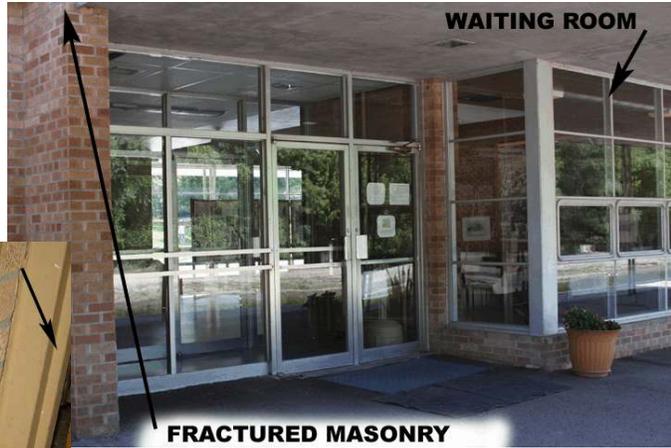
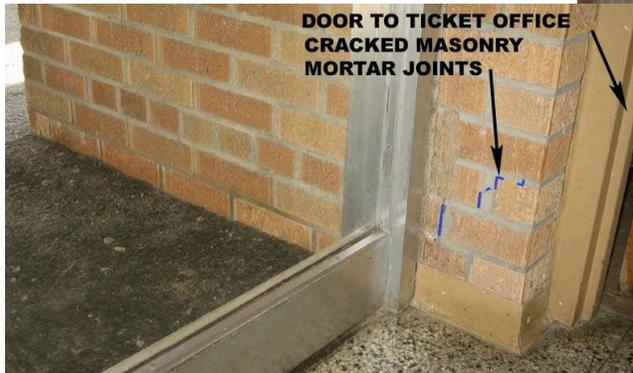






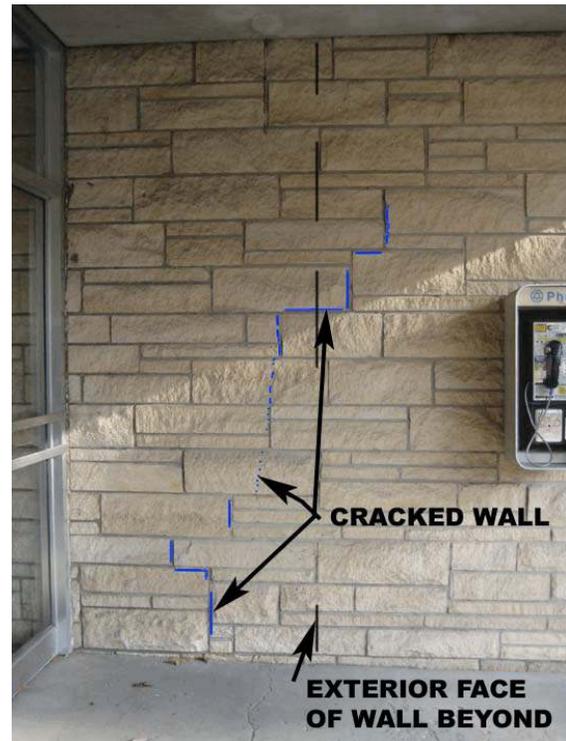
B. Vestibule Area

1. The vestibule/entrance on the track side is protected by the canopy and the brick walls that it is between (from the two

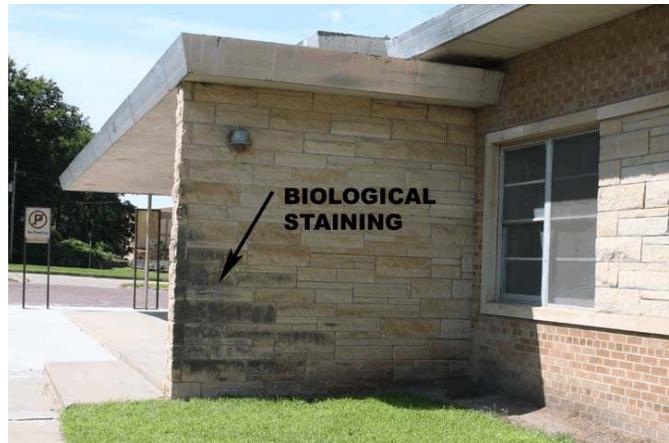


building wings). Inside this entrance we noted the brick wall was cracked at the door jamb.

2. The vestibule/entrance on the street side (southwest) is protected by a canopy and the brick wall at the waiting room as well. There is a stone wall on the southeast side. A crack in the vestibule side of this wall was noted and is referenced on the photo below.

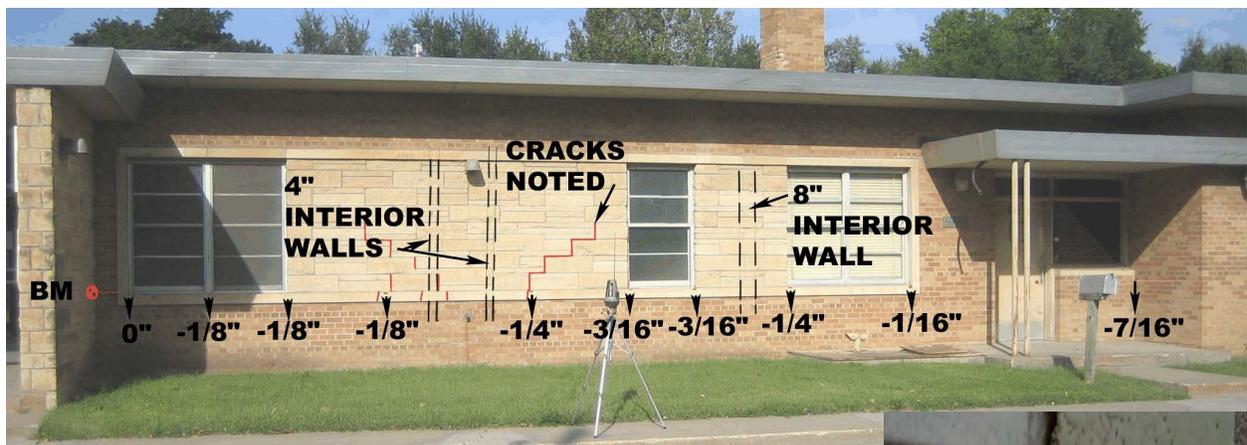


- a. The southeast face of this stone wall was noted to be stained by biological growth.



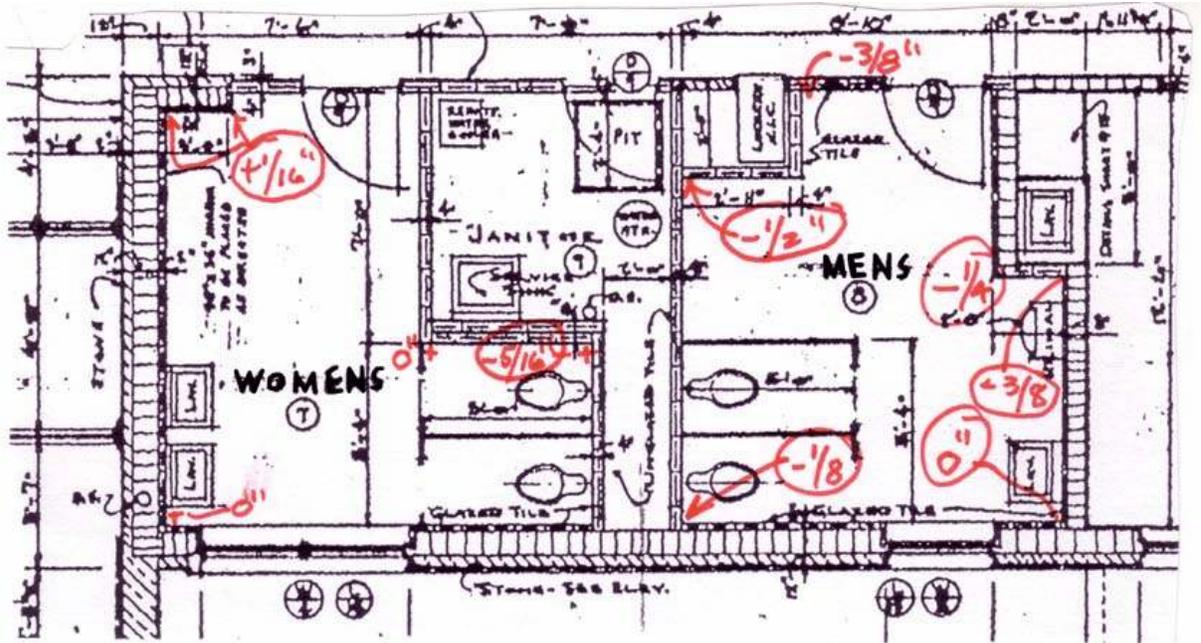
C. SOUTHEAST OFFICE/SHIPPING

- 1. This area will be discussed in the order it was reviewed, starting at the street side just southeast of the vestibule.
 - 2. The first segment of wall is located just outside of the restrooms and the "Agent's Office".
 - a. Interior cracking had been noted in the restrooms as well as cracking in the stone panel of this wall.
 - b. We surveyed the elevation of the stone sill at several spots along this wall segment. The relative fractional changes in elevation were calculated and are noted on this photo. There appeared to be the most notable settlement at the men's restroom and over to the agent's office window.
 - c. The difference in elevation between the starting point (BM) and the Agent's Office entrance porch was the greatest difference.
 - d. The approximate location of walls on the interior was annotated on photo.
 - e. The location of cracks in the stone wythe was highlighted in red on photo.

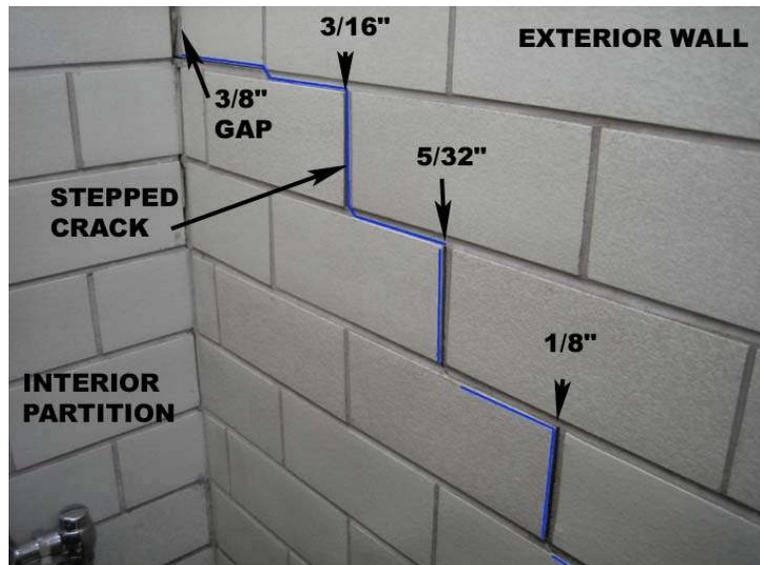
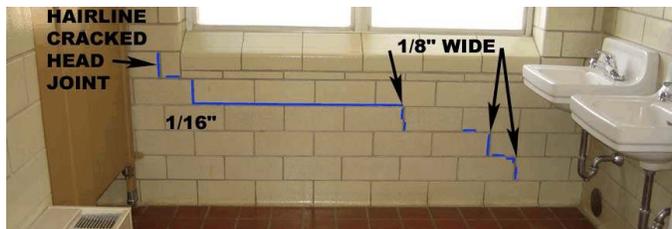


- f. We surveyed the interior glazed concrete masonry unit wall mortar joints and noted cracks and settlement at some locations. A summary of the survey is on the next page. The red numbers are relative to elevations noted as "0".





- g. Women's restroom:
 (1) The mortar joints in glazed concrete masonry walls are cracked along the exterior wall. The crack continues into the stall next to the corner.

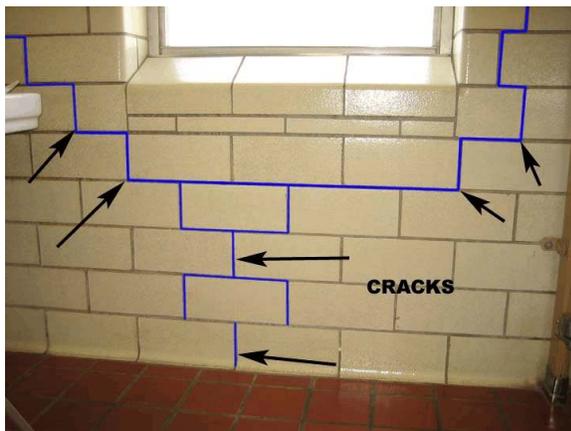




(2) At the corner, a wide crack near the ceiling was noted. This crack diminished to nothing at the floor level.

h. Men's restroom:

(1) The mortar joints in glazed concrete masonry walls are cracked along the exterior wall. The crack continues from the corner by the sink to the right side of the window.



- (2) In the left stall, we noted a similar condition to the women's restroom, the interior 4" partition wall. was pulling away from the exterior wall.



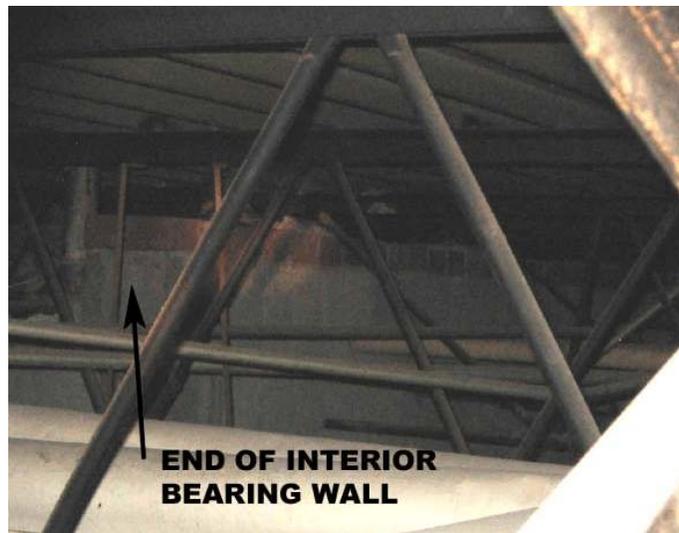
- i. Janitor room:
- (1) This room occurs between the two restrooms and is enclosed with the 4" partition walls.
- (2) The 4" partition walls set on the concrete floor and extend to just above the ceiling. There is 2 feet between the two walls at the stalls to allow room for the plumbing chase.
- (3) We understand, from discussions on site, that at one time there was a plumbing leak in this area.



(4) From the janitor room, we were able to review a portion of the roof structure and how the tops of these partition walls were supported (or not in this case). Our observations correlated with the drawings from what was observed.



(5) The boiler room wall along the corridor was verified to be load bearing as shown on the drawings.



j. The stone window sill mortar joints on the exterior were reviewed and several were noted to be cracked.

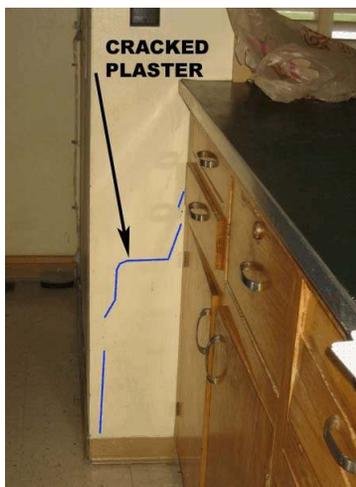


- k. Agents Office: This office was reviewed so the interior side of the exterior wall could be viewed. There was some



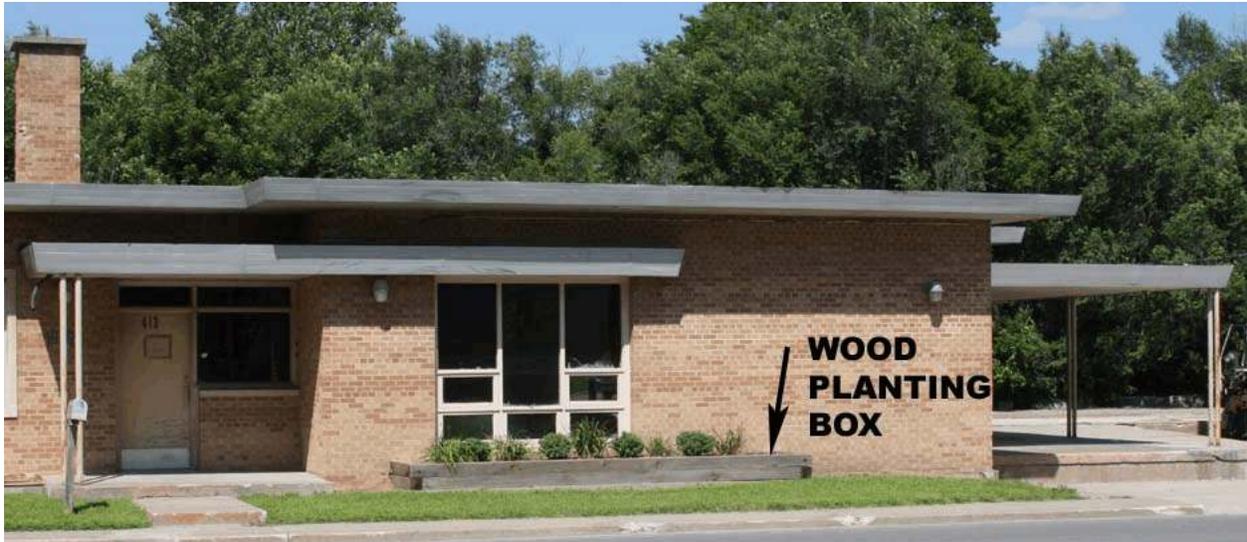
cracking of the plaster finish below and to the left of the window. The peeling paint noted suggests that moisture has been moving through the wall.

- l. Freight Office Vestibule: This vestibule area was reviewed so the interior side of the exterior wall could be viewed. There was some cracking of the plaster finish above the entrance and along the left jamb at the corner.

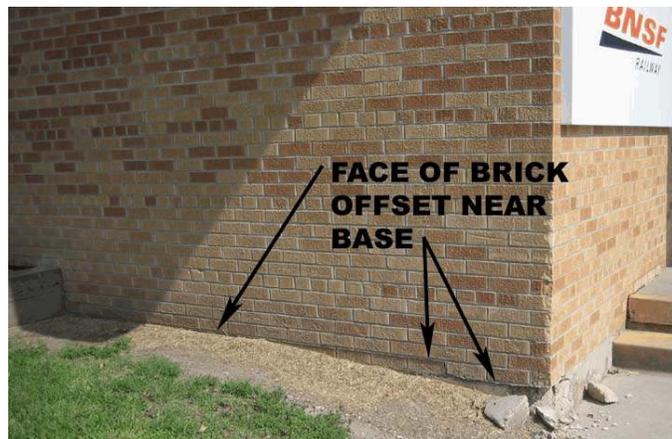


m. Freight Office:

- (1) The southwest wall along the street was reviewed first.
- (2) The wood planter box along this wall is apparently a replacement for the original brick planter noted on the drawings and similar to the one on the track side of the building.



- (3) At the south corner we noted that the brick wythe was offset at the base of wall and the foundation wall was spalled at the corner.



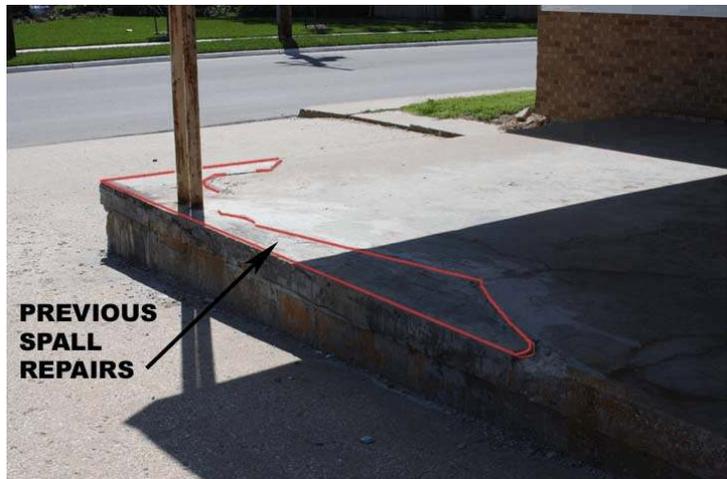
Rusted rebar and vegetation was noted behind the spalled areas.



- (4) Southeast wall: This wall forms the end the building at the freight office as well as the side wall at the dock. We noted 17 spalled brick along the base of this wall.



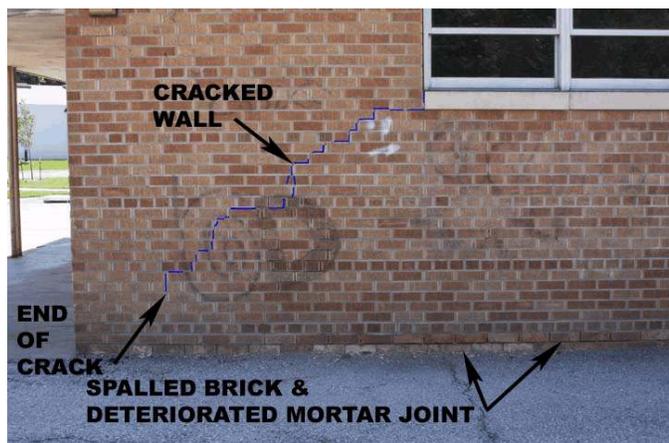
- (5) Canopy: There is a canopy at the southeast end of this portion of the building. The canopy columns are the same type as previously discussed though not quite as rusted. The cementitious concrete walks that embed the column bases have been repaired before and have started to failed again in some spots.



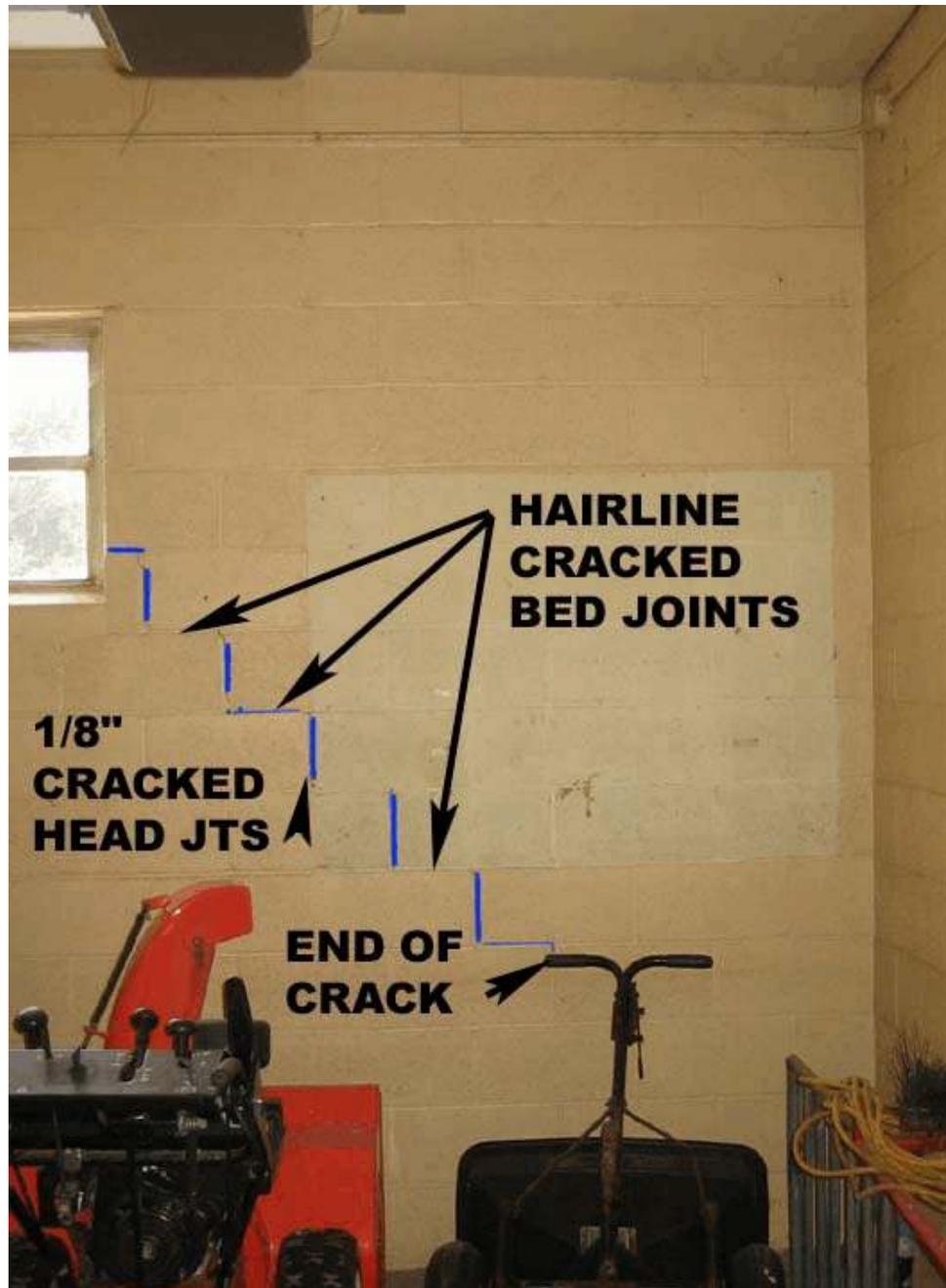
- n. Northeast wall:
(1) This wall encloses the baggage room, the file room, boiler room, and the ticket office.



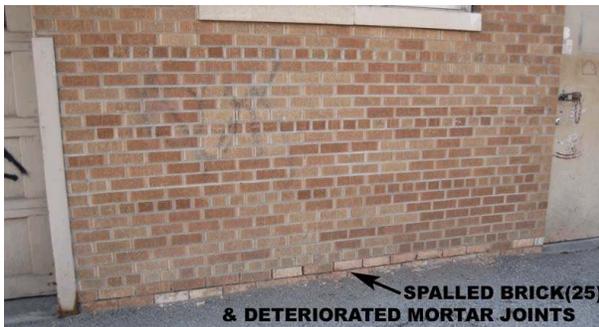
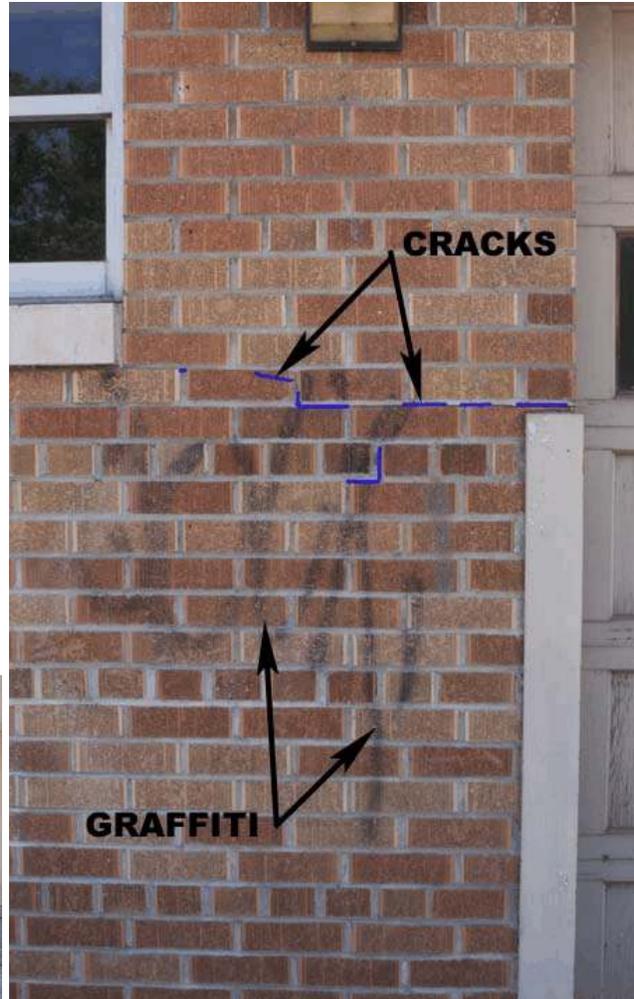
- (2) Near the east corner (baggage room) we noted some cracking of the wall. The crack steps down from the left jamb of the window. The crack is largest at the window sill and stops before the base of wall. There is also spalled brick and deteriorated mortar joints along the base of wall at this location.



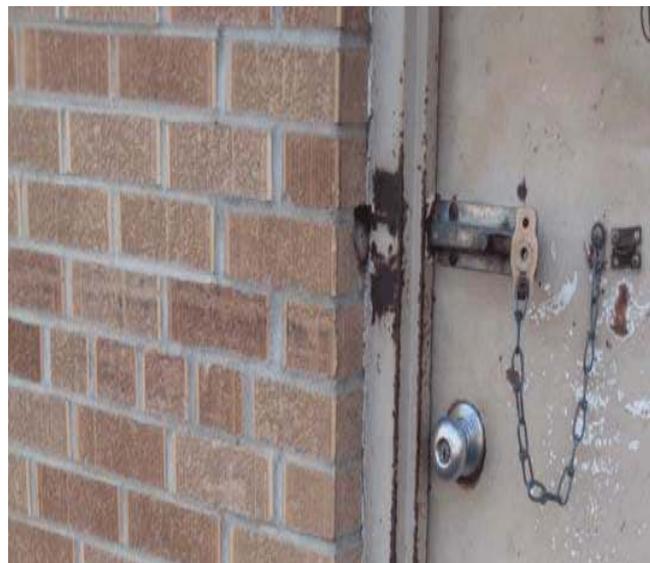
- (3) Inside of this portion of the building there is a similar crack pattern in the concrete masonry wall. There are hairline cracks in the bed joints and about 1/8" wide cracks in the head joints. The crack also stops before the base of wall.



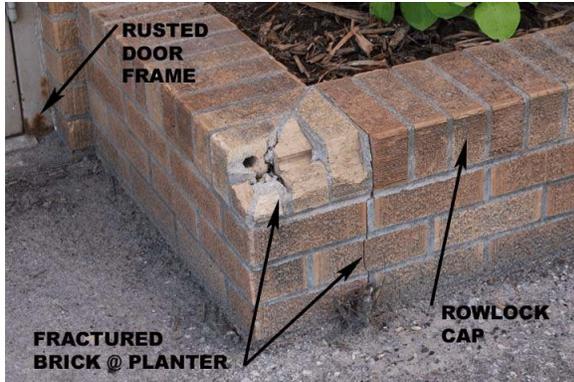
- (4) At the other side of the baggage window (at the overhead door) the brick pier is cracked horizontally (widest at the door jamb).
- (5) Graffiti was noted on the brick at several locations.
- (6) Right of the overhead door is a brick panel that has spalled brick and deteriorated mortar joint at the base of wall.



- (7) At the left jamb of the man door a brick has been chipped to make room for a hasp lock.

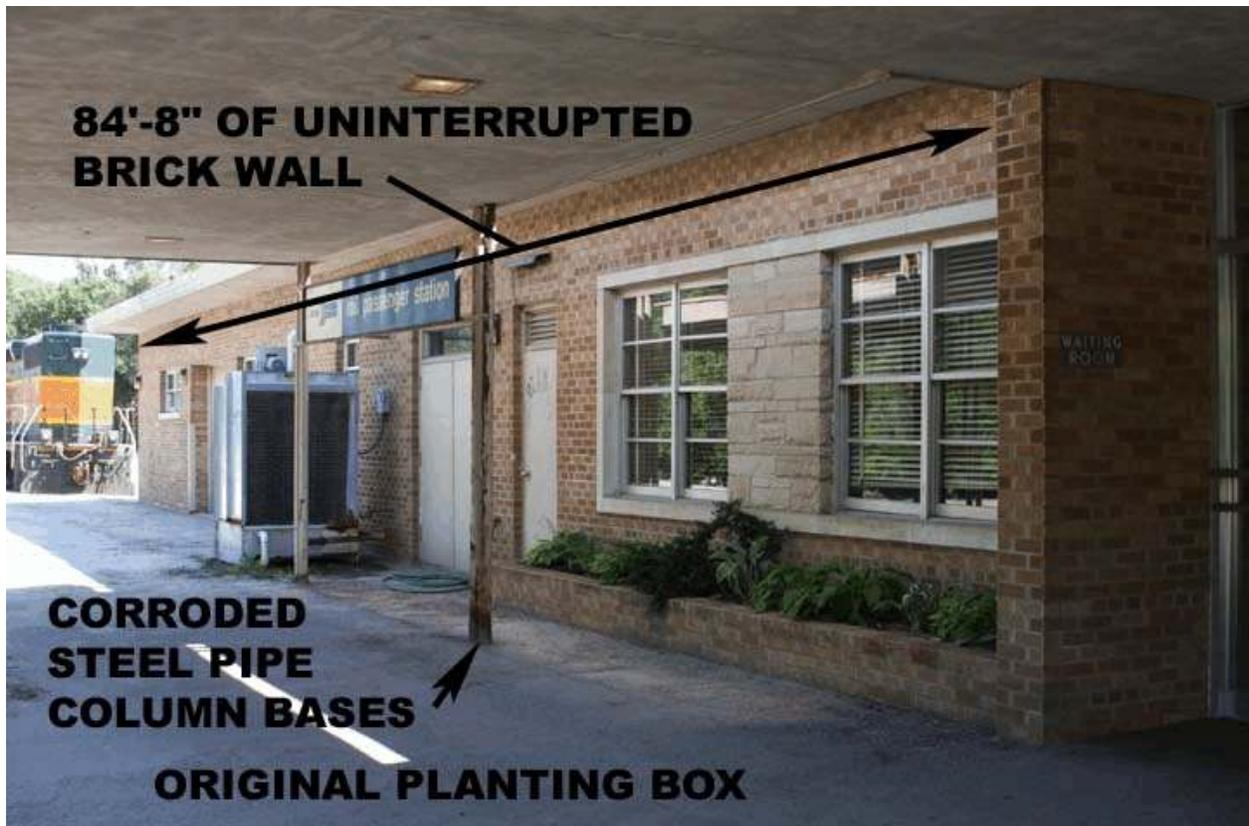


- (8) At the ticket office there is a brick planting bed wall as shown on the

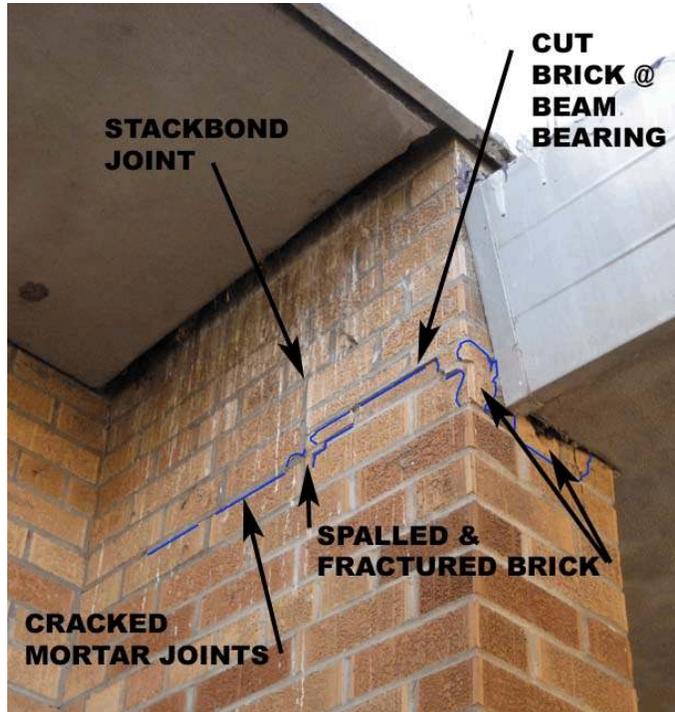


drawings. The corner of the planting bed wall is cracked and there are several fractured bricks in the rowlock cap.

- (9) The northeast wall is an uninterrupted wall over the 84'-8" length above the openings.



- (10) At the right end of this long wall there is a wing wall at the vestibule entrance (reference page 7). The brick wall is fractured at the beam bearing elevation. Closer examination reveals cut brick to form the beam pocket.



3. Masonry above roof:
a. The chimney extends 37 courses above the roof base flashing at the south corner of the boiler room. There are 16 bricks per course around the perimeter of this chimney. About 10 percent of the units are deteriorated and faces are spalled.



- b. The masonry wall above the low roof at the vestibule are appears to be in good condition.



VI. CONCLUSIONS and RECOMMENDATIONS

- A. **Overview:** The buildings reviewed during this survey appear to be structurally sound, except for the areas noted in the previous section. Most of the recommended conceptual repairs or repair options are submitted to repair the deficient conditions. Some of the areas addressed are not serious structural concerns, but are provided for consideration with regards to general safety, maintenance, or preservation concerns.
- B. **Masonry**
 1. Spalled bricks were noted along most elevations of the building at the base of wall and on the chimney. At these base conditions the bricks were typically located partially below grade or the pavement surface. The spalled brick at the chimney is likely due to units that are exposed to a more severe exposer above the roof than they can resist. The ability of this type of brick to resist freeze/thaw cycles has not been tested. These units likely become more absorbent once the face is spalled off and should be replaced to restore the strength of the wall at the base and the chimney.
 2. Cracked brick:
 - a. Cracked brick at the east corner and the jamb next to the overhead door appears to be directly related to the brick expansion along the continuous length of wall. Brick expands for up to 40 years after begin fired in a kiln as the unit absorbs moisture. The Brick Industry Association (BIA)

suggests a formula for this moisture expansion that when used predicts the panel would expand 0.4" or about 3/16" each way from the center of the panel. Brick also expands thermally similar to all materials. BIA's formula for this expansion, based on 100 degree temperature change, predicts a 0.3" total expansion of about 5/32" each way from the center of the panel. At this section, the top of wall expands (moves horizontally) more than the portion below the opening lintels. This movement cracks the masonry producing a rotational type of crack that is wide on one side as the masonry is rotated. To control this masonry movement, an expansion movement joint needs to be installed to reduce the size of the panel and thus the magnitude of the expansion. Since most of the moisture expansion is now complete only one joint is recommended. This joint should be installed between the man door to the baggage room and the file room window. The movement joint will need to be cut through the entire wall thickness and caulked. The cracks will then need to be repaired by replacing cracked brick and pointing the cracked joints. After pointing the joints the joints should also be grouted to further bond the wall together.

- b. Cracked brick at the south corner of the freight office is a shorter wall than the long one discussed at the northeast side, but brick expansion has pushed the brick off the corner some contributing to the initial cracking of the foundation at this location. This is a typical failure condition (as documented by BIA) where a brick wall set on concrete foundation wall and insufficient provision are included to control the amount of movement that occurs at the corner. With the concrete cracked, the exposed reinforcing bar is unprotected and rusts, which can cause more fracturing of the concrete. This reinforcing will need to be cleaned and coated prior to patching the concrete. Since this wall is only about 30 feet long and the moisture growth is essentially complete, It most likely that an acceptable solution is to just repair this area. To be more certain of the repairs needed here, a crack monitor should be installed and readings recorded every two weeks for a year or until such time as the movement is better understood. If the movement is excessive then a movement joint will need to be cut through the entire wall prior to repairing the base.
- c. Cracked and fractured brick at the various areas appear to be a result of impact and possible due to rust expansion at embedded steel. The impact areas (sills and planter wall corners) should be repaired by replacing the damaged units with new or salvaged brick. The damaged areas due to rust expansion need to be opened up, the steel cleaned and painted, and brick relaid around the steel with a 1/2" gap to allow for further expansion.
- d. Replacement units: Finding replacement brick has not been investigated. If it is determined that acceptable units are not available, one solution might be to salvage units from the chimney and use a new close-match unit to reconstruct the chimney. Its remote location makes finding a good match less of a concern.

3. Restroom walls:
 - a. The "settlement" noted from level during our survey can be caused by several factors including, settlement of plumbing trenches, volume changes in a swell potential clay (changes in moisture content), settlement caused by partition loads on interior slab, plumbing leaks, and original construction not being constructed level. Elevations recorded need to be rechecked quarterly to verify if they are consistent or still moving.
 - b. Cracked stone wall needs to be repaired to keep moisture from entering the wall.
 - c. The interior walls that are pulling away from the exterior wall need to be monitored to determine if they are still moving. If no movement, then repair could be more rigid, but if there is still movement noted the repair will need to accommodate it.
 - d. Some of the interior walls could be reconstructed to address accessibility issues and also correct the open joints.
 - e. Cracks in mortar joints in glazed concrete masonry walls need to be pointed if movement has stopped.

4. Miscellaneous repairs.
 - a. Tops of partition walls need to be laterally supported if they are spanning vertically.
 - b. Caulk head joints in stone sills.
 - c. Reconstruct brick planter box on southwest side to replace this missing feature.
 - d. Waterproof the interior of the planter boxes to keep moisture out of the masonry wall.
 - e. Clean graffiti of the face of brick with an acceptable paint remover.
 - f. Clean biological staining from face of stone.

C. Steel

1. General: The primary concern is the corrosion of steel members. The double pipe columns obviously have a corrosion problem where it is visible. The embedded portions of the pipe columns and other steel members encased in masonry need to be exposed more to fully understand the extent of the repair.

2. Pipe Columns: For now we have assumed that all the pipe columns need to have the bases replaced (19 locations) to be certain that all concerns are addressed while the pavement is replaced. There are two repair options being considered for repair of the 19 double pipe columns (38 pipe columns).
 - a. Repair: Replace the base of the column and clean the top portion, then refinish the column with a high performance coating system. This repair will require field welding and inspection to restore the columns to their intended capacity. Then prepare the top portion for a new finish coating which will include preparation of rusted surface, lead paint removal concerns, priming with a zinc rich coating and two top coats. Since the

rust will not be completely removed, it is likely that rust will reoccur in the future.

- b. Second is to replace the entire column with new galvanized pipe columns, repair the canopy soffit, and finish the steel with a three coat system. This will be the longer lasting option (at least twice as long).
- c. These two options will cost somewhere in the same range due to the labor intensive repair option as compared to the replacement option.

D. Miscellaneous Repairs

1. Cast iron downspouts encased in the northwest wall need to be modified while the walk is replaced so that the missing brick at the base of wall can be replaced and the walk protected from future spalling.
2. Replace site paving around the building.
3. Repair cracked plaster in interior of exterior walls.

VII. DISCLAIMERS AND QUALIFICATIONS

- A. This report does not express or imply any warranty of the structure, but only addresses the condition of the masonry walls and roof structure which were readily accessible and observable at the time of the survey. It should be noted that the preceding report is based on visual observations and that there is no claim, either stated or implied, that all conditions were observed. Further review of specific conditions may be necessary in order to establish the appropriate solutions to the noted conditions.
- B. The referenced building was visited for the purpose of observing the physical condition of the masonry and roof structure to the extent reasonable ascertainable. Nondestructive investigations and other physical testing was beyond the scope of this study. No calculations (other than those discussed) have been made to determine the adequacy of the structural system or the masonry, or their compliance with building code requirements.

Please contact me if you have any questions or if we can be of further assistance.

Respectfully submitted,
DGM Consultants, P.A.



Donald G. McMican, PE, F.ACI, CCS
President