Field Test Report

ASTM E 2128 Water Leakage Investigation

Eudora Welty Library
300 North State Street
Jackson, MS 39201

Client: Patty Furr
Jackson Hinds Library System

Testing Date
18 - 20 Aug 2015

13 Sept 2015

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1.0 Testing Summary and Recommendations

1.1 Testing Summary

Building Leakage Investigation & Testing (BLI&T) was contracted by Jackson Hinds Library System Executive Director Patty Furr to conduct a series of water spray and flood tests to determine the cause(s) of water leakage from the first floor meeting room's ceiling cavity and the five areas on the second floor ceiling cavity.

BLI&T arrived 18 Aug 2015at 8:00 AM and met Laurn with building maintenance to begin a preliminary inspection of all identified leakage areas in the building and determine their status. This inspection revealed that none of them were actively leaking since it had not rained in the previous weeks. During the preliminary inspection of this building conducted on 19 Jun 2015, there were six water leakage areas identified; some of which were actively leaking. After this inspection today, thirteen leakage areas were identified. All of these leakage areas are identified in a roof plan located in section 2 of this report.

All together, twelve areas were spray and/or flood tested and three inspections were conducted. All of these areas are identified in the table of contents and on a roof plan view drawing located in section three of this report.

The overall results of this series of water tests revealed a number of facts. First, the two rooftop HVAC units (RTU-1 and RTU-2) closest to the penthouse that were flood and spray tested did not leak. These tests were seen in test areas 1, 2, 3, and 4. This means that the leakage seen underneath them during the preliminary inspection was from water pooling and migrating underneath the roof membrane from other source(s).

Second, none of the retrofit roof drains flood tested leaked between the drain flange and the TPO roof membrane. However, water did leak between the newly installed retrofit drain gasket and the drain pipe at the end of the flood test when the water flowed through the drain. This leakage was seen from the roof drain closest to roof top unit number one (RTU-1) and the first floor meeting room roof drain in test areas 1 and 14. When the retrofit drain nearest to RTU-1 was removed, it revealed that the its compression gasket had not been tightened during installation which allowed water to bypass it and pool on the structural concrete underneath the roof membrane. One of the installers stated that they did not tighten the screws that compress this gasket on the retrofit drains. Water bypassing this gasket caused it to leak through penetrations in the structural concrete underneath RTU-1 within four minutes of removing the pneumatic test plug from this drain.

Third, water leakage did occur through voids in the sealant between the top edge of the TPO roof membrane and the structural brick wall along the parapet walls, the field of the brick walls, underneath the penthouse steel door frame, underneath windows, and underneath brackets installed along the side of the precast parapet caps. Securing the top edge of a roof membrane with a termination bar and sealant along is not adequate. In a structural brick wall such as this, it should have a roof flashing sealed into a reglet cut into the brick mortar joint and a counter

flashing installed into this roof flashing's hem that also laps over the top of the TPO roof membrane to protect it from direct exposure to rain. Water leakage from this condition were seen in test areas 5, 6, 8, 10, & 14.

Fourth, water is leaking through cracks and deteriorated mortar joints in the structural brick walls. Once water penetrates the structural brick wall, it bypasses the TPO roof membrane and pools on the structural concrete roof where it leaks inside at penetrations through it and cracks or cold joints in it. This was another source that caused water leakage through cold joints in the concrete ceiling by the cargo elevator and below RTU-1. Also, water wicked completely through the structural brick wall and wet its interior side thereby causing the white interior formations (efflorescence) on the brick. All of these conditions were seen in test areas 5, 6, and 10 while spray testing the exterior structural brick walls outside of the penthouse and the operator's office.

Fifth, water is leaking through deteriorated mortar joints, sealant voids, cracks, and improper terminations in the precast parapet caps. Depending upon where these joints have failed determines whether the water leaks into the core of the brick and downward through it or leaks behind the roof membrane onto the structural concrete roof. These areas as well as the improper termination of the TPO roof membrane described above were the sources of water leakage into the operator's office, the stairwell, and a new area of leakage below RTU-1 as seen in test area 10. Also, these areas were a source of water leakage by the cargo elevator and below RTU -1 as seen in test area 7.

Sixth, water is leaking inside the technology room in two locations between the floor drains and the steel sleeve installed into the concrete floor/ceiling slab. This leak is caused by a plumbing issue. The third leak into the technology room is being caused by the same conditions discussed in facts four and five above as well as many unsealed penetrations through this structural brick wall above this area that allow water to enter its core and bypass the TPO roof membrane. These penetrations allowing this leakage are the older steel windows with extremely deteriorated sealant, precast sills below the windows with extremely deteriorated sealant and/or mortar, pipe penetrations without sealant, and flat metal plates placed over old penetrations without sealant. These leaks were seen in test area 8.

Seventh, while spray testing the exterior brick wall in test area 10, severe water leakage occurred from the head of the storefront windows in Patty's office. Water leakage such as this only occurs when water runs down the brick core into their head or bypasses their exterior perimeter sealant at the head. This leak was not reported during the preliminary inspection or the pretest inspection. However, evidence seen on other windows points to this type of leakage as being a wide spread issue. This leakage may not have been reported since the part of the water leaking inside runs back into the window through joints in its sill and part of it runs into the wall cavity behind the drywall where it cannot be seen.

Eight, when the pneumatic test plugs were removed from the retrofit drains in test area 9, little to no water drained from the roof. The drain pipes appeared to be fully to partially clogged. Due to this slow rate of drainage, it took approximately twenty-five minutes for this water to drain from

this section of the roof. During this test, no signs of water leakage were found in the offices below.

After this series of testing, BLI&T inspected the perimeter of the parapet wall from the roof. This is inspection area 13 which is shown in section 16 of this report. This inspection revealed that all the issues described in facts 3 and 5 above were widespread along the parapet walls. In addition, there was a large amount of metal framing and equipment along the south parapet wall that was not properly supported to prevent damage to the TPO roof membrane and not properly secured to prevent being blown over and damaging the roof membrane or blowing off of the roof. Also, a nearby satellite dish was properly secured to a stanchion pole that had a TPO boot installed around its base. However, the TPO boot terminated against the upper part of the two piece stanchion pole which can cause water leakage below the roof membrane. The top of the hood next to this equipment where the cables ran through the roof was not secured which could allow it to blow off. Also, these open holes will allow water to leak through them.

Two other concerns were seen along the parapet walls. The first one was steel pipe penetrations through the roof membrane that did not appear to be a vent stack pipe. The top of these pipes were not capped off. Any pipe penetration other than a vent stack pipe should be capped. These pipes should be further investigation to determine their purpose. Second, the overflow scupper drains through the parapet wall appear to be to high above the surface of the roof. This is a structural concern for the concrete roof slab since it may not be able to support the weight of this much water. This should be determined by a structural engineer.

Lastly, the buildings's exterior walls were briefly inspected. This is inspection area 14 which is shown in section 17 of this report. This inspection revealed that the cracking along the exterior structural brick walls is widespread around the building. These cracks appear to be more concentrated at the corners of the building. Also, signs of efflorescence (white deposits) can be seen forming on the brick below or from these cracks. As stated earlier, efflorescence is caused by water repeatedly entering the structural brick wall and saturating its mortar. This type of saturation releases minerals such as salt and lime which are left being on the surface of the brick as the water leaks out of the brick at cracks or debonded joints as it drys. This is similar to how a stalactite forms over time in a cave. However, this process deteriorates the structural brick wall causing it mortar to fail and form more cracks which further accelerates this process.

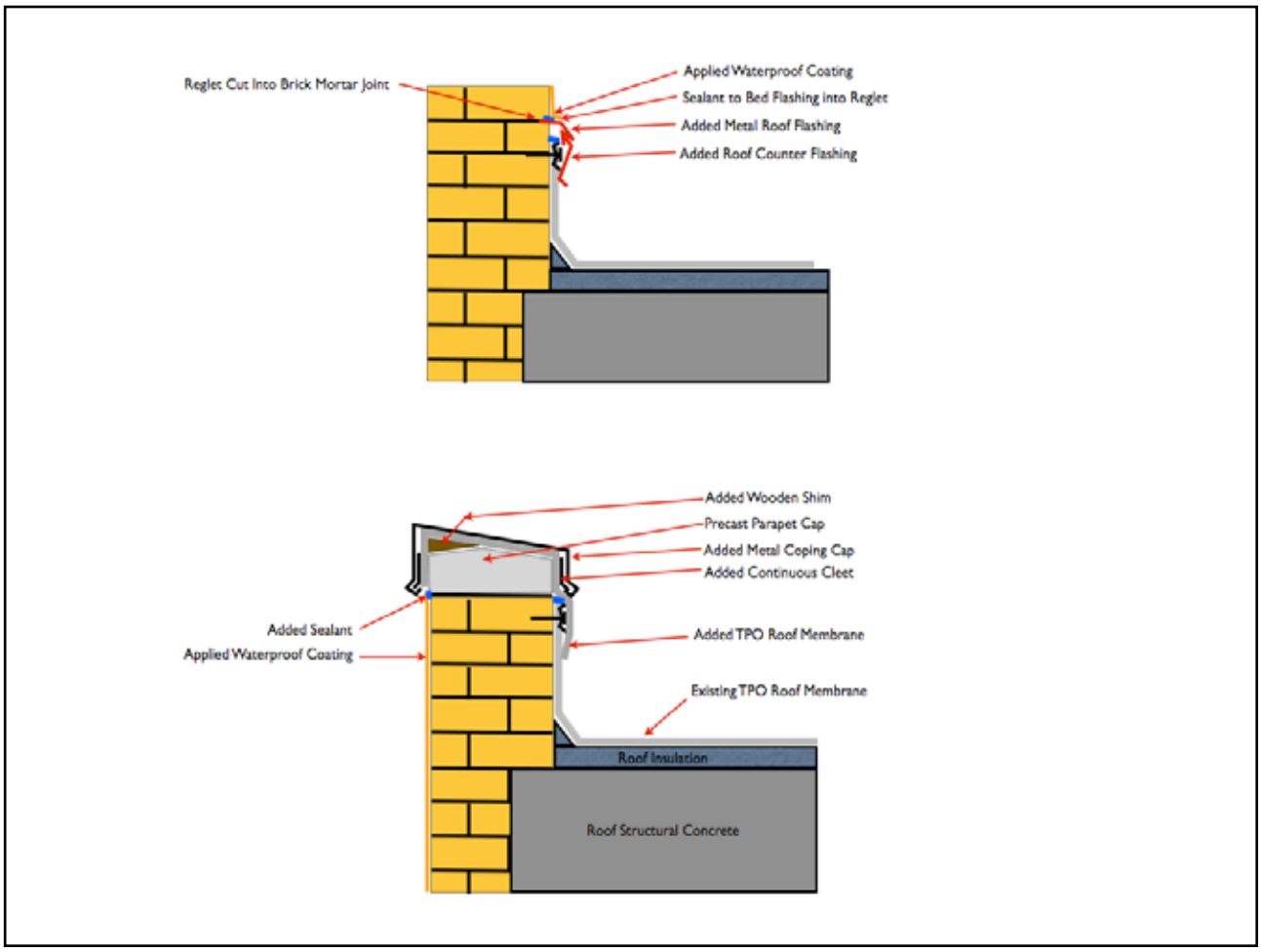
This report is organized into sections that are identified in the Table of Contents. Each of these sections will be discussed in detail. Photos and captions are used in each section to help the reader understand the written description.

1.2 Recommendations

- Ensure the seal between the retrofit drains and the drain pipes are tight to prevent water from leaking underneath the roof membrane and then into the building.
- Have a plumber determine the cause of the blockage in the drain pipes on the north elevation east roof.

- Have a plumber determine the cause of water leakage through the floor drains inside the penthouse above the technology room.
- At all parapet walls, extend the TPO roof membrane over the precast parapet cap and down onto its outer face. Terminate the lower outer edge of the TPO roof membrane with a continuous metal clip and install a metal coping cap over it with its top surface sloped toward the roof. Properly overlap and seal all metal coping cap joints. Do not seal the lower edges of the coping cap along the roof membrane and structural brick wall. Also, along the main roof's west and north sides, two brick walls turn a few feet onto the roof. These should be completely covered by the TPO roof membrane and capped out to the exterior side of the main parapet wall as described above. Additionally, the roof above the first floor meeting room will be more difficult to wrap the TPO roof membrane over the parapet was since it has a sawtooth shape with a precast parapet cap between the teeth and a continuously installed precast parapet cap over the top of its teeth. Likely, the area between the teeth will have to be filled and the TPO roof membrane wrapped completely over the continuous parapet cap as described above. This will change the look but will be the best and most economical choice from a waterproofing perspective.
- Add a metal roof flashing set in sealant along a reglet cut into the brick mortar just above the TPO roof membrane's termination bar on the structural brick walls. The lower side of this roof flashing should have a hem on its bottom edge for a roof counter flashing to set into. Then, the roof counter flashing should extend downward and completely lap over the top of the roof membrane. Together, they will prevent water from reaching the top of the TPO roof membrane.
- For the structural brick walls, there area two options.
  - Option 1: Clean all exterior brick walls in accordance with manufacturer's instructions. Repair the cracks and replace the deteriorated mortar on all exterior structural brick walls. Afterwards, coat the entire exterior with a clear siloxane type sealer with a higher perm rating (30 to 40 perms). Ensure that the type of sealant used to seal penetrations through the brick (door frames, window, pipes, roof flashing, etc...) will be compatible with the selected siloxane sealer. The sealants may have to be placed first depending upon compatibility with the siloxane.
  - Option 2: Clean all exterior brick walls in accordance with manufacturer's instructions. Remove the loose and deteriorated mortar on all exterior brick walls. Use a compatible sealant and/or brick repair material to fill all gaps and form a continuous substrate. Seal all penetrations through the brick (door frames, window, pipes, roof flashing, etc...). Apply a waterproof coating over all exterior brick walls. This coating will be applied to the building like paint but is actually a waterproof coating. This coating must be compatible with the applied sealant/brick repair material and all sealant applied to seal all penetrations through the brick. This coating must be applied over the sealants.
- Inspect all pipe penetrations through the roofs. Ensure all pipe penetrations are a plumbing vent stack or something required that does not allow water penetration below the roof membrane or into the building. Remove all that are not needed.
- Remove the framing and equipment not need on the south elevation of the main roof. For the equipment that is needed, make sure that it is installed on properly designed stanchion legs that have a TPO boot properly installed around its base to prevent water leakage.

- The upper section of the satellite dish's stanchion pole on the south elevation of the main roof should be removed to inspected its bottom pole to ensure that it is not open to the underside of the roof membrane. Also, the top section of the bottom pole should have a stop to limit the vertical movement of the upper pole. The TPO boot must seal against the lower stanchion pole where the upper stanchion pole cannot contact the TPO boot.
- A structural engineer should be hired to determine the correct height of all roof's over flow scupper to prevent structural damage and/or its failure.

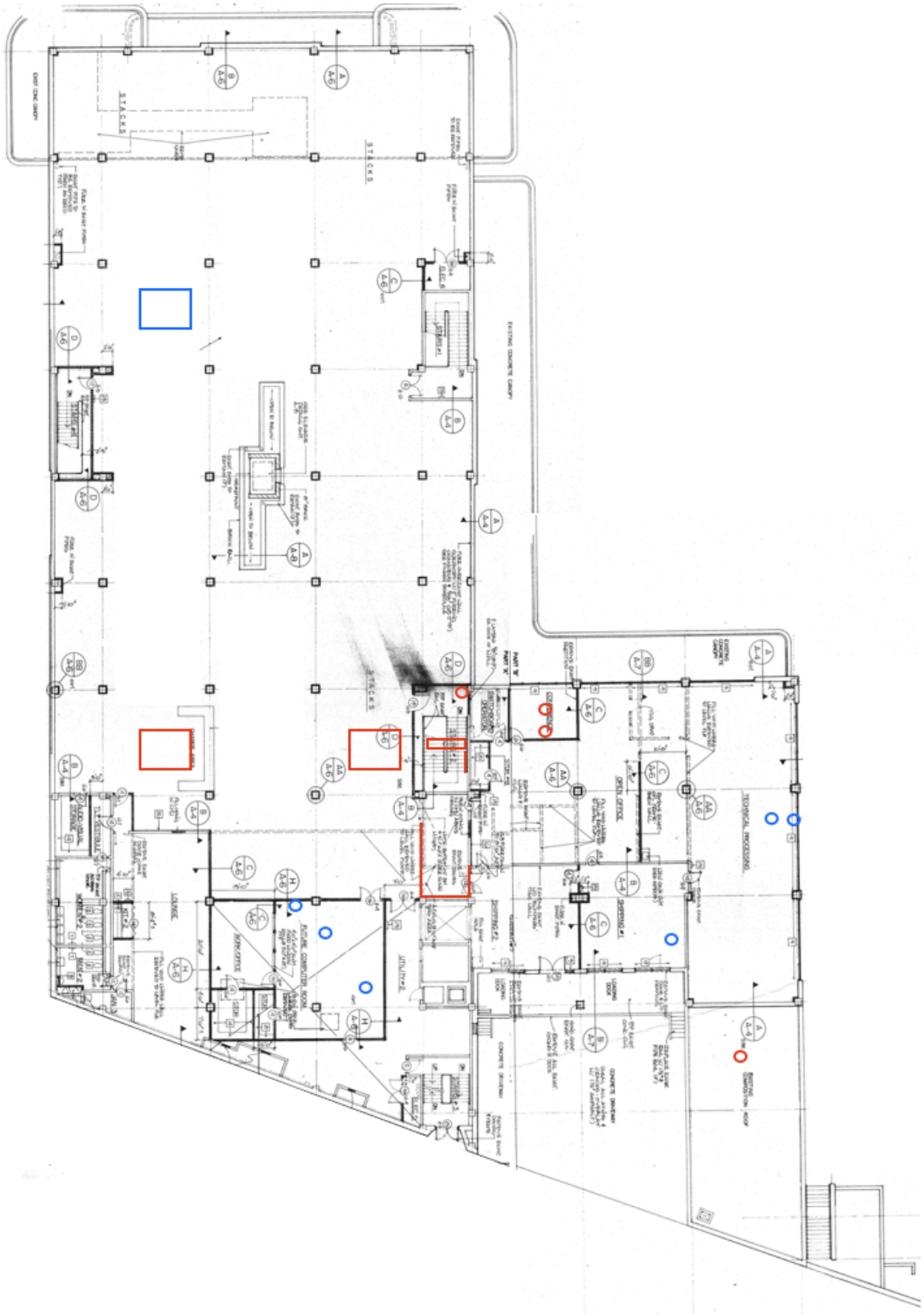


Building Leakage Investigation & Testing
Written by:

Jim Kirkland
President

2.0 Leakage Areas Identified

This second floor plan view drawing shows the areas identified as having water leakage from the concrete ceiling. The red shapes are areas where the water leakage was identified to BLI&T during the preliminary inspection conducted on 19 Jun 2015 and the blue areas are where water leakage was found and/or identified after arrival to conduct these water leakage tests.



3.0 Test and Inspection Areas Identified

The following roof plan view drawing shows the location and number of the areas tested and inspected during this water leakage investigation.