WJE | ENGINEERS ARCHITECTS MATERIALS SCIENTISTS

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Via E-mail: tgormley@pullman-services.com

October 23, 2018

Mr. Tom Gormley
Pullman SST, Inc.
2227 High Hill Road
Swedesboro, New Jersey 08085

Re: Pier 3 Condominium
Atrium Structural and Waterproofing Rehabilitation
WJE No. 2018.1838

Dear Mr. Gormley:

In accordance with contract documents dated June 15, 2018, Pullman SST, Inc. (Pullman) and Wiss, Janney, Elstner Associates, Inc. (WJE) have completed an investigation of the elevated plaza slab and structure within the central atrium at the Pier 3 Condominium. Our investigation included a visual survey, destructive probe openings, and a structural and fire protection analysis. This report presents the findings of our investigation and recommendations to repair the noted distress.

Background

The building at Pier 3 was originally constructed as a cargo pier in the 1920s, was converted into apartments in 1984, and was subsequently renovated and converted into condominiums in 1994. The building now consists of a parking garage at the lower level and approximately 170 residential units constructed on supported slabs above the parking garage. The building structure consists of steel framing supporting reinforced concrete slabs cast on metal form deck. The exterior facades are constructed of steel, brick masonry, and limestone and were reportedly restored when the building was converted to condominiums. The interior of the building contains an open-air atrium, which features exposed steel framing and a split-level concrete structural slab on metal form deck with a waterproofing layer and concrete topping slab. Atrium-facing facades of residential units appear to be clad in an exterior insulation and finish system (EIFS). The atrium slab is elevated above an at-grade, single floor parking garage. The garage floor is paved with asphalt.

The exposed atrium slab consists of two portions: a main center section containing pedestrian walkways, wood planters, benches, and octagonal openings to the parking garage below, and a raised outer portion containing a north and south breezeway, entrance hallways to condominium units, and some patio slabs adjacent to wood planter boxes. The center atrium is approximately two feet lower in elevation than the outer sections. Steel framing at the underside of the atrium slabs (above the at-grade parking garage) is concealed by a drop ceiling.

Both atrium sections consist of a 4-inch thick concrete structural slab on non-composite metal form deck, topped with a waterproofing membrane and 6-inch thick concrete topping slab. The structural slab is reinforced with wire mesh. The lower atrium slab is supported by steel beams, likely constructed in the 1980s. The lower atrium steel beams are supported by built-up riveted steel columns (likely dating to the

1920s) and 6.5-inch diameter tubular hangers which suspend the steel framing from 5-foot deep girders spanning north-south above the atrium. The lower atrium steel framing is covered with spray-on fireproofing.

The upper atrium steel framing consists of steel bar joists spanning east-west between north-south spanning steel beams that are supported by columns and tubular hangers. The steel beams and bar joists are not fireproofed, although a sprinkler system is reported to be present above the garage drop ceiling.

According to documentation provided by Pier 3 maintenance staff, in 2015 the top surfaces of the upper and lower atrium slabs were coated with Sika FlexCoat System, a waterproofing coating that is reported to be breathable.

During our initial visits to the property, WJE observed widespread deterioration and distress in the concrete topping slab of the atrium, as well as evidence of water leakage and related corrosion of the structural steel framing within the lower level parking garage. WJE and Pullman were asked to provide a proposal to investigate and provide recommended repairs to these areas.

Investigation

WJE visited the property several times during the summer of 2018 to make observations of the existing conditions at the building, lay out probe locations, observe probes in progress, and document structural member sizes and dimensions.

Notable conditions observed throughout the property are the following:

- Numerous areas of water leakage and steel corrosion were observed at the steel framing beneath the lower atrium slab. Water leakage was typically identified by stains on the drop ceiling, and was typically associated with debonded spray-on waterproofing and corrosion of steel framing. The most severe corrosion was observed at the easternmost garage/atrium column, where a persistent water leak has caused significant corrosion at the column and intersecting beams (Photos 1 and 2), including 100% section loss at one beam web. Post shores had been installed beneath beams in this area prior to our investigation. According to documents provided by Pier 3 maintenance staff, repairs to these corroded elements had previously been designed by O&S Associates in December 2017, but the repairs have not been implemented.
- Visual observation of exposed portions of the structural steel below the upper atrium slab and condominium units did not reveal any areas of significant corrosion (Photo 3), though the steel was typically concealed by a drop ceiling, and not all areas were observed.
- Widespread deterioration of the lower atrium topping slab concrete and sealant joints was observed. Cracking, spalling, and scaling of concrete and debonding of sealant were observed throughout the lower atrium (Photo 4). These conditions were largely absent from the upper atrium slab, though localized areas of sealant failure and concrete deterioration at sealant joints was observed (Photo 5).
- Spalls, cracks, staining, and incipient spalls were observed at the walls of octagonal lightwell openings between the lower atrium and the parking garage (Photos 6 and 7). Numerous prior patch repairs have reported been implemented at these areas.
- The Sika FlexCoat waterproofing that exists at both the lower and upper atrium slabs appears to be in good condition and well-bonded to the topping slabs, despite the deterioration of the slab, primarily at the lower atrium level.
- Spray-on fireproofing is present at the steel framing (beams and form deck) beneath the lower atrium slab but is not present at the beams and bar joists beneath the upper atrium and condominium units.

Columns in the garage are encased in concrete masonry. The spray-on fireproofing is typically in good condition except in areas of water leaks and corrosion, where the fireproofing has detached from the beams.

Destructive Probes

As part of our investigation, a total of 14 destructive probe openings were made by Pullman at locations determined by WJE. The probe locations are shown on the plan drawing in Appendix A. The probes consisted of the following:

Probe Number	**Activity**
1	Disassemble wood planter wall at Unit 235 (Photo 8)
1a	Topping slab removal at drain (Photo 9)
2	Disassemble wood planter and deck at Unit 236 (Photos 10 and 11)
3	Concrete removal at east lightwell wall and beam spalls (Photo 12)
4	Concrete removal at west lightwell wall spall (Photo 13)
5	Full-depth concrete slab removal at column penetration (Photo 14)
6	Full-depth concrete slab removal at column penetration (Photo 15)
7	Full-depth concrete slab removal at column penetration (Photo 16)
8	Partial-depth/topping slab removal (Photo 17)
9	Partial-depth/topping slab removal (Photo 18)
10	Full-depth core (to top of metal deck) (Photo 19)
11	Full-depth core (to top of metal deck) (Photo 20)
12	Full-depth core (to top of metal deck) (Photo 21)
13	Full-depth core (to top of metal deck) (Photo 22)
14	Disassemble wood planter wall at Unit 215 (Photo 23)

Based on the probes performed by Pullman, WJE was able to make the following additional observations regarding the condition of the atrium slabs and structure:

- The waterproofing membrane beneath the lower atrium slab is in poor condition and is poorly bonded to the structural slab. At octagonal lightwell openings, the membrane terminates inside the lightwell walls, with no means of drainage (Photo 24).
- The membrane appears to be both thicker and better-bonded to the substrate at the upper atrium slab and may be of a different vintage than the lower slab. Based on our observations, the vast majority of locations at signs of leakage were observed in the garage are at the lower atrium slab.
- Steel section loss was measured where corrosion was observed at steel framing, including columns, tubular hangers, and beams (Photo 25). Columns and hangers were typically found to be corroded where they pass through the topping and structural slabs, though section loss was found to be minimal. The greatest severity of section loss measured at a column was 28% at a column flange, and 11% at a column web. At a tubular hanger, the maximum measured section loss was 22%, located at a lightwell wall within the topping slab. Section loss at corroded areas of steel beams was found to vary widely, from 100% at a beam web in the highly-corroded area at the east end of the atrium/parking garage, to less than 5% at lightly-corroded members. The vast majority of steel framing below the lower atrium slab was observed to be uncorroded, with corrosion appearing to be localized and limited to areas of active or prior water leaks.

- Though the membrane at the lower atrium slab is properly flashed into the floor drains, there is no drainage mat above the membrane to allow water trapped at the membrane level to move to the drains. Probes revealed that membrane-level weep holes in the drain body were clogged with concrete, and concrete removed near the drains was wet, despite a lack of rain for several days prior to the probe openings. It is quite possible that this condition exists throughout the atrium lower level. Probes at the atrium level revealed deterioration of the topping slab just above the membrane, even in areas that did not appear to be deteriorated at the slab surface.
- A probe opening at the wood planter outside Unit 236 revealed significant decay of the planter framing (Photos 26 and 27), most likely caused by leaks within the planter bed. It is likely that some extent of decay is present at many if not all similar planter boxes.

Structural Evaluation

WJE performed a structural evaluation of three areas of steel framing beneath the lower atrium slab. The three areas included framing at a typical bay, a lightwell opening bay, and the east end bay (at the location of significant corrosion). WJE also performed hand calculations to check the load-carrying capacities of typical built-up steel columns and tubular hangers. In each case, we calculated the demand-to-capacity ratio (DCR)—the load imposed on a given member divided by its load-carrying capacity—in order to assess to what degree its capacity would be utilized under design loading conditions. A DCR of less than 1 indicates that the member has "reserve capacity" to support additional loads imposed beyond those assumed in evaluation. A DCR of greater than 1 indicates that the member is insufficient to resist the loads imposed. For example, a DCR of 0.60 indicates that when fully loaded, a member is at 60% of its capacity, and retains a 40% reserve capacity.

The results of our structural evaluation are presented in Appendix B. Complicating our results is the fact that the steel material grade(s) (upon which the members' load-carrying capacities are determined) are unknown for the framing elements that are believed to have been constructed in the 1980s. Structural steel commonly available at the time was typically either ASTM A36 (36-ksi yield strength) or ASTM A572 grade 50 (50-ksi yield strength). Therefore, we performed two iterations of our evaluation—one assuming that the existing structural steel has a yield strength of 36 ksi and the other assuming 50 ksi. The models shown in Appendix B show DCRs for each of the three bay types when analyzed assuming 36 ksi and 50 ksi steel. The results of our evaluation indicate that, assuming use of 36 ksi steel, the DCRs of many framing members would be near or above 1.0, indicating little to no reserve capacity remaining at those members.

Hand calculations performed on the columns and hangers show that they typically have significant reserve capacity; the columns typically have a DCR of 0.09 and the hangers are 0.16.

Discussion and Conclusions

Based on visual observations made at the property and based on findings from our structural evaluation, WJE has reached the following conclusions regarding the atrium slabs and supporting structure:

Atrium Slab and Waterproofing

Based on observations at destructive probe locations, the structural slab at both the upper and lower atrium levels appears to be in good condition. The majority of the observed slab distress is confined to the topping slab and waterproofing itself, which has debonded from the structural slab in multiple locations. Because no drainage mat exists above the membrane and because weep holes at drains are clogged, water that penetrates the topping slab cannot sufficiently drain; this has resulted in deterioration of the topping slab, likely primarily through freeze-thaw related distress. This deterioration is likely to continue until the topping slab and membrane are removed and replaced.

The upper atrium topping slab and membrane appears to be in better condition than the lower slab. Damage at the upper slab appears to be limited to debonding sealant at sealant joints, and some concrete spalling and scaling at joint edges. The Sika FlexCoat waterproofing system remains well-bonded. The upper atrium slab can likely be retained with localized repairs and replacement of sealant joints.

Structural Steel

The conditions of the structural steel supporting the lower atrium slab is highly variable. The majority of the structural steel was observed to be in good condition, though localized areas of significant corrosion are present. One such area is the previously-mentioned east column and surrounding framing that is heavily corroded. Based on our structural evaluation, some structural elements such as the columns and hangers were found to have significant reserve capacity, while others, such as some typical beams, were found to be either near or in exceedance of their load-carrying capacities. Based on our measurements of section loss at various members, the steel columns and hangers are likely not in need of repair, even where they are most heavily corroded. Conversely, repairs are likely necessary at several steel beams beneath the lower atrium slab in order to restore load-carrying capacity.

Because the material type and grade of the steel framing used to construct the atrium is not known, it would be prudent to obtain samples for mechanical testing of the steel to determine its grade and strength, prior to implementation of repairs. If it is determined that the steel is ASTM A572 Grade 50 instead of ASTM A36, the number of repairs required would likely be significantly reduced, as the calculated DCRs of the members would decrease (i.e. the reserve capacity would increase); this implies that the beams can accommodate more severe section loss.

Fireproofing

Fireproofing of the atrium slab structure consists of spray-on fireproofing at the beams and form deck below the lower atrium slab. The upper atrium slab structure is not fireproofed. It was reported to WJE that a fire suppression sprinkler system is located within the plenum space above the parking garage drop ceiling; however, we did not observe this system above the lower atrium slab or the upper slab in the locations where the drop ceiling was removed. It is possible that fiberglass batt insulation present below the upper slab obscured the sprinkler pipes.

Based on current building codes (meaning if the Pier 3 condominium were constructed today), it would be required that all structural steel above the parking garage be fireproofed, and that a sprinkler system be used. What is less clear is whether the upper atrium structure would have been required to be fireproofed in the 1980s. Based on brief code research performed by WJE, it is unlikely that repairs to the atrium slab, waterproofing, and/or structural steel would trigger a code requirement to upgrade the fireproofing at Pier 3; however, WJE and Pullman are of the strong opinion that spray-on fireproofing should be added to the structural steel supporting the upper atrium and condominium units.

Recommendations

Based on the conclusions stated above, the following repair recommendations are provided:

- The lower atrium topping slab and waterproofing should be removed and replaced with new waterproofing. This would require removal of the wood planter boxes, wood decks, and walls. These wood structures are already in a state of decay and are in need of repair or replacement anyway. After replacement of the waterproofing membrane, either a topping slab or paver system and new planter boxes may be placed at the lower atrium. WJE and Pullman recommend that the Association engages an architect to provide concepts for the replacement of these elements.

- The upper atrium slab should be repaired where spalled and scaled, which is currently most significant at sealant joints. Sealant should be removed and replaced where it is failed or debonded, and repaired areas should be re-coated with the Sika FlexCoat system or an approved alternative.
- The drop ceiling beneath the atrium slabs should be removed to allow for full visual observation of the structural members. Steel coupons should be cut from approximately 5 to 7 beams and tested to determine yield and tensile strength. Upon determination of steel strength, the number and type of steel beam repairs may be finalized. It is anticipated, based on the severity of corrosion documented, that even if the beams have a yield strength of 50 ksi steel, repairs will still be necessary in many areas. Corroded portions of steel columns and hangers likely do not require repair due to their calculated reserve capacity.
- After steel repairs are made, the repaired areas should be re-treated with spray-on fireproofing. It is strongly recommended that the portions of the upper atrium structure (currently not fireproofed) should be treated as well, even if a sprinkler system does exist in this area.

Closing

It has been a pleasure for WJE to be of assistance to you on this project. Please do not hesitate to contact us if you have any questions regarding this report, or our work so far to date.

Sincerely,

WISS, JANNEY, ELSTNER ASSOCIATES, INC.

Nicholas B. Lehmann, P.E.
Senior Associate and Project Manager

PHOTOS

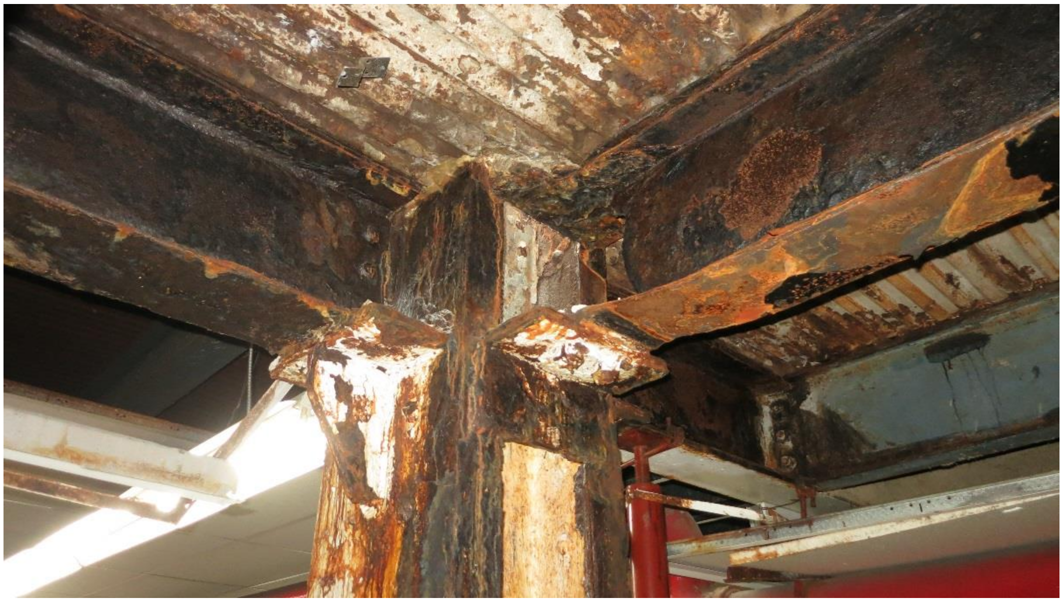

Photo 1. Corrosion at east column and supported members

Photo 2. Corrosion at east column and supported members

Photo 3. Cracked mortar and displaced CMU blocks at the southeast corner of the structure.

Photo 4. Deterioration at lower atrium topping slab

Photo 5. Minor deterioration at joints in upper atrium slab

Photo 6. Stains, cracks, and spalls at lightwell walls

Photo 7. Spall at lightwell wall

Photo 8. Probe 1- cut open planter wall at Unit 235

Photo 9. Probe 1a - Cut open floor drain at Atrium lower level slab.

Photo 10. Probe 2 - Partially disassembled wood planter and deck at Unit 236

Photo 11. Probe 2- Fully disassembled wood planter and deck at Unit 236

Photo 12. Probe 3 at east lightwell.

Photo 13. Probe 4 at west lightwell

Photo 14. Probe 5 - Full depth concrete removal at column

Photo 15. Probe 6 - Full depth concrete removal at column

Photo 16. Probe 7 - Full depth concrete removal at column

Photo 17. Probe 8 - Topping slab removal at drain

Photo 18. Probe 9 - Topping slab removal.

Photo 19. Core at Probe 10

Photo 20. Core at Probe 11

Photo 21. Core at Probe 12

Photo 22. Core at Probe 13

Photo 23. Probe 14 - Patio wall removal at Unit 215

Photo 24. Membrane ends inside lightwell wall with no termination.

Photo 25. Portion of hanger ground clean for thickness measurement.

Photo 26. Deterioration of wood framing beneath planter

Photo 27. . Wood decay at planter

APPENDIX A: PROBE LOCATION PLAN

PL 203
PL 205
PL 211
PL 213
PL 215
PL 217
PL 223
PL 225
PL 231
PL 233
PL 235
PL 237
PL 243
PL 245
PL 251
PL 253
PL 259
PL 261
PL 267
PL 269
PL 273
CN 201
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PL 266
PL 272
PL 204
PL 206
PL 212
PL 214
PL 216
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PL 226
PL 232
PL 234
PL 240
PL 242
PL 248
PL 250
PL 252
PL 254
PL 260
PL 262
PL 268
PL 270
PL 274
CN 202

APPENDIX B: ANALYSIS RESULTS

TYPICAL BAY - LOWER ATRIUM FRAMING

DEMAND/CAPACITY RATIOS,
TYP. BAY - 36 KSI STEEL

DEMAND/CAPACITY RATIOS,
TYP. BAY - 50 KSI STEEL

BAY WITH LIGHTWELL
OPENING

DEMAND/CAPACITY RATIOS,
TYP. BAY - 36 KSI STEEL

DEMAND/CAPACITY RATIOS,
TYP. BAY - 50 KSI STEEL

EAST END BAY

DEMAND/CAPACITY RATIOS,
TYP. BAY - 36 KSI STEEL

DEMAND/CAPACITY RATIOS,
TYP. BAY - 50 KSI STEEL