

Project: **200-300 N.E. Leak Remediation
Design**

Date: **12/15/2014**

RE: **Addenda #1**
93 **(# of pages)**
Pages:

The following revisions and/or clarifications are to be made to the proposal documents for “(200-300 NE Leak Remediation Design RFP)”. They are a result of issues discussed at the pre-proposal conference held on (“December 11th 2014”)

Clarifications:

1. WJE Leak Remediation reports

By signing the line below, I am acknowledging that all pages of the addenda has been received reviewed and understood, and will be incorporated into the bid price submitted. This document must be attached to the proposal for consideration.

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Distributed to: All present and all prospective Proposers

Via Email: (*gwen.dawson@bpca.ny.gov*)

January 10, 2014

Ms. Gwen Dawson, Senior Vice President
Real Property Development & Management
Battery Park City Authority
One World Financial Center
New York, NY 10281

Re: 212 North End Avenue
Expansion Joint Investigation
WJE No.PC13.1965

Dear Ms. Dawson:

Per your request and in accordance with our proposal dated August 22, 2013, WJE Engineers & Architects, P.C. conducted an investigation at the expansion joint located at the Center Courtyard of the Battery Park City Community Center & Parks Conservancy building. This report presents WJE's findings from the investigation, and provides general recommendations for repair.

BACKGROUND

Battery Park City Community Center & Ball Field Maintenance Facility is located on a site that consists of two properties; Site 23 and Site 24. The expansion joint in question runs in the east-west direction along the center of the site, aligning with the property line. See Figure 1 for aerial image noting general location. The expansion joint traverses through the Upper Plaza but stops at the building wall at the Lower Plaza. It is located along the south wall of the building located on Site 23 also known as Building 23, intersects the parapet, and ends at the north entrance of the Center Courtyard at the Lower Plaza. See Figure 2 for plan view of expansion joint.

We understand that leaks have been observed in the vicinity of the expansion joint since construction was completed. WJE's investigation included observations of the existing conditions, observations of probe openings and water testing.

OBSERVATIONS

On September 5th, WJE met with Anthony Buquicchio of Battery Park City Authority (BPCA) on site to perform a walk-thru and a visual survey of the area in question to determine probe locations.

Visible damage presumably from water infiltration in the form of staining and peeling paint was observed at two ceiling locations in the Family Changing Room, each coinciding with the expansion joint above [Figure 2]. Staining was noted at the southwest corner of room C34C [Figure 3], and at the northeast corner of the entry corridor [Figure 4].

At main public corridor, a section of the expansion joint is visible [Figure 5]. Significant staining was observed at the bottom of the knee wall and at the floor [Figure 6]. Additionally, as previously noted in

our *Leak and Probe Investigation* report dated July 26, 2013, evidence of water infiltration in the form of stalactites has also been noted in the parking garage below [Figure 7].

According to building personnel, the noted leaks are currently active.

PROBES

Exploratory probe openings at select locations along the expansion joint were completed by MFM Contracting Corp. engaged by BPCA. Further exploratory probing and review of the existing waterproofing system (Kemper waterproofing membrane) was completed by Maciek Choromanski, a Technical Field Representative from Kemper System America, Inc. It is our understanding the current waterproofing installation is under warranty. At WJE's request, Kemper was engaged to review the waterproofing installation and current conditions.

Typically, most of the probes were taken at active leak locations that coincided with the expansion joint. We identified a total of five (5) locations and generally, the intent of the openings was to expose concealed conditions and review and understand the as-built work, and to potentially identify the path of the water infiltration. See Figure 8 for probe locations. Below is a summary of our findings at each location.

- Probe No. 1 - Per the architectural drawings provided for our review, we understand that the expansion joint passes through the door of the north entrance of the Center Courtyard. Therefore, the door saddle was removed to review the condition of the joint. Upon removal, the joint was noted to be open across the width of the door [Figure 9]. Sealant and a filler material were observed in the joint and adhesive failure was evident along the full length of the joint. The filler material next to the sealant was not identified, but it did appear to be a compressible filler which is meant to be installed under the sealant.
- Probe No. 2 - Upon review of the architectural drawings provided, we did not identify any details at the glass arcade wall and foundation wall at the Lower Plaza, specifically at the expansion joint, so a probe was opened so that we could observe the configuration of the joint at this location. The probe included removal of (from top to bottom); an 18"x18" section of asphalt pavers, asphaltic bed, concrete topping slab, and gravel/fill [Figure 11]. Upon removal, it was noted that the expansion joint did not go beyond the foundation wall [Figure 12]. It is likely that the expansion joint ends between the column line and does not continue through.

The visible portion of the existing waterproofing on the outside face of the foundation wall was noted to be fully adhered to the concrete substrate and in generally good condition. The only visible deficient condition noted was likely a result of the demo work during the probe opening.

In addition to the above observations, approximately 5" of standing water was noted in the opening [Figure 13]. Based on our conversations with BPCA and observations over several days, it is our understanding that the opening maintains the standing water and does not drain. Unfortunately, this made it impossible for us to observe the entire height of the foundation wall or the junction of the wall with the slab.

- Probe No. 3 was performed at the parapet directly above the active leak in the public corridor, adjacent to the north entrance/stair of the Center Courtyard. Removal consisted of approximately 4'x1.5' of asphalt pavers, asphaltic bed, insulation, and drainage board [Figure 14]. Additionally, three courses of granite brick were removed at the parapet exposing the Kemper installation on the concrete masonry unit (CMU) backup wall substrate. The waterproofing at the CMU was noted to be

brittle and delaminating from the substrate [Figure 15]. The material at the curb, which appears to be a slurry coat, was noted to be delaminated from the base Kemper installation [Figure 16]. There was an opening in the expansion joint, however it was likely caused by demo work during the probe opening.

According to Mr. Choromanski, the brittle material observed on the CMU is a protective coating of a primer and sand mixture installed over the final waterproofing application typically used to provide alkalinity protection from the adjacent cementitious materials. Per manufacturer data, we understand that the alkali-resistant barrier is a Kempertec EP/EP5 Primer with silica sand required for cementitious overburden.

To confirm the detailing at the expansion joint, at WJE's request, Mr. Choromanski probed a section of the expansion joint [Figure 17]. Removal consisted of two layers of fabric reinforced flashing membrane and a section of closed cell backer rod [Figure 18]. No moisture was noted at the section probed and according to Mr. Choromanski, the installation appeared to be in compliance with the manufacturer's recommendations.

- Probe No. 4 - To observe the expansion joint in relation to the leak location in the corridor of the Family Changing Room, a probe was performed at the southeast corner of Building 23 at the plaza level. Removal included from top to bottom; approximately 2' x 4' area of asphalt pavers, asphaltic bed, insulation, and drainage board [Figure 19]. No granite finish wall panels were removed during our investigation.

The expansion joint at this location is located directly below the base of the granite panel wall and approximately 6" from the outside face of the concealed backup wall of Building 23 [Figure 20]. A cementitious grout was noted to be installed over the expansion joint and under the bottom of the granite panel [Figure 21]. We noted there was a section of waterproofing membrane that was installed over a length of the cementitious grout. Separation in the waterproofing membrane, likely caused by movement, was noted along this area [Figure 22]. Where the parging material was not present below the granite panel, separation in the waterproofing membrane above the expansion joint was noted [Figure 23].

- Probe No. 5 - The expansion joint directly above the leak in room C24C could not be probed because it coincides with the emergency exit of Building 23. Therefore, a probe was taken at the planter area approximately 5' west of the leak. Removal consisted of a section of soil and sand down to the concrete deck [Figure 24]. At this location, there is a change in slab elevation and the configuration of the expansion joint varies in that it is a horizontal to vertical transition. The waterproofing installation at this probe appeared to be in good condition [Figure 25]. The only deficient condition identified was at the perimeter of a steel angle where the membrane was open [Figure 26]. Additionally, some soil/sand was noted behind the felt and on the membrane.

WATER TESTING

During our investigation, WJE performed water testing with the intent to recreate leaks and to confirm the point of moisture infiltration. The two areas tested were at the leak at the public corridor and the leak in Room C24C. See Figure 27 for water test locations. The following is a summary of our water leakage test findings.

Table 1. Leak Testing Procedure at Expansion Joint

Test No.	Duration	Spray Type / Location	Observations / Comments
1	25 min.	Sprayed AAMA nozzle at corner of parapet above west jamb of north door and north jamb of storefront window [Figure 28].	Water penetrated door threshold 2 minutes after initiating test [Figure 29]. Test was stopped and threshold was isolated with plastic and tape. Some water continued to bypass the plastic sheathing, thus the test was ended. Water was observed to be emanating from the bottom of knee wall 25 minutes after initial test [Figure 30]. Point of water entry unclear due to water infiltrating under the door and through threshold.
2	15 min.	Sprayed AAMA nozzle at a very low pressure at breach identified in probe No. 4 [Figure 23].	Water began to pour into opening behind drywall within 15 minutes of running water at low pressure [Figure 32 & Figure 33]. Note - testing apparatus was located approx. 10 ft from leak location.
3	2 min.	Sprayed AAMA nozzle at a very low pressure at opening made at expansion joint [Figure 34].	Water infiltration occurred 2 minutes after applying a small amount of water to the expansion joint, recreating the current leaks [Figure 35].
4	15 min.	Sprayed AAMA nozzle at jamb of storefront window and door [Figure 36].	The staining at the north corner of the storefront window appeared to grow [Figure 37].
5	15 min.	Sprayed AAMA nozzle at corner of parapet above north door and storefront window [Figure 38].	No changes to the staining patterns were observed.

For tests 3, 4, and 5, the north entrance was isolated with plastic sheathing. Upon putting the plastic sheathing in place, there appeared to be a negative pressure at this location because the plastic was drawn inward towards the interior of the building [Figure 39]. While according to Mr. Buquicchio, the HVAC in this building is positively pressurized, we observed a negative pressure at this specific location.

DISCUSSION

Building expansion joints are typically installed to accommodate expansion and contraction due to thermal changes and differential movement of the structure. They are intended to allow movement without inducing stress on adjacent materials and can be oriented horizontally and vertically.

Through our testing, we were able to verify that the expansion joint flashing in question is failing at various locations allowing water to readily bypass the joint seal and penetrate the building envelope. Through the probes, we did not observe a clear breach in the system, however, with the water testing, we were able to recreate the leaks almost immediately. Typically, in the design of an expansion joint, there are various levels of protection. Specifically with the Kemper system, there are two levels of protection: the two-ply top membrane and the bottom ply below the backer rod [Figure 40]. The bottom layer is loosely laid within the joint to allow for movement and the installation of the backer rod. If there were a breach at the top two-ply reinforced layer, the secondary layer would catch any water that would infiltrate the system and therefore limit water entry into the building. Thus, based on the results from our

investigation, it is likely there may be multiple breaches within both layers of the expansion joint flashing membrane.

In order to provide a watertight system, the entire length of the joint must be tightly sealed and properly detailed and installed in order to allow for the typical movement of a building while maintaining the watertightness of the system. One breach in the system can compromise the entire installation.

Further, based on the negative pressure noted while performing our investigation, it is likely that moisture is drawn into the cavity wall via cracks, small openings (e.g. weep holes), penetrations, and even small breaches in the fenestration perimeters. With that said, should the secondary backup system not be fully sealed, moisture can be drawn into the building.

RECOMMENDATIONS

Given our observations and understanding of the current conditions via our probe observations and water testing, we recommend the removal and replacement of the full length of the expansion joint that traverses the building in the east-west direction [Figure 41]. The scope of recommended repairs is described below:

- At the Upper Plaza, the expansion joint is located along the south wall of Building 23. Therefore, partial removal of the planter in addition to the paving system along this same wall will be required for access in order to remove and replace the expansion joint. According to the structural drawings provided, a change of elevation occurs along this joint, slightly modifying the expansion joint detail. Therefore, at several locations a horizontal to vertical transition flashing detail will be required, and for the remaining joint, a horizontal (in-line) flashing detail will be required. Where a horizontal flashing detail is required, granite wall panels will have to be removed and likely modified during the repair work.
- While the joint at the building wall is being replaced, the penetrations at the angle brackets used to support the granite cladding at the building wall should be sealed. Also, the grout used below the granite cladding at the building wall should be removed as this might restrict movement of the expansion joint and pinch the waterproofing membrane. A new support system should be designed for this location.
- Where the expansion joint intersects the parapet, further removal of granite brick units will be required to allow for the removal of two courses of CMU block for access to the joint. The removal of granite brick units also applies to the opposite side of the parapet wall, which work at this area will tie-in to the proposed work at the window perimeters, see our report *Leak and Probe Investigation* report dated July 26, 2013.
- The expansion joint located below the door saddle at the Lower Plaza should be properly resealed. To ensure that the full length of the joint is sealed, the saddle in addition to the surrounding interior finishes (approx. 1 foot above finished floor or as needed) will require removal. Additionally, at the window head, the lintel and flashing will have to be designed to allow for movement of the expansion joint which is right next to the window.
- Since the water does not drain properly at the area directly outside of the north entrance of the Center Courtyard, there is built-up hydrostatic pressure against the foundation wall. A provision should be made for draining the water at this area, thus relieving/alleviating the current pressure caused by the water. This will likely require consultation with the MEP designer.

Once the repairs are completed, WJE recommends water testing the replaced expansion joint prior to installing both interior and exterior finishes, and overburden. Since the waterproofing system is under warranty, we also recommend that Kemper be allowed to review and comment on the final design documents before they go out to bid and they should also be allowed to complete regular inspections during construction and final water testing

Please contact us should you have any questions.

Sincerely,

WJE ENGINEERS & ARCHITECTS, P.C.



Jessica Alzate
Project Associate



Matthew Haberling, R.A.
Associate Principal and Project Manager

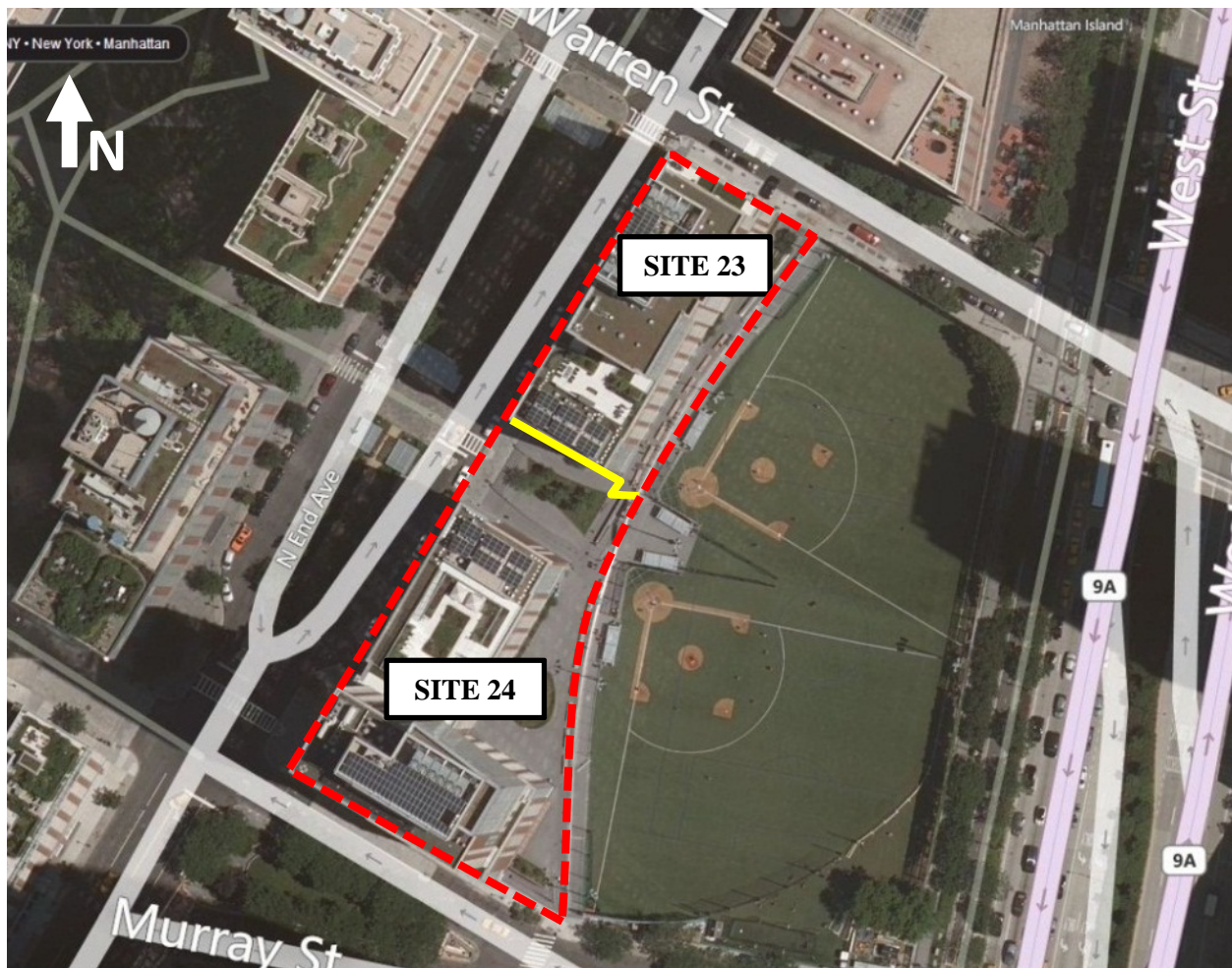


Figure 1. Aerial View of Battery Park City Community Center & Parks Conservancy Building (red dashed line). Note general location expansion joint (yellow solid line). Image from www.bing.com.





Figure 3. Note damage noted at west corner of room C34C of Family Changing Room (as noted on 9/25/2013).



Figure 4. Note damage noted at northeast corner of entry corridor of Family Changing Room (as noted on 9/25/2013).



Figure 5. Section of expansion joint visible from the main public corridor (dashed line). Yellow highlights indicate sections where staining is readily visible.



Figure 6. Note significant staining at bottom of knee wall (solid line) and at slab (dashed arrows).



Figure 7. Evidence of water infiltration in the form of stalactites noted at the parking garage (arrow).

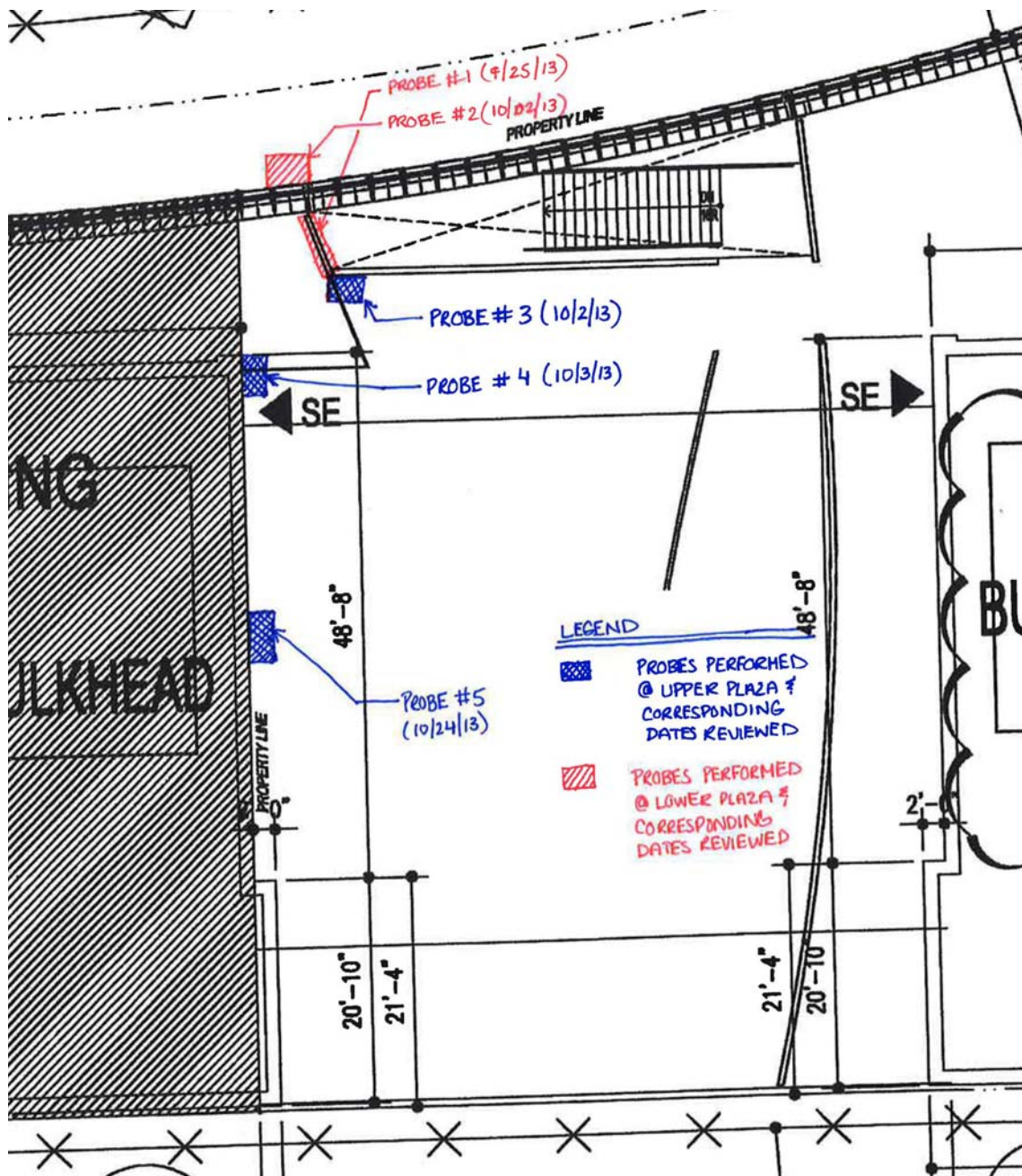


Figure 8. Location of exploratory probe openings performed between 9/25/2013 and 10/24/2013.



Figure 9. Probe #1 - removal of door saddle of north entrance of Center Courtyard.



Figure 10. Note evidence of sealant (dashed arrow) and a compressible filler material (solid arrow).



Figure 11. Probe #2 - Lower Plaza at foundation wall. Water noted to pond at probe location.



Figure 12. No expansion joint observed to not go through the foundation wall. Waterproofing on wall appeared to be in good condition.



Figure 13. Note standing water at probe opening #2.



Figure 14. Probe #3 - opening performed at parapet-plaza interface in the vicinity of the expansion joint (arrow).



Figure 15. Kemper at the face of the CMU block within the parapet wall was noted to be brittle and delaminating from the substrate (arrow).



Figure 16. Material at curb, which appears to be a slurry coat, noted to be delaminated from base Kemper installation (arrow).



Figure 17. Probe taken at expansion joint to confirm detailing. Removal consisted of two layers of fabric reinforced liquid membrane and a section of closed cell backer rod.



Figure 18. Two layers of fabric reinforced membrane (solid arrow) and a section of closed cell backer rod (dashed arrow) shown above.



Figure 19. Probe opening performed at building wall and plaza intersection, above expansion joint. General location of EJ noted by arrows.



Figure 20. Expansion joint is located approximately 6" from the outside face of the backup wall of Building 23.



Figure 21. A cementitious parging material was noted to be installed along the joint between the concrete slab and granite panel.



Figure 22. Separation noted at top coat of membrane that overlapped the cementitious parging applied at joint (arrow).



Figure 23. Separation noted in existing Kemper System directly above expansion joint.



Figure 24. Probe opening performed at planter (10/24).



Figure 25. Probe No. 5 taken at planter. Difference in slab elevation exists at this location. Note that the joint configuration varies in that it is a horizontal to vertical transition (arrow).



Figure 26. Note opening observed around perimeter of steel plate (solid arrow). Also, note soil behind felt (dashed arrow).

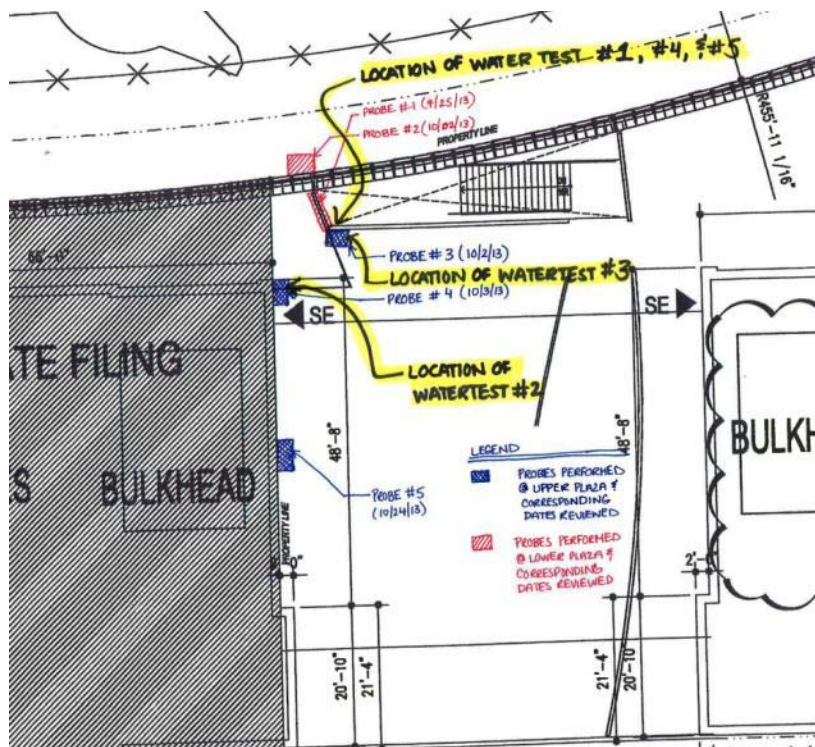


Figure 27. Location of water tests performed. Note locations coincide with probe locations.



Figure 28. Water test 1 - performed at corner of parapet above north door and storefront window.



Figure 29. Water penetrated through door threshold two minutes after initiating test.



Figure 30. Water observed to be emanating from the bottom of the knee wall 25 minutes after running the testing apparatus.



Figure 31. Water test 2 - sprayed AAMA nozzle at a very low pressure at separation noted during probe no. 4.



Figure 32. Water infiltration occurred 15 minutes after applying a small amount of water to the expansion joint (approximately 10 feet east of this location).



Figure 33. Water continued to pour in for several minutes after shutting off the water source once initial moisture was noted.



Figure 34. Water test 3 - sprayed AAMA nozzle at very low pressure directing water into expansion joint system.



Figure 35. Water infiltration occurred 2 minutes after applying a small amount of water to the expansion joint.



Figure 36. Water test 4 - sprayed AAMA nozzle at jamb of storefront window and door. Note - door is masked off with plastic sheets.



Figure 37. During water test 4, the staining at the north corner of the storefront window appeared to grow.



Figure 38. Water test 5 - sprayed AAMA nozzle at jamb of storefront window and door. Note - door is masked off with plastic sheets.



Figure 39. Note plastic sheathing drawn inward towards the interior of the building denoting a likely negative pressure at this location.

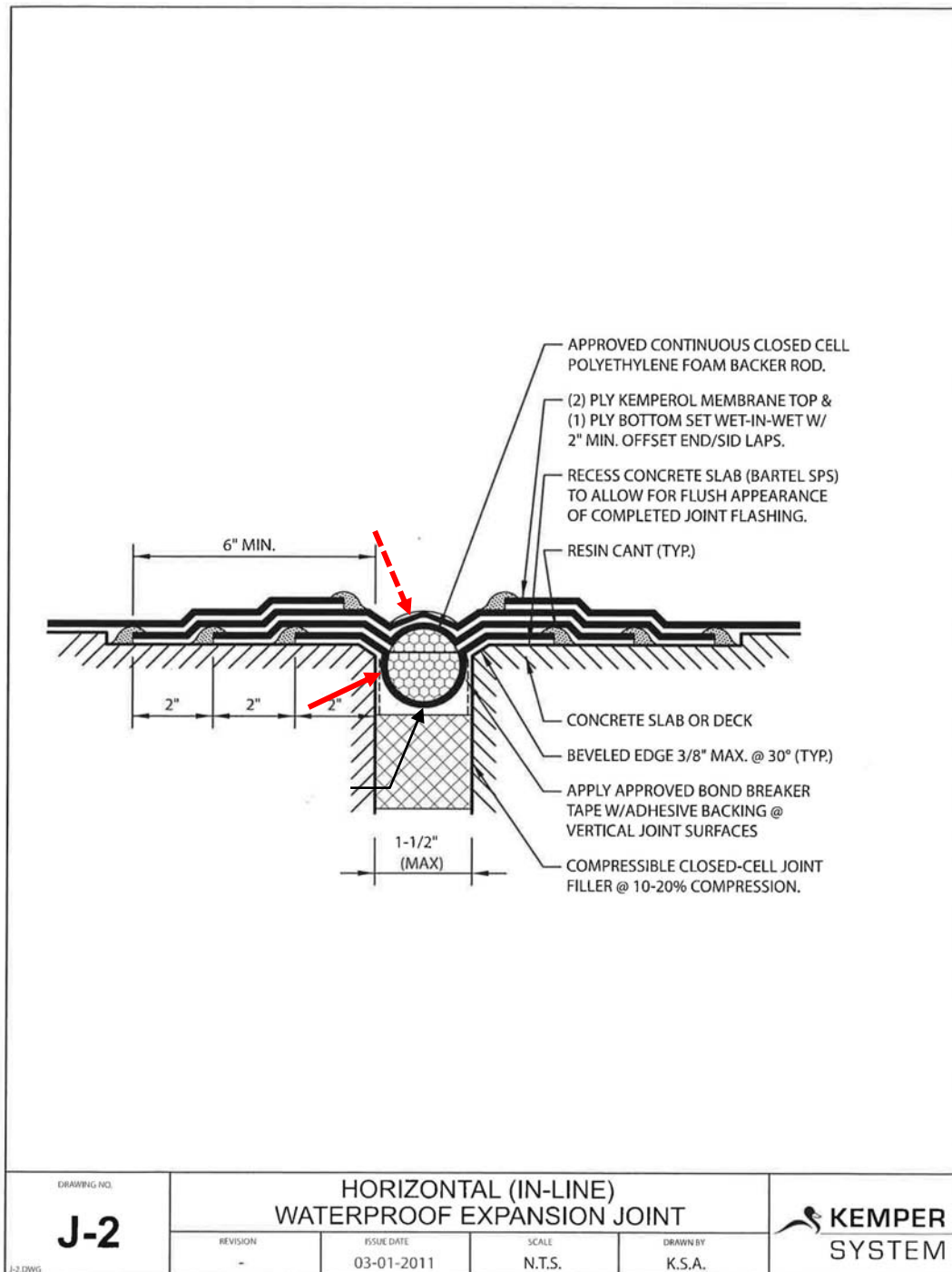


Figure 40. Typical section through an expansion joint as detailed by Kemper. The two-ply top membrane (dashed arrow) and the bottom ply below the backer rod (solid arrow).

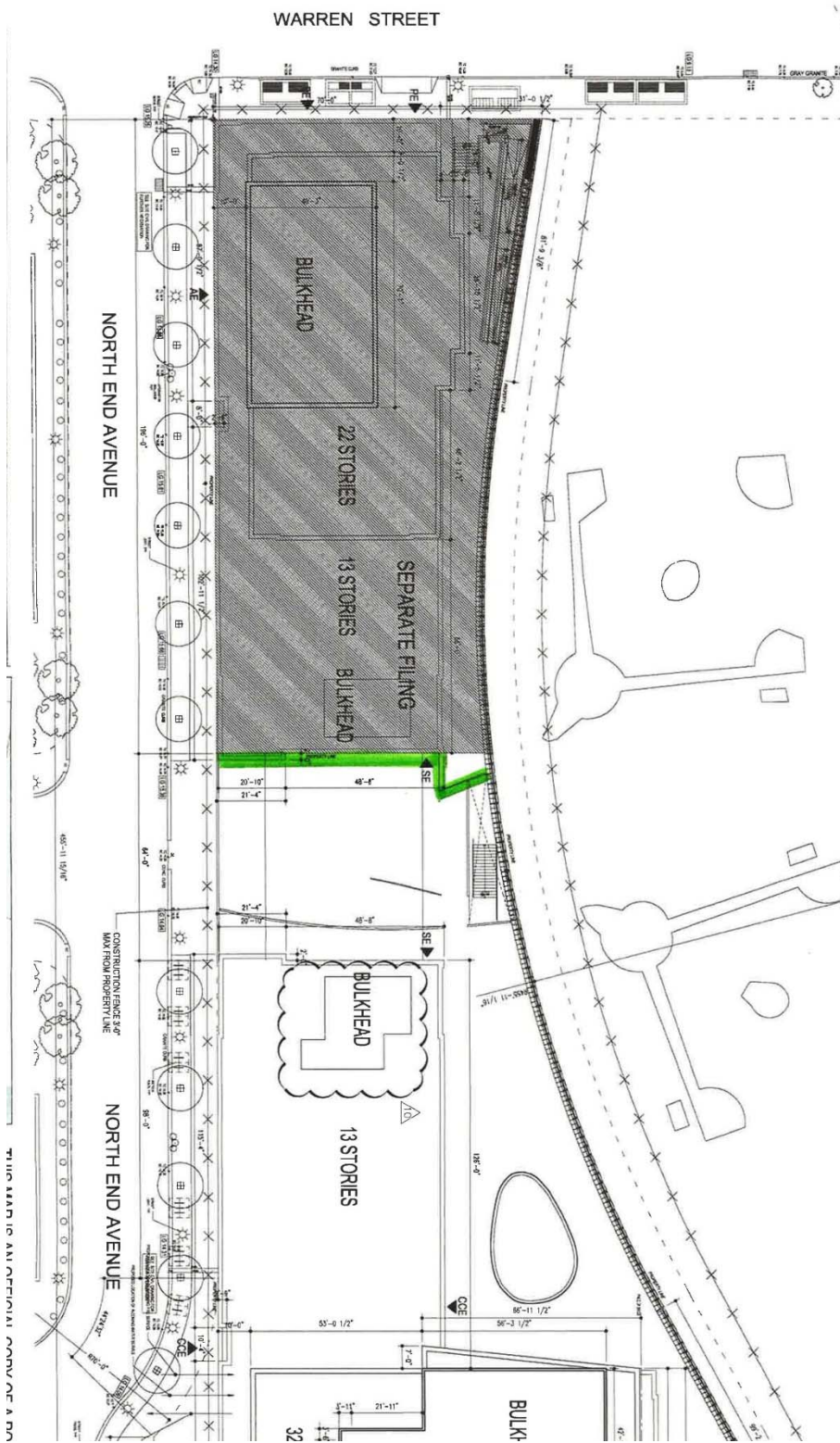


Figure 41. Recommended extent of removal and replacement of expansion joint highlighted in green.

Via Email: (*gwen.dawson@bpca.ny.gov*)

July 26, 2013

Ms. Gwen Dawson, Senior Vice President
Real Property Development & Management
Battery Park City Authority
One World Financial Center
New York, NY 10281

Re: 212 North End Avenue
Leak and Probe Investigation
WJE No.PC13.1965

Dear Ms. Dawson:

Per your request and in accordance with our proposal dated April 21, 2013, WJE Engineers & Architects, P.C (WJE) has completed a leak and probe investigation at Battery Park City Community Center & Parks Conservancy located at 212 North End Avenue in New York City. The scope of our services was based on conversations at the site with Battery Park City Authority (BPCA), Hanranhan Meyers Architects (HMA), and LiRo Program & Construction Management (LiRo) on April 15, 2013. The investigation was performed to determine the conditions contributing to reported water leakage occurring at the Center Courtyard of the subject building and our focus was not on determining fault or assignment of responsibility for the repairs. This report presents WJE's findings from the investigation, and provides general recommendations for repairs.

BUILDING DESCRIPTION AND BACKGROUND

Battery Park City Community Center & Ball Field Maintenance Facility is a one-storey tall, reinforced cast-in-place concrete building under fit-out construction at the time of our investigation. It is curved in plan along the primary axis which generally runs north-south at a length of approximately 430 feet. In the east-west direction, the building measures approximately 90 feet. See Figure 1 for aerial view. The exterior of the building is clad with a cavity wall system consisting of 4 inch thick solid granite set in mortar and aluminum framed fixed windows and swing doors. Exposed concrete finishes exist on the interior.

The building roof consists of a public plaza which can be accessed from street level on the west, north and south sides of the building. On the east side, access from the lower plaza is via a central stairway finished with granite stone over a stainless steel armature. From herein, this area will be referred to as the Center Courtyard. See Figure 2 for representative photo and Figure 3 for plan view of area. At the lower plaza level, serving as the front of the building, there is a paved walkway and synthetic turf athletic field beyond. Directly below is a parking garage that extends underneath the paved walkway but not below the athletic fields. There is also an expansion joint which follows a property line between two separate lots. The building joint appears to be continuous across the entire width of the building.

It is our understanding that the exterior of the building was designed and constructed by parties that are not involved with the construction work currently underway. The work currently in progress involves the installation of exterior and interior finishes which were designed by HMA and the general contractor is Stalco Construction Inc. and LiRo Group (LiRo) is the construction manager.

Based on our initial walkthrough with BPCA, HMA, and LiRo on April 15th, it is our understanding that the building has experienced ongoing water leakage problems at the Center Courtyard area prior to LiRo's involvement. We understand that the general contractor has performed minor temporary repairs (e.g. spraying foam insulation at select window perimeter locations and applying sealant at exterior masonry joints) with the intent to stop the leaks. Despite these repair efforts, it is our understanding that water leakage continues to remain active during precipitation events. Lastly, LiRo informed us that during Storm Sandy which occurred on October 29, 2012, approximately 18-inches of water accumulated at lower plaza flooding the interior of the building.

REVIEW OF EXISTING DOCUMENTS

As part of our investigation, WJE reviewed documents that were made available to us by BPCA. The drawings reviewed were prepared by Hanranhan Meyers Architects dated July 01, 2010. Overall, the building plans, elevations and sections provided for our review show the general scope of work when the project went out to bid. The following sheets provided information relevant to our investigation:

- A-125.00 Terrace Parapet Wall Layout Plans
- A-210.00 Enlarged Plan: Center Courtyard
- A-260.00 Reflected Ceiling Plan - Center Courtyard
- A-310.00 Center Courtyard Section
- A-410.00 Elevations - Center Courtyard
- A-430.00 Courtyard Exterior Elevations Buildings 23 & 24
- A-700.00 Section Details
- A-713.00 Courtyard Wall Sections
- A-720.00 Center Courtyard Exterior Stair

Below is a summary of some of the pertinent information gathered from the above-listed drawings:

- Per sheet A-713, detail D2, *Section Center Courtyard @ Granite Wall* [Figure 4], the parapet wall is 1'-6" wide and is composed of solid granite veneer on the plaza side, CMU block wall infill with brick ties to restrain the veneer granite on the exterior. No thru-wall flashing is shown at the parapets. A layer of waterproofing membrane is depicted as being installed at the exterior side of the cast-in-place concrete and continues along the face of the backup wall, extending to the concrete curb and slab of the upper plaza. Additionally, at the lower plaza, below the asphalt pavers, there exists a space of approximately 36-inches of gravel/fill. The concrete at the slab below is also shown as being waterproofed.
- Per sheet A-713, detail D1, *Section Center Courtyard @ Window Assembly* [Figure 5], the continuous layer of waterproofing membrane is interrupted by the storefront window. At this location, per detail D1 of sheet A-310 [Figure 6], it is tied in to waterproofing membrane installed at the lintel. Also, at this window sill the waterproofing on the outside of the foundation wall (as indicated by the dark dashed line on the drawing), is shown to terminate at the outside face of the wall without extending into the return surface of the opening and no sill pan flashing is shown [Figure 7].

- Per sheet A-210, detail S1, *Door Header + Sill @ S.S. Break Mtl. Cladding* [Figure 8], shown is the north door threshold of the Center Courtyard. Depicted below the door saddle is the expansion joint that reportedly runs continuously across the building. We understand that a foundation wall exists at the north side (left) of the expansion joint. No further information/documentation in reference to the building joint was made available to us.
- Per sheet 210, detail S2, *Door Header + Sill @ Break Mtl. Cladding* [Figure 9], shown is the south door threshold of the Center Courtyard. Noted at the door threshold is the door saddle partially supported by stainless steel shelf angle and concealed by a break metal panel. Also, the waterproofing on the outside of the foundation wall (as indicated by the dark dashed line on the drawing), is shown to terminate at the outside face of the wall without extending into the return surface of the opening and no sill pan flashing is shown.

The specifications for this project were not made available to us, thus we were not able to find information on the materials used during construction or determine if any substitutions were made.

In addition to receiving the HMA design documents, BPCA also provided us with window shop drawings stamped by Plaza Construction Corp. on 2/18/2011.

We also reviewed various photographs of the building under construction provided by Mr. Anthony Bucchiquio of LiRo. We were provided with a total of five (5) images specific to the area of investigation.

SCOPE OF INVESTIGATION

The investigation was completed by Matthew Haberling, Kenrick Hartman, and Jessica Alzate of WJE between May 1 and June 4, 2013. Our investigation included a visual assessment of the building interior and exterior at the reported leak locations, water testing at multiple locations, observation of exterior probe openings. A total of fourteen (14) water tests were performed at the Center Courtyard. Testing included the parapets at the upper plaza, and the fenestrations below, which will be referred to as Storefront No. 1, Storefront No. 2, Storefront No. 3, and the north door [Figure 10], and the foundation wall at the lower plaza. Contractor support for the probes was provided by LiRo.

WJE performed water leakage testing using hand held spray nozzle in general accordance with AAMA 501.2 and a spray rack in general accordance with ASTM E1105 which was modified to exclude the pressure chamber. The intent of the testing was to identify potential sources of moisture infiltration. Based on the results of the water tests performed and our visual survey, six (6) masonry exploratory probe openings were performed to gather detailed information regarding the underlying construction and as-built conditions.

OBSERVATIONS

The following is a detailed description of our visual inspection, water testing procedure, and probe observations. The description of the water testing procedure that was followed is summarized in tabular form.

Interior Survey

Various locations at the interior of the building in the vicinity of the Center Courtyard exhibited signs of water infiltration. An interior survey was performed prior to leak testing to document any existing water damage and other signs of water intrusion. The following summarizes the conditions observed:

- Apparent water staining was observed at the bottom of the north and south stairway [Figure 11 and Figure 12]. At the north stair, it is our understanding that the leak at the west corner of the first step is reportedly active during precipitation events and during dry weather. Additionally, at the south stair, we understand that the water stains become active following precipitation events.
- The wall of the stairway, approximately 48-inches in height, continues throughout the length of the Center Courtyard. Evidence of water intrusion was observed at the slab-to-wall interface at select locations [Figure 13] and at localized areas along the wall [Figure 14]. Note, during WJE's investigation, no finishes were installed at the floor, however, a skim coat of cementitious parge was installed over the knee wall and sills of the storefront windows.
- Water stains were observed at the storefront window sills on the exposed cementitious finish [Figure 15]. Reportedly, the large extent of the staining occurred during the major weather event, Storm Sandy when the site was flooded due to the storm surge. Since the major weather event, the full extent of the leak staining has reportedly not been recreated, however, small leaks were observed following precipitation events.
- There are large gaps between the horizontal and vertical window frame members [Figure 16]. Upon review of the shop drawings, it appears that these are glazing stops [Figure 17]. Water stains were observed emanating from these storefront framing joints at the window head and extended down the vertical mullions at multiple locations [Figure 18]. In addition, evidence of water intrusion was observed at the framing joints [Figure 19].
- At select locations near the window head, specifically at Storefront No. 1 and Storefront No.2, water damage to the finished ceiling was noted [Figure 20].
- Spray foam insulation was observed to be installed at select window perimeter locations [Figure 20].

We also observed signs of water infiltration in the parking garage in the form of visible moisture and mineral deposits forming stalactites in the vicinity of the expansion joint and at adjacent areas [Figure 21 and Figure 22]. According to building personnel, the leak is typically active during and/or the day following a precipitation event. This location is outside the scope of our investigation, however, we continued to observe the expansion joint on the interior of the parking garage during our testing so that we can verify the occurrence of infiltration through the waterproofing system.

Exterior Survey

The upper plaza is composed of asphalt pavers set in an asphaltic bed on top of insulation, drainage mat, and waterproofing membrane. The stair, which serves as an entry point to the lower plaza, is tied into the upper plaza at the stair landing which is also fabricated with a metal armature. At the parapets, efflorescence at localized areas below the coping stones was observed and no flashing was evident at the top of the wall [Figure 23].

The lower plaza is composed of asphalt pavers set in an asphaltic bed on top of a topping slab over gravel/fill. The following observations were made at the lower plaza level:

- A significant amount of efflorescence was observed at the walls directly below the stair landing at the north facing and east facing facade [Figure 24 & Figure 25].
- Weep tubes above the window head of Storefront No. 2 exhibited a significant amount of efflorescence, with staining clearly visible at the vertical mullions [Figure 26]. The weeps at the window heads were spaced 18-inches to 24-inches apart. There were also weep tubes observed at the lower portion of the wall which were spaced approximately 24-inches to 36-inches apart.

- Ferrous staining and evidence of efflorescence was noted at the stainless steel armature of the stair [Figure 27].
- Ferrous staining and efflorescence noted at the electrical box located on the east facing facade [Figure 28].
- Missing finish metal panels at the south column of the Center Courtyard [Figure 29] were observed. According to Mr. Buquicchio, the metal panels were removed by LiRo with the intent to mitigate the water infiltration at this location. Currently, the window jamb at this location is exposed to the elements. From the exterior, there appears to be a large void next to this window jamb and spray foam insulation is installed to fill the gap [Figure 30].

As seen in photographs provided to us by LiRo, we understand that Grace Perm-A-Barrier was installed at the walls and tied into the Kemper waterproofing [Figure 31]. We also understand that the installation of the stair armature was subsequent to the installation of the flashing membrane. Also, as noted in another photo provided by LiRo, there does not appear to be any provision for movement at the joint between the two buildings in the waterproofing membrane, reported by LiRo to be Kemper, [Figure 32]. Normally, we would expect to see a joint at this location which we would expect to be visible in the photograph.

Water Leakage Testing

The majority of the water testing was completed within a span of three days between May 1 and May 3, 2013. The purpose of these tests was to apply water to select conditions to recreate leaks. Often, various elements were isolated so that only select conditions could be evaluated.

The test locations are identified in Figure 33. The following is a summary of our water leakage test findings, including information on whether the leaks we created during our testing recreated the leaks observed prior to the start of our investigation.

Table 1.

Test No.	Duration	Spray Type / Location	Recreated Leak (Yes/No)	Observations / Comments
1	60 min.	Sprayed AAMA nozzle below north door threshold [Figure 34] at Lower Plaza Level	Yes	Leak detected at bottom of step within 60 minutes of running testing apparatus. Water was observed to be emanating from bottom of stairway [Figure 35].
2	60 min.	Used spray rack below Storefront No. 2 [Figure 36].	No	Drain adjacent to the north door was observed to be discharging water [Figure 37]. No visible leak noted at interior of building.
3	60 min.	Sprayed AAMA nozzle at Storefront No. 2 at various window components including the sill, jambs and window head.	Yes	At approximately 25 minutes, while spraying the center mullion, a leak was observed at south corner of sill [Figure 38]. At approximately 40 minutes, while spraying the north jamb, a leak was observed at the sill, midpoint between south window jamb and center mullion [Figure 39].
4	10 min.	Used spray rack 6-inches above window head of Storefront No. 2.	No	Test stopped short due to water infiltration at south door threshold [Figure 40].

Test No.	Duration	Spray Type / Location	Recreated Leak (Yes/No)	Observations / Comments
5	8 min.	Sprayed AAMA nozzle at corner window-wall joint between the east facing elevation and north facing elevation.	No	Test stopped short due to water infiltration at south door threshold [Figure 41].

Due to water infiltration that occurred at the south door, no further testing was performed on this day. For subsequent water testing, it was determined that the Storefront windows would be isolated with plastic sheeting with the intent to isolate any leakage that may occur from overspray at known gaps in the envelope (e.g. opening at door threshold).

Table 2.

Test No.	Duration	Spray Type / Location	Recreated Leak (Yes/No)	Observations / Comments
6	120 min.	Used spray rack at approximately 12-inches above window head of Storefront No. 2 [Figure 42].	Yes	After approximately 50 minutes, moisture was observed at the sill at the bottom of the north column [Figure 43]. After 75 minutes, moisture was apparent at the bottom of the south column adjacent to south door [Figure 44].
7	90 min.	Used spray rack at approximately 6-inches above window head of Storefront No. 1.	Yes	Prior to start of test, leak at bottom of south column grew. After approximately 60 minutes, moisture stains were observed to keep growing [Figure 45]. Approximately 1 minute later, moisture was observed at the center and corner of the window sill of Storefront No. 2 [Figure 46 & Figure 47]
8	113 min.	Used spray rack directed to midpoint of parapet above Storefront No. 1.	Yes	Leak patterns discerned from Test No. 7, specifically below the south column adjacent to door, grew while running test [Figure 48].
9	255 min.	Used spray rack directed at opposite side of center parapet located above Storefront No. 2 & Storefront No.3 [Figure 49].	Yes	After approximately 15 minutes, moisture was noted at the mortar joints of the exterior granite brick cladding and perimeter of electrical box [Figure 50]. After approximately 90 minutes, a leak was noted at the south jamb and at the north jamb of Storefront No. 2 [Figure 51].

Test No.	Duration	Spray Type / Location	Recreated Leak (Yes/No)	Observations / Comments
10	255 min.	Used spray rack directed at opposite side of center parapet located above Storefront No. 1.	Yes	After approximately 180 minutes, water was noted at bottom east corner of Storefront no. 1 [Figure 52]. Water continued to pond at this location throughout remainder of test. After approximately 140 minutes, water appeared to be emanating between glass-to-frame interface of Storefront no. 1 [Figure 53]. In addition, at the window-wall joint, drops of water were exfiltrating via the sealant joint [Figure 54].
11	38 min.	Sprayed AAMA nozzle at Storefront No. 3 at various window components including the sill, window jamb only, and the window-wall.	Yes	After approximately 18 minutes, a leak was observed at the window sill adjacent to the south jamb [Figure 55].
12	60 min.	Used spray rack directed above center parapet (above Storefront #2 and Storefront #3) [Figure 56].	No (Reportedly, leak was not observed prior).	After approximately 20 minutes, moisture was noted below column north of Storefront no. 2. Moisture continued to infiltrate at this location throughout remainder of test [Figure 57].
13	60 min.	Used spray rack above south parapet (directly above Storefront #1).	Yes	Leak at east bottom corner of Storefront #1 continued to grow [Figure 58].
14	15 min.	Ran a hose at a low pressure intended to mimic the flow of water once in the cavity at probe location No. 3 (at east corner of Storefront #1) [Figure 59].	Yes	Within 15 minutes of spraying directly at probe, a leak following the typical leak pattern on the interior window frame was observed [Figure 60].

During our testing, while we were able to create a leak during the majority of the testing, we did not re-create the leak at the expansion joint in the garage.

Exploratory Probe Openings

Based on the results obtained from the water testing, we identified six (6) locations on or near the exterior wall for probe openings. In general, the intent of the probes was to expose concealed conditions and review the as-built work, and to potentially identify the path of the water infiltration. See Figure 61 through Figure 63 for probe locations. Below is a summary of our findings at each probe location.

Probe #1

Per test no. 1, water leakage occurred at the bottom of the stairway within one hour of testing. Therefore, in order to understand the nature of the leak, probe #1 was opened at the lower plaza adjacent to the north door threshold [Figure 64].

On 5/13, WJE was onsite to review the exposed conditions. It was observed that approximately 3 feet of asphalt pavers, asphaltic bed, concrete topping slab, and gravel/fill were removed. Per the design documents, the cast-in-place concrete was noted to be waterproofed.

Adjacent to the door step is a concrete ledge. In order to review the joint at this location, additional removal of the topping slab was requested. The joint between the wall and the ledge appeared to be in good condition with no discernible defects [Figure 65].

WJE returned to site on 5/14. According to the general contractor, the gravel was further removed. Standing water approximately 4-inches deep was observed [Figure 66]. WJE returned to site on June 4th to further document the conditions and continue excavating so that we can observe the horizontal joint between the lower slab and the foundation wall but the watertable at this location was now 9-inches above the bottom of the test pit and this made further excavation impossible [Figure 67].

Probe #2

Per test no. 12, water was directed at the opposite side of the parapet wall and water infiltration occurred at the bottom of Storefront No. 1 (east corner). Therefore, probe #2 was opened at the south parapet wall adjacent to the horizontal metal panels [Figure 68].

The area of removal consisted of approximately 4 square feet of asphalt pavers, asphaltic bed, and rigid insulation. Drainage board and Kemper waterproofing were left in place. Approximately four courses of granite were removed at the parapet wall. The Kemper on the cast-in-place concrete appeared to be in good condition. However, the Kemper installed at the CMU block wall appeared to be brittle and delaminating from the substrate at the wall and at the tie-in condition [Figure 69]. Additionally, various voids were noted in the membrane. Since we were not present to observe the probe opening in progress, we cannot confirm whether this condition is pre-existing. What appeared to be a slurry coat was also observed at the curb. Limited bond between this material and the Kemper appeared to exist [Figure 70].

Probe #3

Per various tests performed at the parapet, water infiltration was noted at the base of the column located directly below the end of the parapet wall. Therefore, a probe opening was performed at this location, specifically at the corner, to understand how the stair landing intersected the plaza [Figure 71].

The area of removal consisted of an area of approximately 3'x 1' of asphalt pavers, asphaltic bed, and insulation. Drainage board and waterproofing were left in place. Two courses of granite were removed at the parapet exposing the Kemper installation. The waterproofing exhibited similar characteristics as in Probe #2, where it was observed to be brittle and delaminating from the substrate at the tie-in location. The slurry coat, also present, was noted to be delaminated from the base Kemper installation [Figure 72]. Additionally, it was observed that the stair landing sits atop the stone veneer and is fastened into the cast-in-place concrete wall. Minor corrosion was observed at the angle [Figures 73 and 74].

Probe #4

Per various tests performed at the window head, and subsequent water infiltration, Probe #4 was taken at the east top corner of Storefront No. 1 to evaluate the window-wall condition above the window head [Figure 75]. Area of removal consisted of four courses of granite and insulation, revealing the existing waterproofing in place at the window head and the end dam condition. The following conditions were noted at this location:

- Hole noted in the Grace Perm-A-Barrier membrane which also appeared to be through the lintel [Figure 76].
- Delaminated Kemper at tie-in location [Figure 77].
- Moisture noted to be present under the Kemper [Figure 78].
- Cavity largely filled with mortar droppings [Figure 79].

On 5/21, during our probe investigation, we water tested the probe with a garden hose, see description of Water Test #14 above.

Probe #5

Per various tests performed, water infiltration was noted at the bottom of the south column of Storefront No. 2. Additionally, per our visual observations, a significant amount of efflorescence was observed at the exterior of the wall.

Initial review of the probe opening was performed on 5/14. At this time, the insulation was still in place, limiting the review of the existing conditions. The deficiencies observed were moisture present underneath the Grace Perm-A-Barrier and a partially blocked drainage cavity with mortar droppings.

At WJE's request, the size of the probe opening was increased to allow for more exposure including the tie in condition where the stair beam intersects the wall [Figure 80]. The following conditions were noted at this location:

- Breach in the waterproofing and corroded shims at the stair beam / wall intersection [Figure 81].
- Metal panel at wall spans the height of the door [Figure 82]. The metal panel is installed behind the door frame and sealed with a bead of sealant. During our investigation, the sealant observed to be defective and was easily removed showing little to no adhesion to the substrates.
- Openings in the flashing membrane at various locations that exhibited signs of moisture underneath [Figure 83].
- The metal flashing at the head did not have any end dams [Figure 84].

Probe #6

At WJE's request, probe location #6 was opened in order to verify and understand the flashing condition at the base of the wall [Figure 85]. The metal panel noted in Probe #5 was observed to extend to the base of the wall. Perma-A-Barrier flashing, installed above the metal panel, extends approximately 10-inches above the wall. The waterproofing at this location was observed to be delaminated from the door jamb and at the base of wall [Figure 86]. Corrosion was also noted at the angle where the door and storefront window partially sit on. Additionally, at the base of the storefront window, where the break metal panel was installed in lieu of plywood as per the design documents, the void was observed to be filled with spray foam insulation [Figure 87].

DISCUSSION

From our review of the documents and observations made during our water testing and probe investigation, it appears that this wall system at this building was designed to function as a cavity wall system. This means that the wall is constructed of multiple layers each fulfilling a specific function and when properly detailed and installed correctly, all the layers work in conjunction to separate the exterior and interior environments. Looking at specific layers of the wall system at the Center Courtyard of Battery Park City Community Center, from outside to inside we find the following: granite cladding, cavity, rigid insulation, waterproofing, backup system (in this case reinforced concrete and concrete masonry unit (CMU) infill wall, vapor retarder (typically) and interior finishes. This system is also penetrated by aluminum framed storefront fenestration.

The granite cladding fulfills an aesthetic function as this is the finish material that everyone sees on the exterior, but it also serves as the initial barrier and it should be designed to direct the majority of the moisture away from the wall assembly. The cavity behind the cladding is intended to serve as a conduit to facilitate drainage of any incidental moisture which breaches the cladding. The insulation is intended to provide a thermal barrier between the sometimes vastly different temperatures between the interior and exterior environments. The waterproofing is intended to shed water which may collect inside the cavity and direct it to the exterior. The waterproofing layer may consist of a membrane and a combination of flashings and sealants which are typically installed at penetrations or wall terminations. The backup serves to provide structural support and transfer loads imposed by the other elements of the wall. The vapor retarder is sometimes installed to limit the passage of vapor into the assembly and interior finishes protect the assembly from the interior and provide an aesthetic finish. There is also typically an air barrier installed somewhere in the assembly which we did not identify during our investigation since this was not part of our scope. It also was not depicted in the design drawings. Our investigation focused on the exterior components of the wall assembly which contribute to the management of water resulting from precipitation events. Therefore, our discussion will be focused on the exterior cladding, the drainage cavity, the waterproofing, and the storefront fenestration.

Exterior Cladding

During our investigation, we did not observe any metal flashings at the parapet walls along the upper plaza. As revealed by the our water tests, moisture migrated into the cavity relatively quickly and appeared to fill the cavity between the cladding and the waterproofing as evidenced by the appearance of moisture at the lower portion of the wall in Figure 50. In looking at the design documents provided for our review, it does not appear that the installation of flashings at this location was part of the design.

During our investigation, we could not observe the exact points of infiltration through the cladding; however, it is not uncommon for moisture to breach masonry cladding through separations in mortar joints and may even migrate through sound mortar either through absorption over time or more rapidly if it is exposed to hydrostatic pressure. Given that the masonry units are 4 inch thick solid granite, it is unlikely that moisture migrated through sound masonry units (some units may be cracked but none were observed by WJE). Hydrostatic pressure can build up along the base of the wall during a heavy rainfall or when snow is melting at the base of the wall. We also noted infiltration when spraying at the top of the wall at the coping. The point of infiltration at these locations may have been the coping joints and the joints around the guardrail posts which protrude out of the top of the copings.

While the exact breach locations in the cladding could not be identified during this investigation as there could be numerous locations along the pull length of the assembly, the fact remains that a significant amount of water was observed to enter the drainage cavity and that there were limited provisions in the design of the cladding system which direct water away from the wall assembly at vulnerable locations, specifically the base of the wall and the copings.

Drainage Cavity

Our observations of the drainage cavity revealed that the relatively large portions of the cavity were filled with mortar droppings. Mortar Net, a product intended to facilitate drainage of the cavity by keeping the mortar from collecting at the bottom, was installed at the locations we probed. However, there were still very large quantities of mortar within the cavity which block a large portion of the cavity and limit the ability of the cavity to drain.

We also observed small weep tubes spaced anywhere from 24-inches to 36-inches on center. These small weep tubes were approximately 3/8 inch diameter and they were installed above the fenestration and near the bottom of the wall at the lower plaza. The weeps near the bottom of the wall are shown on the design documents to be in the vicinity of metal flashing with a drip edge protruding out of the wall; however, there was no visible drip edge flashing at the lower portion of the wall and the presence of the flashing could not be confirmed during our investigation.

The combination of the mortar droppings and the limited quantity and size of the weep tubes is likely restricting drainage of the cavity. This will cause the water that breaches the cladding to collect inside the cavity and buildup hydrostatic pressure resulting in added potential for the water to breach the waterproofing.

Waterproofing

The waterproofing at this building consists of the following: Kemper membrane installed over the structural slab, Kemper installed over the CMU parapet wall, Grace Perm-A-Barrier at the perimeter of the fenestration, and metal flashing with sealant at the perimeter of the fenestration.

At the probe openings, the Kemper installed over the structural slab appeared to be sound. However, we did observe that the Kemper waterproofing installed over the parapet was delaminating at the tie-in locations with the previously installed Kemper. Also, the portions of the newer Kemper may not have been mixed thoroughly or mixed in the wrong proportion, since the membrane appeared to be hard and brittle at certain locations. While this may be problematic in the long term as the membrane may continue to delaminate, we did not observe any breaches at these locations other than the ones at Probe #2 which appeared to have been caused by the contractor during the probe removal process. The Kemper was also observed to delaminate from the Grace Perm-A-Barrier membrane in at least one of the probe locations. Our tests revealed that this condition is likely contributing to one of the leaks at the southeast corner of Storefront #1. With regard to the brittleness of the Kemper, this did not appear to contribute to the current leaks, but over time we would expect the membrane to crack and likely result in leaks. Furthermore, Kemper may not honor any material warranty claims in the future if the material was not mixed correctly or installed correctly.

The Grace Perm-A-Barrier was also observed to be separating from a metal flashing installed over the fenestration openings. Again, this condition may be contributing to the infiltration of water into the building as observed during one of our water tests in the vicinity of Probe #4 [Figure 88].

Other breaches in the waterproofing are caused by penetrations resulting from the installation of the stair and landing. Our observations at Probe #5 indicated that there did not appear to be any provision for sealing around the fastener penetrations which attached the support beams of the stair landing to the wall. At least one breach was observed in the membrane near a steel shim which appeared to be caused by the shim during installation.

Another waterproofing element in this wall assembly is metal flashing and sealant at the perimeter of the fenestrations. There were numerous separations and breaches observed in these elements at our probe locations. Typically, the perimeter sealant was either missing or poorly adhered at the junction between the metal flashing and the window frame. The metal flashing is also missing end dams which are required to prevent moisture from flowing off the ends of the flashing by directing moisture to the exterior at the ends of the lintel. Lastly, at the southeast corner of the Center Courtyard, there is a large void next to the window jamb. This void is currently filled with spray foam and there is no evidence of

any other flashing at this location. It does not appear that any provision for tying in waterproofing was made for this location.

Our investigation of the waterproofing at the foundation wall in the vicinity of the north stair could not be completed due the presence of groundwater at the probe location. However, our review of the construction progress photographs provided by LiRo revealed that there may not have been any provision made in the waterproofing for movement at the expansion joint. If the Kemper membrane was installed without any provision for differential movement between the two buildings, the membrane, which appears to span across the joint in LiRo's photograph, would likely separate over time and allow water to migrate into the building. Given that we were able to generate a leak by spraying along the base of the wall under the north door, and that the leak is reported to remain moist at most other times, a breach may have already developed in the foundation waterproofing and is allowing the groundwater observed at Probe #1 to migrate into the building. Our probe investigation did not reveal any visible breaches directly under the north door, however, further excavation of the site was not within the scope of this investigation and we could not verify the condition at the expansion joint.

Our investigation of the leaks at the south stair could not be reproduced. According to LiRo, the north and south stairs are cast-in-place concrete which is formed over loose laid rigid insulation. This forms a large reservoir under the stairs which may fill with water. Staining at the south stair remained unchanged during our investigation. Given that the leak patterns have remained unchanged following several days of water testing but not following significant precipitation events, it is possible that moisture migrates into the space under the stairs from the east jamb of Storefront #1 where there is no waterproofing provided. This location was not water tested because it was modified by the removal of the metal panels prior to the start of our investigation and we did not want to induce unrealistic precipitation scenarios.

Storefront Fenestration

During our investigation, we observed water exfiltration at the exterior joint between the glass and the aluminum framing. This occurred while we were water testing the window head with the window masked off with plastic sheeting. This indicates that the water observed during the test breached the waterproofing above the window and potentially the thermal break in the window frame. We also observed exfiltration of water at the interior aluminum framing components. Once again, this indicates that water is somehow getting into the window frame. In both cases, water is also likely traveling inside the window jambs, which are hollow aluminum tubes, and contributes to the leaks observed at the sills [Figure 88].

Our review of the construction drawings also revealed that the foundation waterproofing is shown to terminate on the outside face of the wall at the fenestration openings and there is not sill pan flashing shown. The combination of lack of sill pans and omission of waterproofing at the return surfaces of the openings means that any moisture which breaches the storefronts or door thresholds can migrate to the interior. This would not only contribute to leaks at the window sills, but also the leaks observed at the north and south stairs.

RECOMMENDATIONS

Given our observations and understanding of the current conditions at this building, we recommend that repairs be completed to the exterior cladding as well as the waterproofing so that as much water as possible is kept out of the building on the outermost portion of the wall assembly, the cladding, and the waterproofing is in place to serve as a backup system.

Cladding Repairs

At the cladding, we recommend installation of flashing at the base of the parapets at the upper plaza and flashing under the coping stones. We recommend metal flashing that can be soldered and formed to fit around the various configurations and profile changes in the backup wall. Because this flashing will be exposed to the exterior, metal flashing will also be more resistant to damage by the public than a membrane system. The design of this flashing system should also consider thermal movement and allow the metal to expand and contract with properly designed expansion joints.

The cladding at the base of the wall at the lower plaza should also be removed and proper metal flashing which includes a drip edge should be installed as shown on the construction documents. Furthermore, we recommend that larger weeps spaced closer together be installed at all locations where masonry is terminated on a horizontal flashing. This includes the base of the wall at the lower and upper plazas, when the new metal flashing is installed, and above fenestration.

Waterproofing around Storefront Perimeters

We also recommend that the cladding in the vicinity of the fenestration be removed and the waterproofing replaced. This includes the replacement of the metal flashing at the head and jambs with a new configuration which would allow for the proper installation of perimeter sealant and also capture and direct moisture away from the interior. It is also unclear if there is any sill pan flashing at the bottom of the windows as none were observed by WJE. Sill pan flashings with end dams soldered watertight provide additional protection if moisture infiltrates the perimeter of the window opening. Due to the configuration of the pan which includes three vertical sides and a continuous bottom, a retrofit installation of this flashing typically requires removal and reinstallation of the entire window. We understand that this is a very intrusive repair option; however, the installation of this sill flashing will provide an extra layer of protection that will collect water and direct it to the exterior. This is especially important at these locations, since the glazing stops of this storefront system are installed on the exterior and the large gaps between horizontal and vertical stops allow water to migrate to the return surfaces of the openings. The current configuration shown in the construction documents show that there does not appear to be any waterproofing at the return surfaces of the opening however, this could not be verified by WJE under the current scope of the investigation.

Given that water was observed to enter the building underneath doors from overspray during our tests, we recommend that door sweeps be installed on all the doors. Door sweeps are shown on the construction documents and the contractor should review which type of sweep is specified with the architect of record and install them in accordance with the manufacturer's recommendations and the architect's specifications.

Once the repairs to the waterproofing system at the fenestration perimeters are completed, we recommend that inspections and water testing be completed to ensure that these locations are watertight before the granite and metal panel cladding that was removed by others prior to our involvement is reinstalled.

Expansion Joint/Foundation Wall

With regard to the waterproofing at the expansion joint, we recommend that the joint at the lower plaza be exposed so that a proper inspection of the waterproofing can be completed prior to the development of the repair details. We recommend starting the inspection at the upper portion of the foundation wall before the entire area is excavated since a closer inspection of the expansion joint may reveal conditions which we could not identify during our investigation. Depending on the findings of this inspection, a long term

repair may need to be developed for implementation along the entire joint since the buildings will continue to move differentially and new leaks may continue to develop and intensify as the slabs move.

Finally, at the south stair we recommend that the repairs noted for the cladding, waterproofing, and storefronts be implemented and the stains under the stairs monitored during and immediately following precipitation events. If the leaks continue to remain active, a detailed inspection of the foundation waterproofing may be necessary. Once again, this would be very invasive and we recommend eliminating the other known areas of infiltration before the investigation of the foundation waterproofing is undertaken.

Please contact us should you have any questions.

Sincerely,

WJE ENGINEERS & ARCHITECTS, P.C.



Jessica Alzate
Project Associate



Matthew Haberling, R.A.
Associate Principal and Project Manager

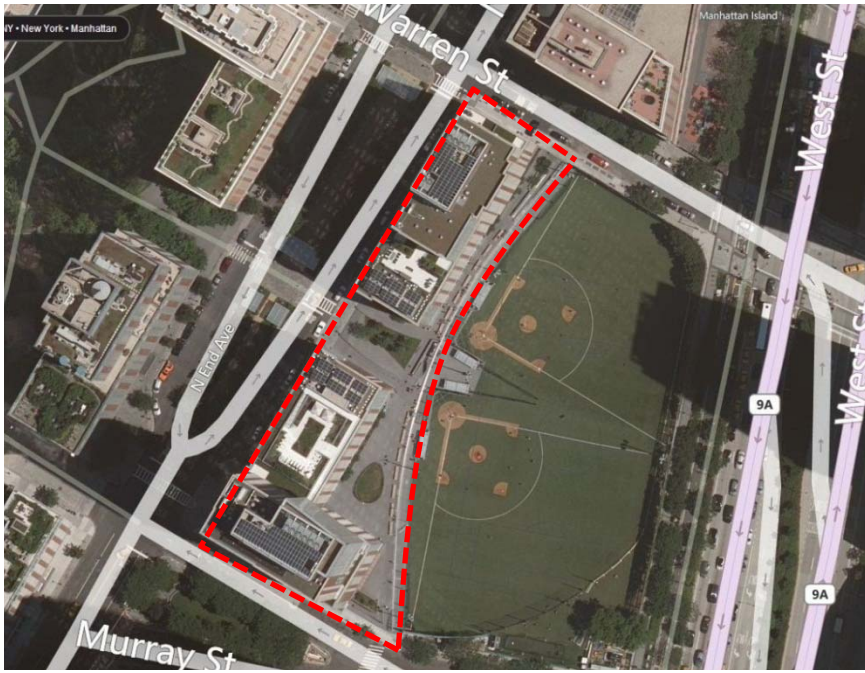


Figure 1. Aerial View of 212 North End Avenue (www.bing.com)



Figure 2. Overall view of subject location under investigation - Center Courtyard.



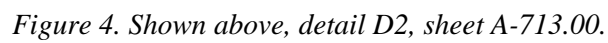
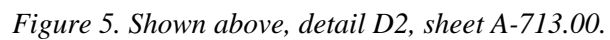


Figure 4. Shown above, detail D2, sheet A-713.00.



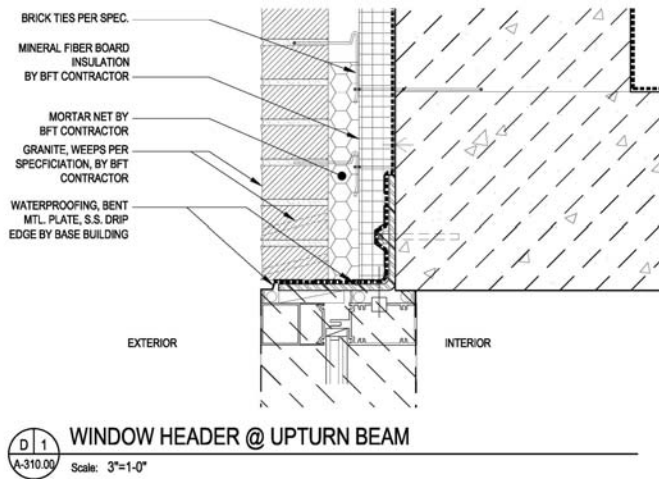


Figure 6. Shown above, detail D1, sheet A-310.00.

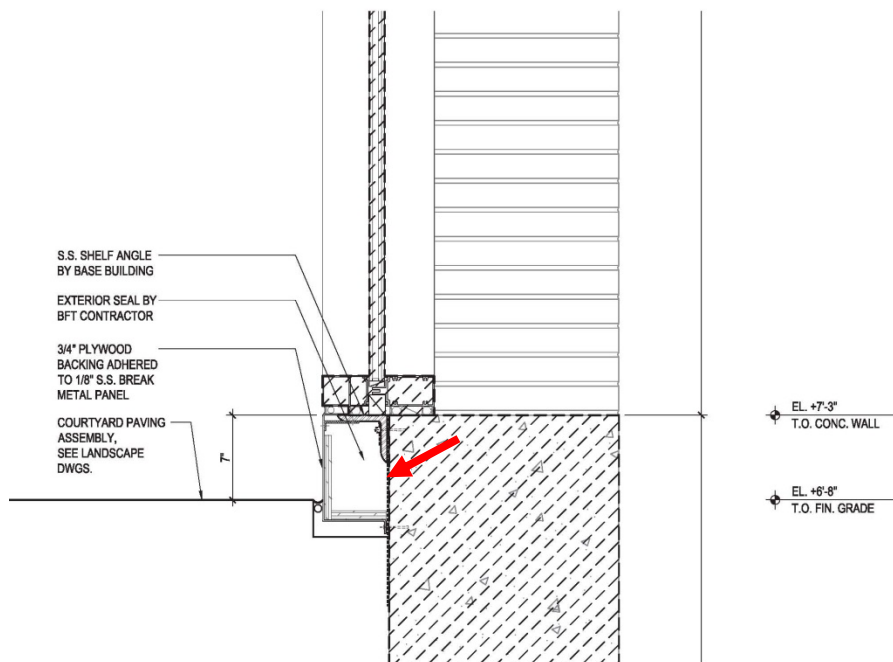


Figure 7. Detail D1, sheet A-713. Note waterproofing on the outside of the foundation wall shown to terminate at the outside face of the wall without extending into the return surface of the opening (arrow). Also note no presence of sill pan flashing.

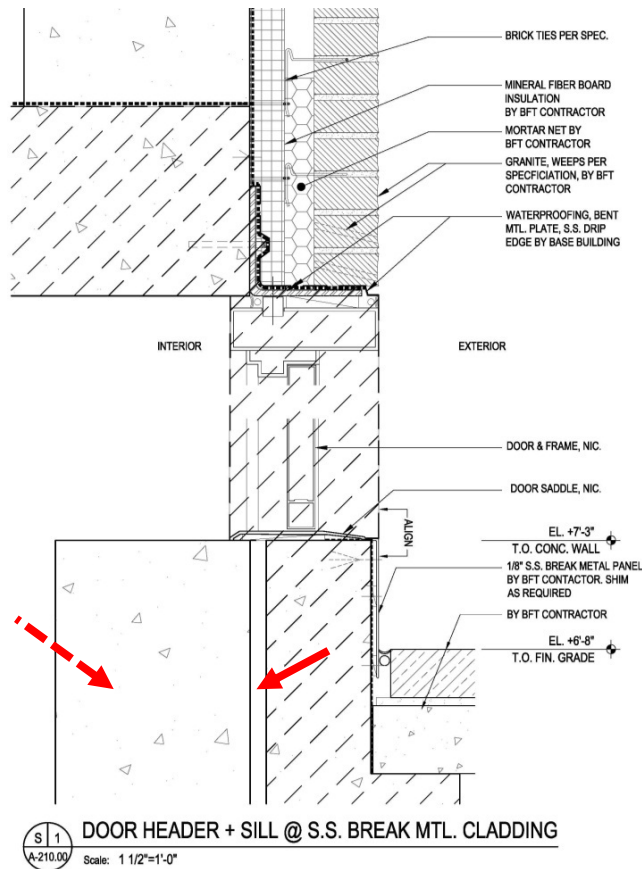


Figure 8. Shown above, detail S1, sheet A-210.00. Note expansion joint below door saddle (arrow). Foundation wall shown by dashed arrow.

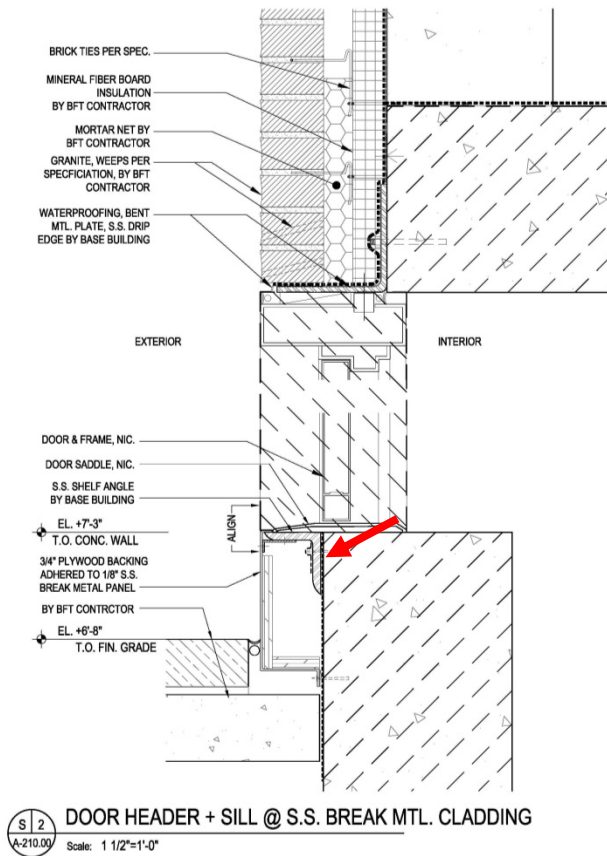


Figure 9. Shown above, detail S2, sheet A-210.00. Note waterproofing shown to terminate at the outside face without extending into the return of the opening.

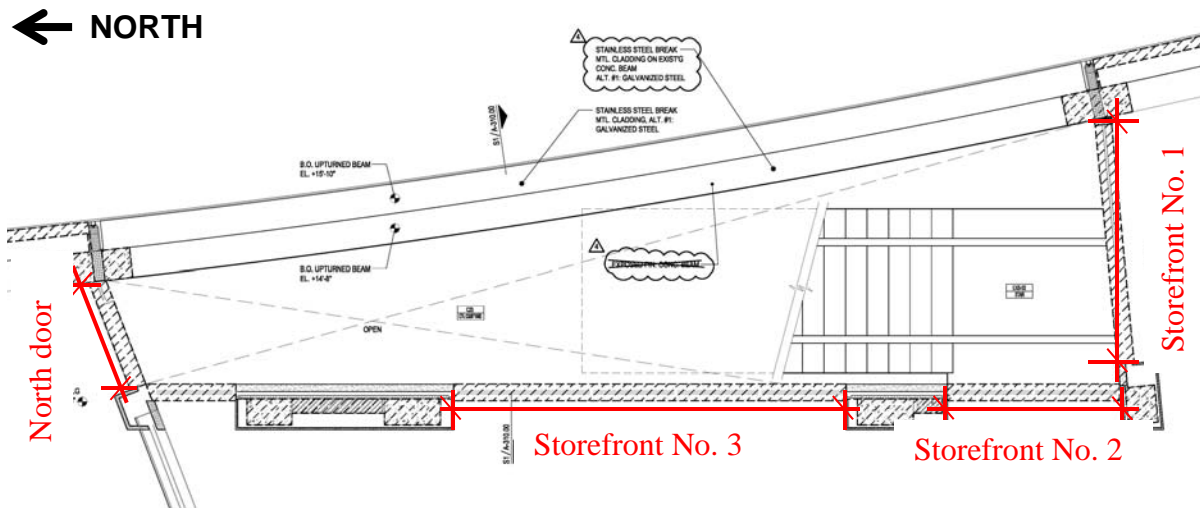


Figure 10. Water tested fenestrations located at the Center Courtyard.



Figure 11. North stair of Center Courtyard depicted above. Note staining at bottom of stair on each end (arrows).



Figure 12. Staining at slab-to-wall interface at the gym floor. South stair shown above.



Figure 13. Staining noted at the slab-to-wall interface at the north stair of the Center Courtyard.



Figure 14. Staining observed at localized areas of the knee wall.



Figure 15. Water staining noted below storefront window. Noted at three east facing storefront windows of Center Courtyard location (arrow).



Figure 16. Large gaps observed between the horizontal and vertical frame members.

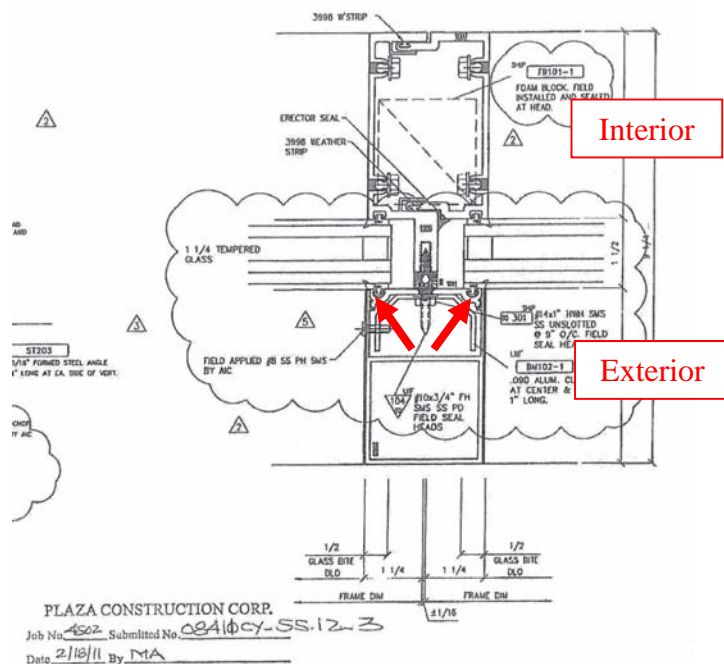


Figure 17. Shown above, detail P, sheet D-09 of window shop drawings.
Note glazing stops (arrows).



Figure 18. Water stains observed emanating from the storefront window framing joint at the window head and extending down the vertical mullion (arrow).



Figure 19. Note evidence of efflorescence leeching out of framing joints of storefront window (arrows).



Figure 20. Damages at existing plaster finish at ceiling. Note the use of spray foam insulation at window perimeter (arrows).

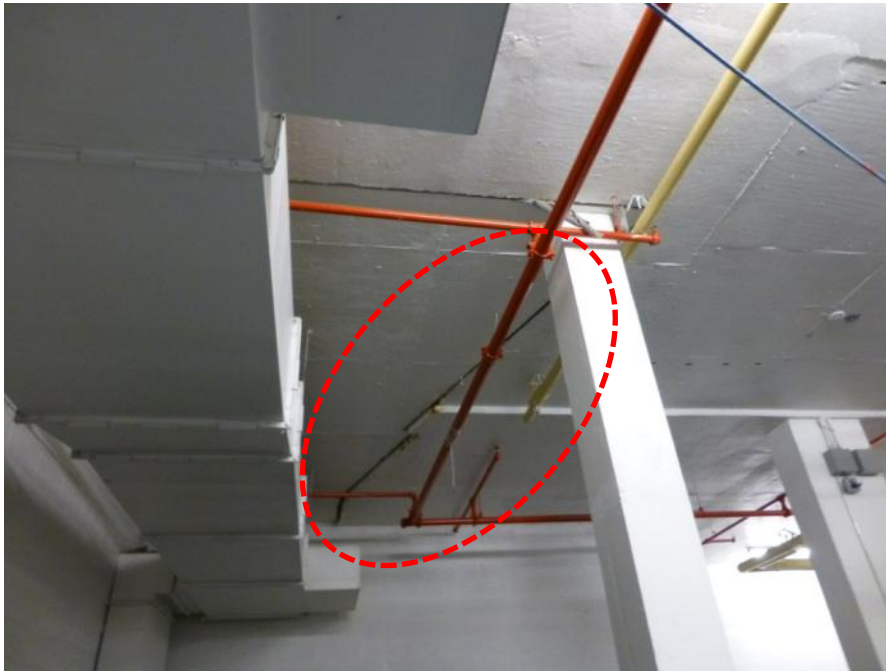


Figure 21. Expansion joint as viewed from parking garage below.



Figure 22. Note stalactite at pipes directly below expansion joint (arrow).



Figure 23. Note evidence of efflorescence at parapet walls, directly below coping stone above center parapet wall (arrows).



Figure 24. Shown above, Storefront No. 1. Note efflorescence at stair landing above and at window-wall location (arrows).

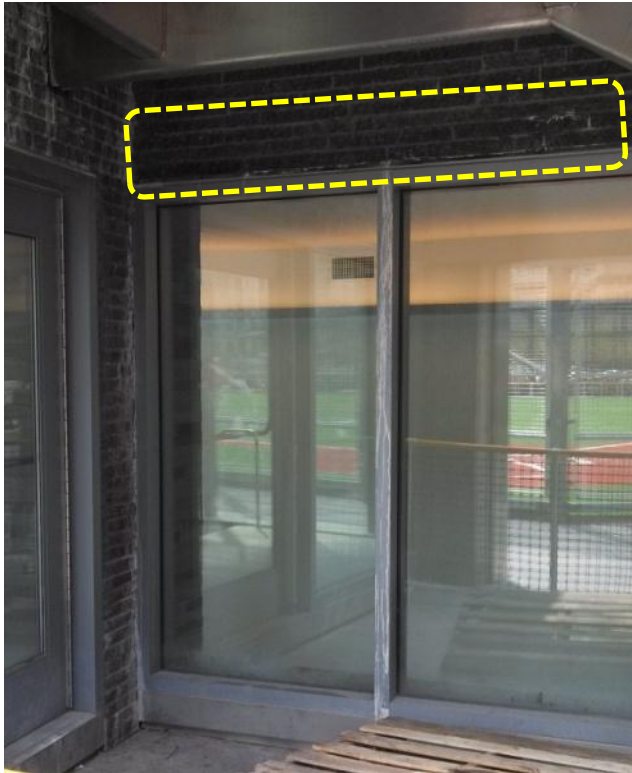


Figure 25. Storefront No. 2 (east facing) shown above. Note efflorescence above window.



Figure 26. Note significant efflorescence leeching out of weep hole above window head (arrow).



Figure 27. Staining (ferrous and efflorescence) observed at stainless steel armature of stair (arrows).



Figure 28. Note corrosion at electrical box (dashed arrow) and evidence of efflorescence (solid arrow).



Figure 29. Note missing metal panel at south column of Center Courtyard.



Figure 30. Spray foam insulation filling a large void was observed at the window jamb (arrows).



Figure 31. Photo provided by LiRo, dated 12/19/2011. Installation of stairway armature in progress. Note flashing membrane installed at wall (arrow).



Figure 32. No evident provision in the Kemper waterproofing for the expansion joint between the two buildings. Approximate location depicted by yellow dashed line (photo provided by LiRo dated 9/20/2011).

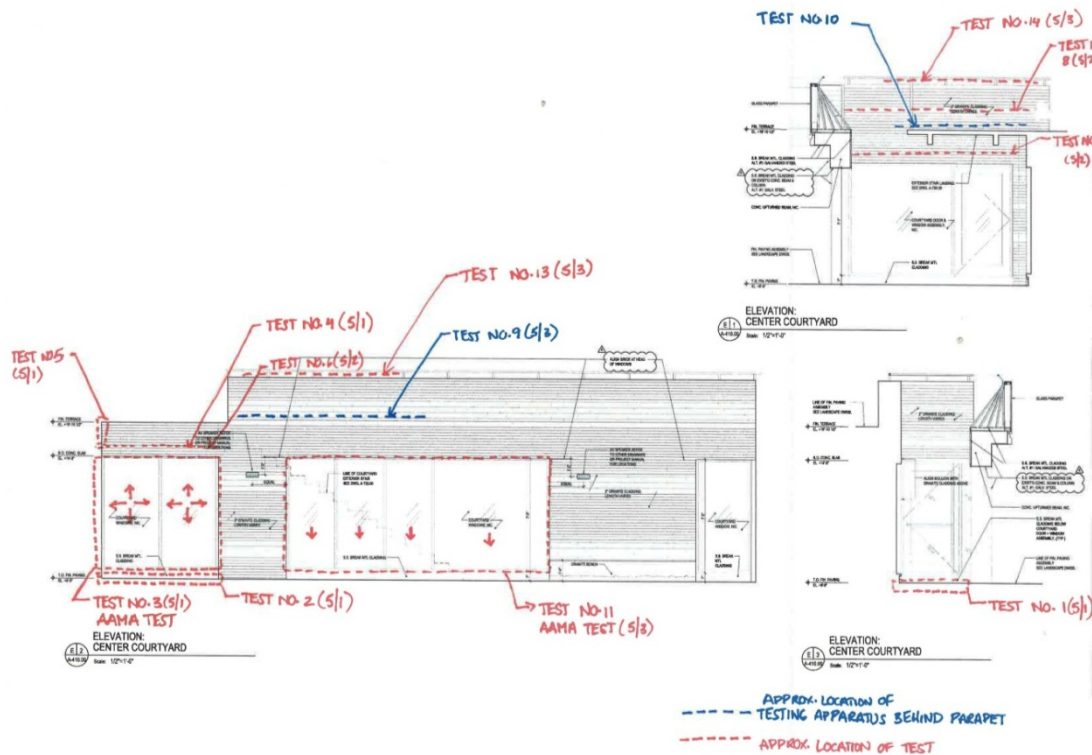


Figure 33. Locations of water tests performed.

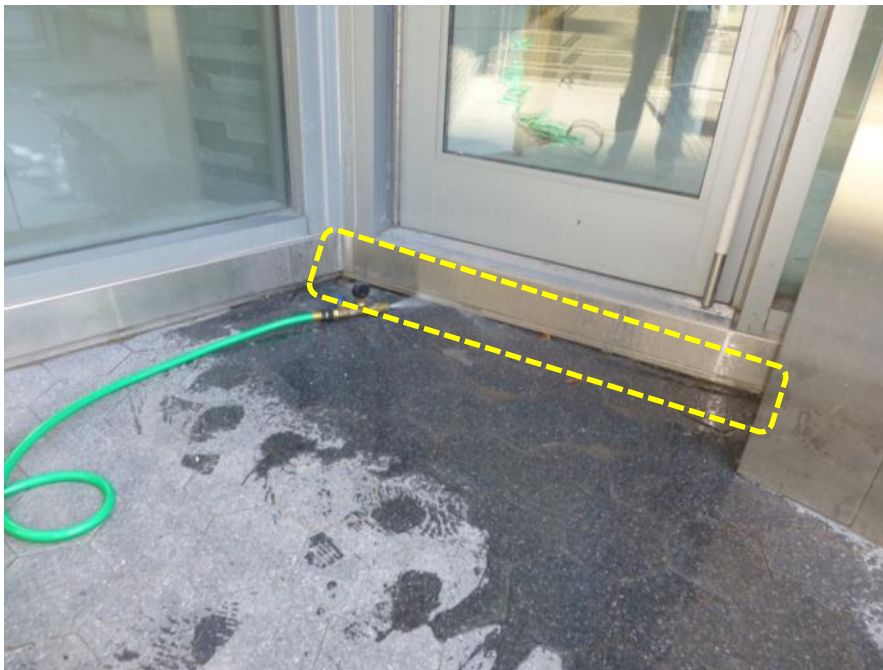


Figure 34. AAMA nozzle sprayed below north door threshold.



Figure 35. Leak detected at bottom of step within 30 minutes of running test apparatus (arrow).



Figure 36. Spray rack positioned below Storefront No.2.



Figure 37. Drain observed to be discharging water during Test No. 2. Testing in progress was located at opposite end of drain.



Figure 38. Leak detected at south corner of sill, while spraying at center mullion (arrow) during test no. 3.



Figure 39. Leak detected at sill, midpoint between south window jamb and center mullion while spraying at north jamb during test no. 3.



Figure 40. Water intrusion occurred through door threshold while running test no. 4.



Figure 41. Water intrusion continued to occur through the door threshold while running test no. 5.



Figure 42. Spray rack positioned approx. 6-inches above the window head of Storefront no. 2. Note plastic sheathing installed at fenestrations.



Figure 43. Leak detected at bottom of north column of Storefront No. 2.



Figure 44. Moisture at the bottom of south column adjacent to south door noted after 75 minutes of into test no. 6.



Figure 45. Leak at bottom of south column continued to grow during test no. 7.



Figure 46. Moisture observed at the center of window sill of Storefront no. 2 during test no. 7 (arrows).



Figure 47. Moisture observed at the corner of window sill of Storefront no. 2 during test no. 7 (arrow).



Figure 48. Leak at bottom of south column adjacent to south door grew while running test no. 8 (arrow).



Figure 49. Directed spray rack behind center parapet for test. No. 9 (arrow).



Figure 50. After approximately 15 minutes of running test no. 9, moisture was noted at the mortar joints of the brick cladding (arrows) and perimeter of electrical box (dashed arrow).



Figure 51. After approximately 90 minutes of running test no. 9, moisture was noted at the sill of Storefront no. 2 (arrow).



Figure 52. Leak noted after approximately 180 minutes after running test no. 10. East corner of Storefront no. 1 shown above.



Figure 53. Note water emanating from glass-to-frame interface at approximately 140 minutes during test no. 10.



Figure 54. Note water exfiltrating via window-wall sealant joint during test no. 10.



Figure 55. Moisture noted at jamb of Storefront no. 3 after approximately 18 minutes of running test no. 11 (arrow).



Figure 56. Note spray rack positioned over parapet during test no. 12 (arrow)



Figure 57. Moisture noted during test no. 13 at north column of Storefront no. 2 (arrow).



Figure 58. Leak at east of bottom corner of Storefront no. 1 continued to grow during test (arrow).



Figure 59. Ran hose at probe opening no. 1 with the intent to re-create leak at interior.



Figure 60. Note water running down aluminum frame (arrow).

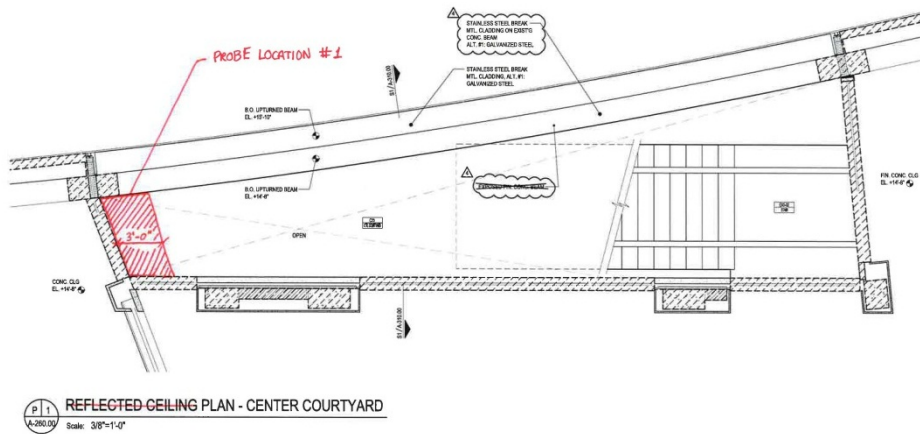


Figure 61. Probe location #1 at Lower Plaza Level.

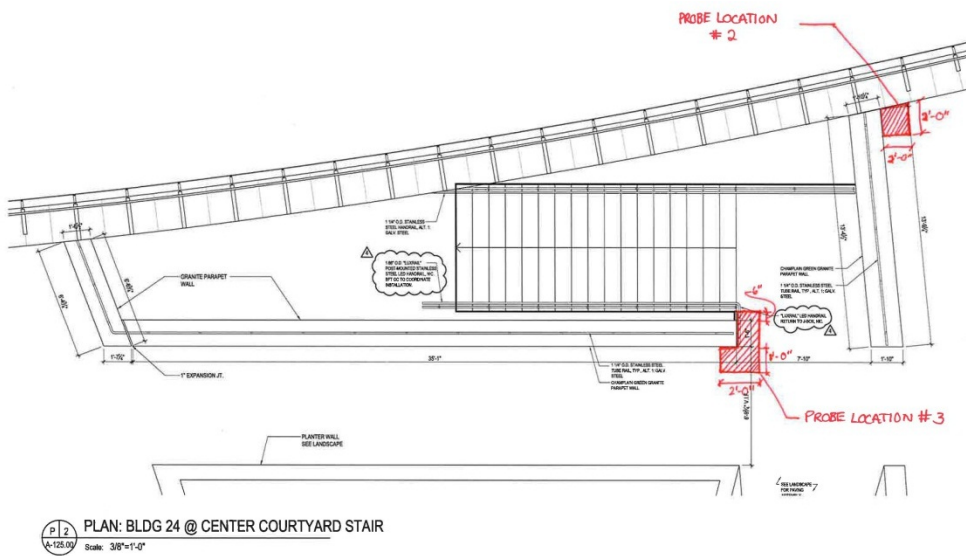


Figure 62. Probe location #2 & #3 at Upper Plaza Level.

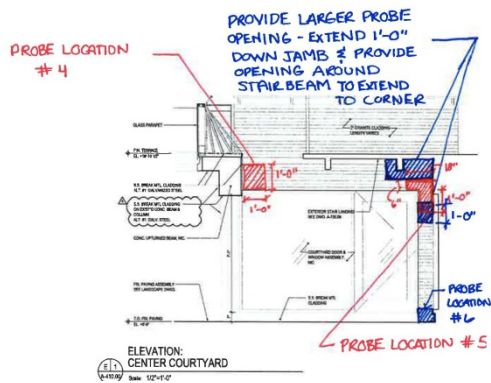


Figure 63. Probe location #4, #5, and #6 at exterior wall assembly.



Figure 64. Probe #1 was taken at north door threshold (5/13/2013).



Figure 65. Further concrete topping slab removed to reveal the joint (arrow).



Figure 66. Standing water as observed on May 14, 2013.



Figure 67. Standing water as observed on June 4, 2013.

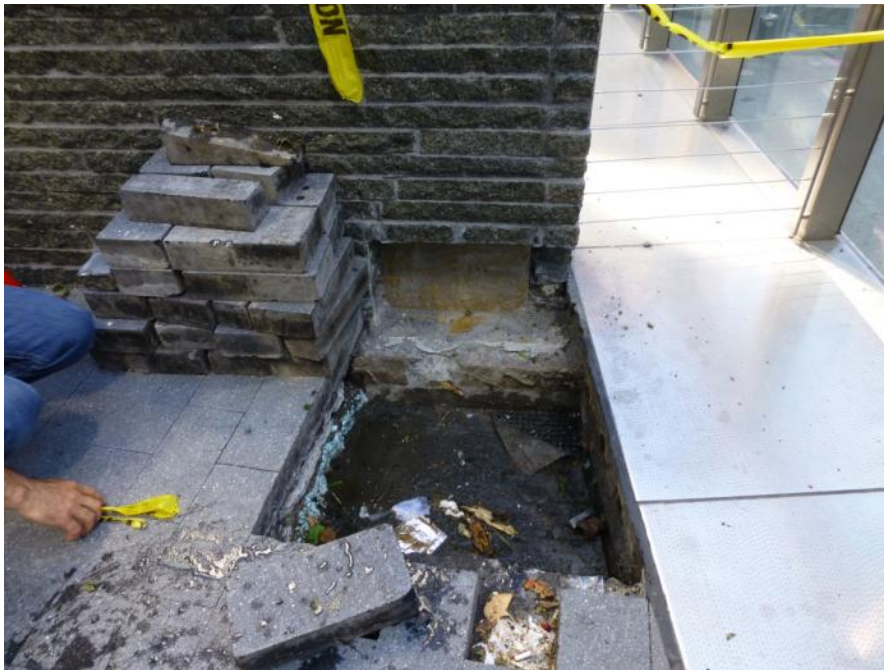


Figure 68. Probe #2 taken at Upper Plaza south parapet level adjacent to metal panel.



Figure 69. Kemper installed at CMU block wall was observed to be brittle and delaminating from the substrate (solid arrow). It also contained voids (dashed arrow).



Figure 70. Slurry coat noted to not be bonded to base Kemper installation (arrow).



Figure 71. Location of Probe #3 at center parapet.



Figure 72. Slurry wall observed at probe location noted to be delaminated from the base Kemper installation.



Figure 73. Corrosion noted at angle at stairway intersection (arrow).



Figure 74. View of inside of cavity wall with stair landing directly above. Note corrosion at fastener (arrow).



Figure 75. Probe #4 taken at window head condition and at window-wall condition above.



Figure 76. Hole noted in the Grace Perma Barrier membrane (arrow). It appeared that the void at the location was also at the lintel.



Figure 77. Delaminated Kemper membrane at tie-in location (arrow).



Figure 78. Moisture noted underneath the Kemper.



Figure 79. Largely filled membrane with mortar droppings.



Figure 80. Probe opening adjacent to south door.



Figure 81. Corroded shims and fasteners at stair beam / wall intersection (solid arrow) and breach in the waterproofing at a shim (dashed arrow).



Figure 82. Metal panel spanning the length of the door observed at this probe location.



Figure 83. Openings noted in the flashing membrane that exhibited moisture underneath.



Figure 84. The metal flashing above the south door at probe location #5 did not have any end dams (arrow).



Figure 85. Probe #6 adjacent to south door.



Figure 86. Perm-A-Barrier noted to be delaminated at door jamb and base of wall at Probe #6 location (solid red arrows). Note corrosion at angle (yellow dashed arrow)



Figure 87. Note spray foam insulation behind metal panel.

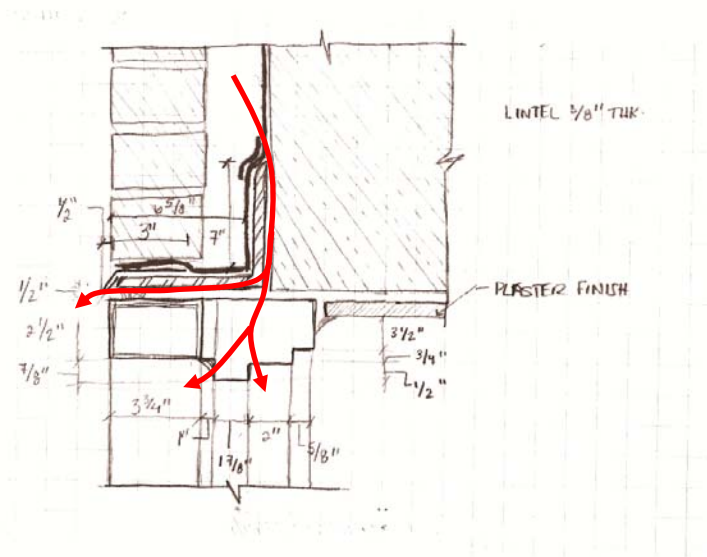


Figure 88. Section through door head showing potential path of water leakage. Directly above, south parapet wall of Center Courtyard