REPORT

Rain Water Intrusion Investigation

Presented to:

10/16/2010
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APPENDIX A: Scope of Work
1. INTRODUCTION

1.1 Terms of Reference and Scope of Services

We were retained by [Redacted] to undertake the investigation of the water leakages [Redacted].

The scope of our services was provided in our proposal letter dated August 24, 2010 and has been included in Appendix A for reference purposes. The scope was limited to the identification of the sources of water leaks in the area identified with the red color on the photograph of the south façade below.

The south façade with the area of investigation marked red.

1.2 Assessment Methods

The assessment field work was carried out on site on the following days:

- 8/24/2010 (review of documents and reconnaissance review),
- 9/23/2010 (review of documents and field review),
- 9/28/2010 (water testing on south façade),
- 9/29/2010 (leak observation during rain),
- 10/07/2010 (water testing of the north and east facades),
- and 10/14/2010 (re-testing after drying and masking).

The field work consisted of the document review in the storage room located on the 6th floor, and a visual review and water testing of the deficient areas and their vicinities.

- We were presented with telltale signs of leakage and the water damage in rooms adjacent to the areas marked with red color on the photograph of the south façade above: 928A, 928B, 830, 831, and 832.
- We also observed active leakage in room #928B and in the mechanical room on the 10th floor during rain.
- The exterior wall was visually reviewed from ground level with aid of binoculars.
- We performed a close-up visual investigation from a boatswain chair of the south exterior façade in front of the gridline #4.
- We accessed and inspected the tenth and eleventh floor roof and the coping of the south parapet wall above the intersection of gridlines #4 and F with the aid of extension ladder.
- We entered and investigated the wall cavity behind the external signage on the 10th floor.
- We measured and compared moisture contents in suspect areas in room #928B.
- We measured and compared surface temperatures of suspect areas in room #928B and the roof above.
- We water-tested the 8ft wide section of the façade east of gridline #4, starting from the sill of the 9th floor window and going up to the top horizontal joint of metal panels while monitoring the differential pressure across the building envelope, and observing the interiors for leakage. The interior soffit at the room #928B was partially demolished prior to the tests in order to facilitate the observation. The test was performed using a remotely-controlled, custom designed water spray rack, 8ft long, spraying water from six nozzles in a horizontal manner.
• We also water-tested the exterior wall areas facing the 9th floor roof, adjacent to the intersection of gridlines #4 and F. Once we replicated the leak, we masked the suspected areas and re-tested to identify the source of the leak. The test was performed using a regular ASTM E1105 water spray rack measuring 4ft x8ft.

Observations and tests were conducted by Karol Kazmierczak of Building Enclosure Consulting, LLC. We were accompanied by [redacted] and the maintenance staff of [redacted] during the initial walkthrough, and then granted full unaccompanied access.

1.3 Documents Reviewed
We had opportunity to review an architectural as-built drawing set produced by [redacted] and dated 2/1/1984, and a package of documentation of the recently undertaken façade repairs. No shop drawings of cladding and fenestration were found.

2. ASSESSMENT OF CURRENT CONDITIONS

2.1 General Information

The [redacted] Tower is located within a [redacted] complex under address [redacted] as identified by the Broward County tax appraiser’s office with tax ID [redacted].

The plan of the property copied from the Broward County tax appraiser’s webpage.
The Askew Tower is a ten storey structure of rectangular plan, built in 1987. The primary cladding is aluminum-faced, soft core composite panels. Fenestration consists of aluminum strip windows, storefronts, and a sloped glazing. The roofing is a low-sloped single ply modified bitumen membrane.

North facade – aerial view

South facade – aerial view
2.2 Exterior Walls

2.2.1 Assembly

The exterior wall assemblies as outlined in the architectural drawings and confirmed by our assessment work consist of:

- Aluminum cladding panels with a soft, insulative core.
- Air cavity
- Backing light-gauge steel wall framing
- Gypsum wall interior finish

The aluminum strip windows are 4’-6” high and glazed with a single ply of tempered glass with a pyrolytic reflective coating on its outer surface. The window consists of combination of fixed and operable panels. Fenestration is internally glazed by snap-in extruded aluminum bars. Both fixed and operable glazing panes are dry-gasketed. The typical section through the exterior wall at these location is presented below.
2.2.2 Relevant Observations and Findings

1. Rooms 928A, 928B, 830, 831, and 832: We observed whitish and yellowish stains on windows and adjacent surfaces. The absorptive mat, rolls, and carpet in #928B were observed to be wet in touch. Plastic buckets placed in front of the window were observed to be partially filled with water. Musty odor was identifiable in the air. We observed water dripping during rain from the window head and the concrete slab above.
2. During the water test, water was observed dripping from the sill of the fixed window in room #928B. The area is marked on the photograph below. The vertical glazing bar was observed missing. No other areas were observed leaking during the water test of the south wall. However, the room was found to be positively pressurized in range 0-3Pa in spite of the south wind; therefore, the water test results may not be representative of the actual conditions.
3. Water was observed collecting along the base of the east, external wall in the mechanical room on the 10th floor during rain. The areas are marked on the photographs below.

The mechanical room on the 10th floor - water puddles observed during rain on 09/29/2010.
4. Splices and corners of tracks and window framing and sashes were observed remediably sealed. The seals were observed to be generally in good condition. Glass panes were observed remediably sealed around perimeters. Additional weepholes were observed drilled in some starter tracks of metal panels located above window heads.

Head of the operable window in room #928B observed from the exterior on 09/28/2010.

5. Weepholes of window sill tracks were observed to be marked with dark stains, indicating they are in a good working order.

Sill of the operable window in room #928B observed from the exterior on 09/28/2010.
6. On our way down on the exterior facade, below the 8th floor, we noticed adhesive sealant failures at some vertical metal panel joints, which we believe are unrelated to the leaks observed on the 8th and 9th floor.

7. The casual observation of the areas adjacent to roof on the 9th floor turned out multiple moisture-related deficiencies, such as open holes in sealant joints, flashing constructed in violation of common industry standards, such as SMACNA (Sheet Metal and Air Conditioning Contractors’ National Association), (e.g., metal plate patchwork), and in violation of NRCA (National Roofing Contractors Association) standards, and microbial growth on the concrete beams. (Such a growth is an indication of high moisture content.) The base flashing measures only 4 inches, which represents half of the minimum 8 inches required by NRCA standards.

8. We sprayed the areas of the 10th floor roof and adjacent walls directly above the observed leakage in the room #928B with water and were able to replicate the leakage observed during rain when the spray rack was positioned against the NW corner of the roof, shown on the picture below. Similar, but less intensive leak was produced by the rack positioned against the north wall, in the same corner.
Water spray rack position which replicated the rain leakage on 10/07/2010.

9. The spray rack position described above also produced a leakage from the mechanical intake duct in the mechanical room behind the wall, pictured on the photo below.

Leak produced by the water test in the mechanical room on 10/07/2010.
10. After the assembly dried enough to repeat the test, we masked the base flashing and the starter track of the metal panels with a plastic sheet and duct tape in a manner pictured below. We repeated the water test and observed the interior of the room #928B. No leak was observed; therefore, we concluded that we have just identified the main source area of the leakage.
3. RECOMMENDATIONS

The following sections outline remedial work that is required to address the areas of defective construction and to repair the observed damage. Further assessment is also recommended to confirm specific items noted during the course of our assessment work.

3.1 Window

The following repairs are recommended to address the minor leakage observed at the strip window in room #928B.

We recommend that the window glass pane is sealed and the bottom drainage pan is formed by a sealant. In order to achieve that, glazing bars should be temporarily removed while the glass is temporarily secured against wind and gravity forces. Glass edges should be sealed in a continuous fashion to the adjacent aluminum framing upon preparation of the substrates adhering to the sealant manufacturer’s requirements (e.g., old sealant removal). We recommend Dow Corning 795 or a similar low-modulus silicone sealant. The drainage paths and weepholes should be cleaned and the glazing bars reinstalled, including the one which was observed missing and may need to be reproduced to match the other ones. The bottom glazing bar should be set in a continuous bead of a non-curing butyl sealant, including the end dams, in order to form a sill water stop.

3.2 Mechanical Intake Duct

The following repairs are recommended to address the leakage observed at the air intake.

We recommend that the beginning section of the intake duct is sealed and positively sloped to allow for exterior discharge. This operation would require that the air intake fan is temporarily switched off. The intake grille would need to be temporarily dismantled to allow for interior access, and the joinery of the duct sealed with low-modulus sealant, providing proper bond breaks, surface preparation, and other parameters of the seal joints per the manufacturer’s recommendations. The duct would need to be propped to the position that would allow water to drain out. This may require readjusting of the connections and a provision of an additional soffit hanger.

3.3 Roof Flashing

The following repairs are recommended to address the main leakage originating at the bottom flashing at the 10th floor roof.

Three alternative methods are proposed, differing in cost and effectiveness:
1) We recommend that the flashing is redesigned and installed in a way compliant with the common industry standards.

Metal panels would need to be cut horizontally 8” above the roofing surface and the bottom strip removed to allow for a sufficient space for the flashing underneath.

The started track would need to be relocated approximately 4 inches higher, with all splices and corners sealed watertight in a manner that would allow for the differential movement and drainage outward.

The affected structural connections of the metal panels and the bottom track should be engineered and produced to achieve the adequate support.

The roofing flashing and counterflashing should be engineered and installed underneath to provide the proper 8 inch tall assembly, including the elevated support curb with thermal insulation.

The joinery should be sealed to achieve water and air tight assembly, capable to allow free differential design movements.

Care should be taken to avoid disabling the weepholes and drainage of the bottom track of the metal panels.

The picture below shows a conceptual sketch of repair.
2) A less expensive and a less reliable method is a production of an aluminum face flashing cover in a manner replicating the current temporary duct tape fix.

Such a flashing would need to be continuously attached and sealed along its top but be open along its bottom edge to allow for the free drainage from the starter track above. A 1/8" thick aluminum plate brake bent to shape is recommended.

The picture below shows a conceptual sketch of repair.

![Conceptual Sketch of Repair](image)

3) The least expensive and reliable method is a repair of the current flashing to achieve a temporary watertightness.

It can be achieved by application of a preformed membrane, resistant to weather exposure, and sealed to the current flashing below the starter track.

We recommend the Dow Corning 123 silicone band or a similar low-modulus silicone preformed seal. This type of membrane seals well, is very UV durable, and allows for the differential movement, but sometimes fails as a result of wildlife attack (e.g., birds pecking), therefore bird deterrents may be a desired addition.

### 3.4 Further Assessment/Testing

Based on the outcome of our findings, no additional testing and assessment will be required to identify the sources of the leakage.

However, we recommend that the roof is checked for wet insulation. In the process of our investigation, we read temperatures of the roofing surfaces
measured with the pyrometer and found differences up to 10 degrees F; however, these differences were not confirmed with a thermal imaging camera on another day. We suspected that roof might have been compromised as a result of the leakage from its perimeter flashing. Since the results were inconclusive, we recommend that the roof is tested again at the lack of strong heat reflections, (which would require a night visit when the sky is overcast).

3.5 Summary

The diagnostic work has led through a process of gradual elimination to the eventual identification of the sources of the leaks experienced in the [Redacted] Tower. The alternative courses of repair outlined above and differing in the cost and durability are recommended to correct the observed issues.

This document has been prepared to assist you in finding the source of the leak at the [Redacted] Tower. The comments contained in this report are not to be viewed as being fully comprehensive in nature, but are representative of observed conditions. We have no other direct knowledge of (and offer no warranty regarding) any concealed conditions that may subsequently affect the performance of the various building structures, support and anchorage systems beyond what was revealed during our site visit.

We reserve the right to alter or amend our comments regarding these items if new circumstances associated with the condition of the project site or materials are brought to light by further investigations at a later date. If you have any questions regarding these observations or our general conclusions, please contact me at your earliest convenience at (786) 877-7108.

We thank you for your confidence in Building Enclosure Consulting LLC.

Karol Kazmierczak AIA,ASHRAE,CSI,CDT,LEED-AP, NCARB

Senior Building Science Architect
APPENDIX A:
Scope of Services
August 24, 2010

RE: Building enclosure forensic investigation for the [Redacted] Tower.

Dear Mr. W. Reid Morgan:

I am pleased to provide you with the proposal for the forensic investigation of leakage of the building enclosure for the [Redacted] Tower.

Background

The [Redacted] Tower is a ten storey structure clad with aluminum panels and aluminum framed glazing. It is my understanding that there is water damage on the walls and ceilings of the eight and ninth floor adjacent to the south exterior wall (marked with the red color on the attached photograph). I reviewed the areas of concern and familiarized myself with the general conditions on Tuesday 08/24/2010.

Base Scope of Services (Phase 1)

Background Document Review: I will review any available construction documentation, submittals, ASI’s, and RFI’s related to the failed assemblies, and current and past maintenance logs and documents, any past failure investigation reports. This review is necessary for me to become familiar with the complex building enclosure details prior to undertaking the fieldwork. This review will be performed in [Redacted] in Boca Raton, where the documents are stored.

Visual Observation: I will visit the site and visually examine the building enclosure, investigating the cause(s) of the water intrusion. This review will include the windows, metal cladding, parapet wall, and adjacent roofing. My review will be performed from the ground, from the interior, and exterior of the building, from the roof, and a bosun chair.

Testing and Opening: I would perform testing and exploratory openings following AAMA 501.2 “Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems” procedure (with exception of p. 4.5) which entails spraying the exterior of the enclosure with clean water while observing the interior for signs of leakage and subsequently masking the suspected areas for re-testing leading to the eventual identification of the source(s) of the leakage. This procedure may be modified to utilize a custom water spray rack covering a 5ft long section of a cladding joinery in a single pass. Prior to the testing I will temporarily seal all conspicuous deficiencies of the building enclosure identified during the visual observations.

Reporting: Following the visual review and testing, I will provide a written report documenting my observations and findings, including detailed analysis and possible solutions to the problem. Photographs of the chosen observations will be included in the report. Observed deviations from the construction documentation will also be reported. The report will also include suggested conceptual repair recommendations. If two or more alternative courses of reparations are found,
their description would be accompanied by comparison regarding expected estimated cost difference and longevity of alternative courses of reparations. I will provide two bound copies of the report and a PDF copy.

**Limitations**

This scope of work is intended to provide a specific assessment of the present conditions of the compromised area of the building enclosure as related to the weatherization function and repair recommendations only. Depending on the extent and nature of any problems that may be observed, additional forensic work may be recommended to aid in confirming the general extent of the problems and allow development of a scope of repairs.

Specifically excluded are: performing any repairs including the repair of the exploratory openings, the assistance in negotiating with an original builder, original architect, neighbors, and authorities having jurisdiction, fire and life safety issues, and assistance in litigation support.

These services would be provided under a separate proposal if required.

**Schedule**

I am prepared to begin the work within ten business days of receiving written authorization to proceed. We will follow with our report within five business days.

**Fees and Expenses**

My services will be provided on a fixed-fee basis.

1) The not-to-exceed fee for the base scope of services identified above is $12,360. This is calculated as 65 hours of the senior building science architect at $190 hourly rate, portal-to-portal, and includes petty expenses, and travel.

This proposal is open for acceptance for 30 days and is subject to the enclosed standard terms and conditions of the Building Enclosure Consulting Miami, LLC.

I look forward to completing this project. Please do not hesitate to contact me if you require additional information or if you have questions regarding this proposal.

Sincerely,

[Signature]

Karol Kazmierczak (Kaz), AIA, ASHRAE, CSI, CDT, LEED-AP, NCARB
Senior Building Science Specialist
Building Enclosure Consulting Miami, LLC

Encl. Proposal Acceptance Sheet