

Pier 5 at Miamarina, Miami Dade County, Florida

Overwater Deck, Bulkhead,
Pile Caps and Piling
Structural Investigation Report



Prepared for:

The City of Miami
Department of Real Estate
and Asset Management
444 SW 2nd Avenue
Miami, FL 33130



Prepared by:

Coastal Systems International, Inc.
464 South Dixie Highway
Coral Gables, FL 33146

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COASTAL SYSTEMS INTERNATIONAL, INC.
464 South Dixie Highway • Coral Gables, Florida 33146
Tel: 305-661-3655 • Fax: 305-661-1914
www.coastalsystemsint.com

220260.07

August 9, 2017

Mr. Daniel J. Alfonso
THE CITY OF MIAMI
DEPARTMENT OF REAL ESTATE
AND ASSET MANAGEMENT
444 SW 2nd Avenue
Miami, FL 33130

**RE: IMPROVEMENTS OF THE OVERWATER DECK INVESTIGATION AND PIER 5 AT MIAMARINA,
CITY OF MIAMI, MIAMI DADE, FLORIDA.**

Dear Mr. Alfonso:

The purpose of this letter report is to document the field investigation conducted by Coastal Systems International, Inc. (Coastal Systems), to evaluate the current condition and summarize engineering recommendations to repair or replace the existing concrete pile caps, concrete piles beam, topping slab hardware, and the repair of the existing bulkhead at the above-referenced site. An upland and in-water investigation was conducted on July 24th, 25th and 28th, 2017, by an engineer in accordance with the American Society of Civil Engineers (ASCE), Underwater Investigations Standard Practice Manual. The findings of the field investigation are detailed below:

1 - BACKGROUND

The project site is located at 401 Biscayne Blvd, Miami, FL 33132. Coastal Systems was authorized by the City of Miami (Client) to perform an engineering investigation to evaluate the current condition of the existing concrete pile cap, piles, and bulkhead. The work was authorized by the Client in an agreement dated June 21st, 2017. The existing structures mentioned above may be repaired or replaced, depending on the existing structural integrity of the structure, potential costs, and other factors noted below.

Coastal Systems visited the above-referenced site on July 24th, 25th and 28th, 2017. An above and in-water investigation of the existing pile cap, concrete piles, beams, topping slabs, hardware, and bulkhead was performed by an engineer to evaluate the condition of the structures. Field measurements were collected to verify the as-built information. Stationing was established in the field with Station 0+00 starting from the southwest corner of the Project and terminating at Station 5+32; at the north east corner of Pier 5. Exploratory excavations were not conducted on the upland portion of the bulkhead, as they were not included in the approved scope of services. Photographs documenting the site conditions at the time of the survey were collected and are enclosed in this letter report.

2 - OBSERVATIONS

2.1 - Bulkhead

The existing bulkhead is approximately 32 inches wide and approximately 8 feet tall. The wall is continuous along the length of Pier 5 (overwater deck). It consists of a steel sheet pile wall with a cast in place concrete cap. Refer to (Photo 5) for a typical view of the bulkhead.

Condition

The structure was observed to be generally stable and vertically plumb; however, the bulkhead showed minor signs of overstressing. Observations made from the upland side of the wall revealed no increase of soil settlement. Rip-rap was not observed along the toe of the bulkhead, and water depths along the base of the bulkhead were generally 5ft to 11ft at mean tide. The existing bulkhead exhibited random hairline vertical and diagonal cracks (photo 31). Exposed reinforcing and moderate spalls were observed at the bottom of the bulkhead (submerged portion of bulkhead). Outfall pipes and abandoned electrical conduits and piping were observed on the west and south portion of the bulkhead (photo 52 and 53). The wall above the mean waterline is covered with moderate marine growth within the tidal zone and mild abrasion to the concrete surface.

The bulkhead was randomly sounded with a 1-pound masonry hammer at different elevations along the wall. The concrete exhibited structural solidity without any "hollow" areas, despite the previously noted areas of abrasion and cracking. Sign of bulkhead spall, and exposed rebar below water were verified. Typical repair details, quantities, and locations will be illustrated in the Construction set.

2.2 - Boardwalk

The boardwalk is located directly water ward of the bulkhead and is approximately 10 feet wide by approximately 530 feet long. The wood decking and pre-cast concrete beam are planned to be removed as part of the scope on this project (photo 4).

Condition

Most of the 14-inch square precast concrete support piles were observed to be in fair condition. The existing 14-inch concrete pilings were randomly sounded with a 1-pound masonry hammer at different elevations above the waterline. Above the mean waterline, the piles exhibited none to minor deterioration in the form of hairline cracking (horizontal) and mild spall and occasional mild abrasion along the exposed faces (photo 40). One pile exhibited has approximately 10% loss of cross section due to spall (photo 30). Internal reinforcement was visible and exposed to the marine environment. Refer to (photo 27) for a typical view of the piles. No sign of repairs exhibited over the entire precast concrete piling. The piles above the mean waterline are covered with moderate marine growth within the tidal zone.

Above the mean water line, the 24-inch by 24-inch concrete pile caps exhibited fair to poor deterioration. Exposed steel chairs (at underside of pile cap), hairline cracking and isolated failure/breakage were observed. One concrete pile cap on the north east of the decking exhibited localized concrete breakage, thereby, affecting load bearing capacity of the structural components. Refer to (photo 19) for a typical view of pile caps. Typical repair details will be illustrated in the Design Development Plans, and more detailed quantities and locations will be illustrated in the Construction set.



2.3 - Timber - Mooring/Fender Piles

The timber structures were observed to be generally stable; however, the piles presented minor to moderate cracks and splits above the water line. Some piles presented up to 50% cross section loss at the mean water line. Refer to (photo 44 and 45) for a typical view of timber piles. Typical timber mooring pile replacements will be illustrated in the Design Development Plans and more detailed quantities and locations will be illustrated in the Construction set.

2.4 - Timber Finger Piers

The finger pier structures were observed to be generally stable; however, some of the structural elements are in the mid/advance stages of deterioration to complete breakage or failure at the mean water line (photo 43). The existing conditions, quantities, and locations will be illustrated in the Construction set.

2.5 - North Concrete Finger Pier

The existing structure in this area is part of a 14ft 9-inch wide by 74ft concrete dock with a 12-inch thick reinforced precast slab with a cast in place closure pour (photo 10). Some of the existing crib threaded rods containing the rock wave baffle under slab exhibited complete breakage similar to Pier G. The structure includes 18-in square precast concrete piling and some exhibited hairline cracks at the mean waterline.

2.6 - Pier G

The existing structure in this area is part of a 9ft 8-inch wide concrete dock with a 12-inch thick reinforced precast slab with a cast in place closure pour (photo 13). The structure includes 18-in square precast concrete piling and some exhibited structural cracks at the mean waterline (photo 46 and 47). Also, some of the existing crib threaded rods containing the rock wave baffle under slab exhibited complete breakage (photo 50). The existing conditions, quantities, and locations will be illustrated in the Construction set.

3.0 - CONCLUSIONS

3.1 - Bulkhead

The existing bulkhead may not be greater than 30 years old and original to the area, which was developed in the 1990's. The existing concrete bulkhead, precast piling, and precast concrete pile caps all exhibited signs of minor to moderate deterioration. The size and orientation of the cracks in portions of the bulkhead indicate areas of localized overloading. As-built information was not available at the time of the investigation.

In conclusion, the bulkhead is given a rating of *Fair* in accordance with the ASCE "Underwater Investigation Standard Practice Manual". Refer to the rating system enclosed in Appendix A for additional information.

Based on the existing site conditions and anticipated rates of deterioration, the estimated remaining service life for this bulkhead, if no action is taken, is approximately 5 to 8 years. This remaining service life does not include potential impacts due to coastal storm events or flooding.



3.2 - Boardwalk

Based on the level of deterioration to many of the concrete piles supporting the 24-inch by 24-inch concrete pile caps (i.e. 14-inch square precast piling), the existing concrete piling is given a rating of *Fair* in accordance with the ASCE manual. Refer to the rating system enclosed in Appendix A for additional information.

Based on the existing site conditions and anticipated rates of deterioration, the estimated remaining service life for these pile caps, if no action is taken, is approximately 5 to 8 years. This remaining service life does not include potential impacts due to coastal storm events or flooding.

The existing 24-inch by 24-inch precast concrete pile caps supporting the wooden decking is given a rating of *Fair-Poor* accordance with the ASCE "Underwater Investigation Standard Practice Manual". Refer to the rating system enclosed in Appendix A for additional information.

Based on the existing site conditions and anticipated rates of deterioration, the estimated remaining service life for this bulkhead, is approximately 5 to 8 years. This remaining service life does not include potential impacts due to coastal storm events or flooding.

3.3 - Timber - Mooring/Fender Piles

Based on the level of deterioration to most of the timber piling at the mean water line, the existing piles are given a rating of *Fair* condition. However, some of the timber piles were given a rating of *Poor* condition. The estimated remaining service life 3 to 5 years. This remaining service life does not include potential impacts due to coastal storm events.

3.4 - Timber Finger Piers

Based on the level of deterioration to most of the timber structures, the existing structures are given a rating of *Fair-Serious* condition. However, some of the structural timber elements were missing or complete failure. The estimated remaining service life 3 to 6 years. This remaining service life does not include potential impacts due to coastal storm events.

3.5 - North Concrete Finger Pier

The existing concrete North Finger Concrete Pier has minor level of deterioration to a few of the 18-inch square precast piling supporting the (25-inch by 36-inch pile caps). The existing concrete piling is given a rating of *Fair* in accordance with the ASCE manual. Based on the existing site conditions and anticipated rates of deterioration, the estimated remaining service life for this structure, if no action is taken, is approximately 4 to 6 years. This remaining service life does not include potential impacts due to coastal storm events or vessels.

3.6 - Pier G

The existing concrete Pier G has minor to moderate level of deterioration to a few of the 18-inch square precast piling supporting the (25-inch by 36-inch pile caps). The existing concrete piling is given a rating of *Fair-Poor* in accordance with the ASCE manual. Based on the existing site conditions and anticipated rates of deterioration, the estimated remaining service life for this structure, if no action is taken, is approximately 4 to 6 years. This remaining service life does not include potential impacts due to coastal storm events or vessels.



4.0 – RECOMMENDATIONS

Coastal Systems International performed an investigation of the existing above water and below water substructure. Coastal Systems reviewed and analyzed the data collected performed during the field investigations on July 24th, 25th and 28th of this year. Our recommendations as follows:

4.1 - Bulkhead

Based on the observed conditions, performing preventative maintenance, assessing the structure on a regular basis, or minor repairs to the bulkhead will extend the service life. Repairs are recommended in the future, within one year time.

4.2 - Boardwalk - (concrete piles/concrete pile caps)

Based on the observed conditions of the overwater boardwalk, all the existing wood decking and post tensioned beams will be removed. Repairs are planned under this Project and will significantly extend the life of the structure.

Most of the existing 14-inch square precast concrete support piles exhibited minor deterioration and no overstressing was observed. Repairs are planned under this Project and will significantly extend the life of the structure.

Most of the existing cast in place concrete pile caps exhibited minor deterioration. However, one isolated breakage/overstressing affected the load bearing capacity of the structure. Repairs are planned under this Project and will significantly extend the life of the structure.

4.3 - Timber Mooring/Fender Piles

Several of the timber mooring piles need to be replaced due to current conditions. The extent of the deterioration of the piles presented vertical cracking, splitting, signs of impact loads, fungal rot (soften of the wood) and reduction of cross section area loss at the splash zone. Therefore, more wide spread of failures are likely to occur. Repairs are planned under this Project and will significantly extend the life of the structure.

4.4 - Timber Finger Piers

Several of the timber diagonal bracings, headers, and connection hardware, will need to be replaced.

4.5 - North Concrete Finger Pier

The current condition to the cast in place concrete piles exhibited minor deterioration. Repairs are planned under this Project and will significantly extend the life of the structure.

4.6 - Pier G

The current condition to the cast in place concrete piles exhibited minor deterioration. However, one isolated structural crack may affect the load capacity of the structure in the near future. Repairs are planned under this Project and will significantly extend the life of the structure.



Photos were taken to document field conditions:



Photo 1: End of new construction with concrete beams (looking north)



Photo 2: Beginning of wood decking construction (looking south).



Photo 3: Existing wood decking construction, floating ladder, cleaning station, and pedestals (looking south).



Photo 4: Existing wood deck corner, and pedestals (looking northeast).





Photo 5: Existing bulkhead, sidewalk and wood deck (looking east).



Photo 6: Existing bulkhead, pedestals, sidewalk and wood deck (looking east).



Photo 7: Existing bulkhead, pedestals, sidewalk and wood deck (looking west).



Photo 8: Existing bulkhead, pedestals, sidewalk and wood deck (looking west).

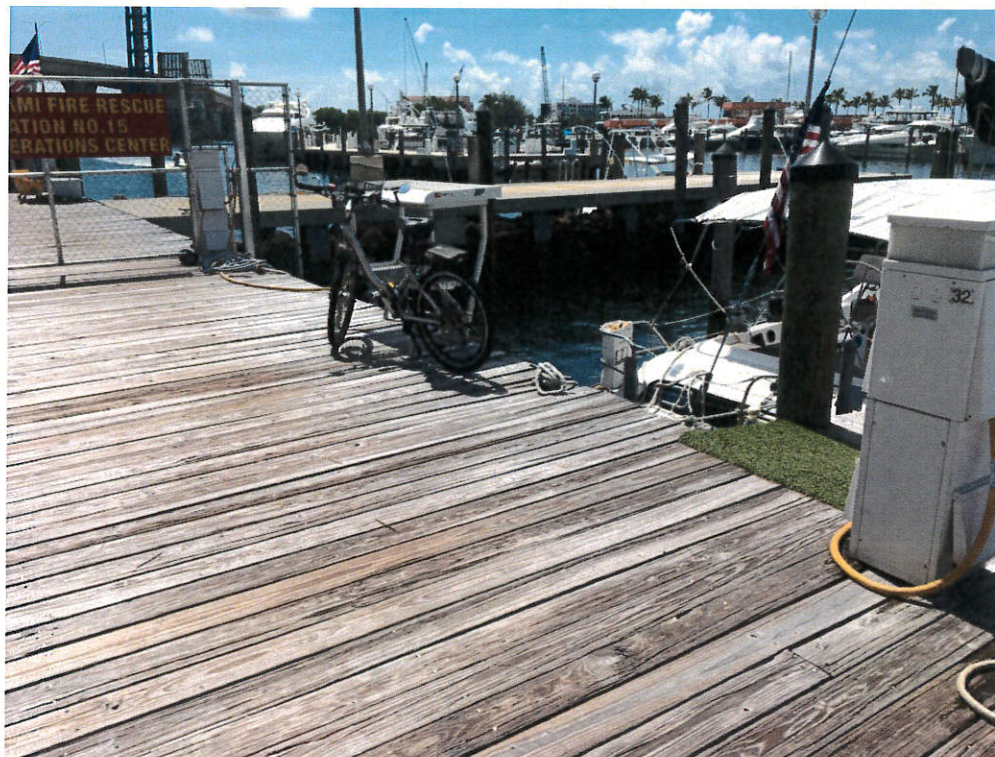


Photo 9: Approaching Miami Fire Rescue existing concrete pier (looking southeast).



Photo 10: Existing Miami Fire Rescue concrete pier (looking southeast).



Photo 11: Transition from Pier 5 to Pier G (beyond).



Photo 12: Transition from Pier 5 to Pier G (beyond).



Photo 13: Overall view of Pier G (looking east).



Photo 14: Existing Pier G (most eastern side).

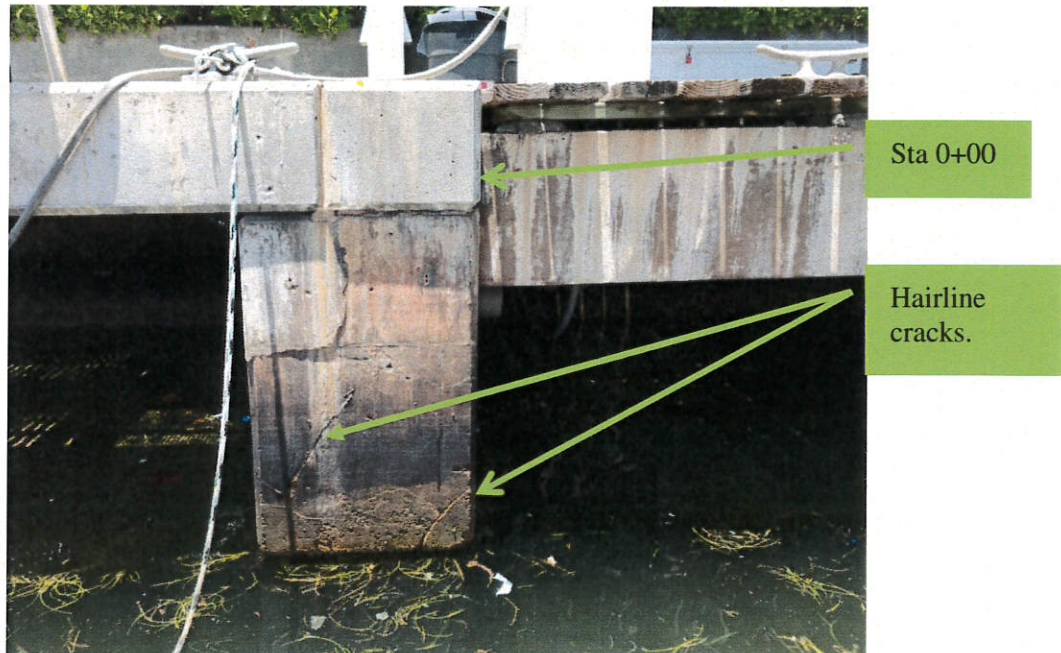


Photo 15: Above water observation; new construction (left), existing construction (right).



Photo 16: Underside at end of new construction (concrete beams); existing pile cap exhibited minor delamination, sign of previous repairs, corrosion stains, and hairline cracks (looking north). See photo #17 for reference.



Photo 17: Underside at end of existing construction (wood decking and pre-cast concrete joists); this face of pile cap (Sta 0+00 looking south). Utility chase under wood decking from pile cap to pile cap.



Photo 18: Underside of wood decking; bulkhead above. The waterline, exposed reinforcing noted.





Photo 19: 24x24 concrete pile cap exhibited hairline crack and random honey combs.

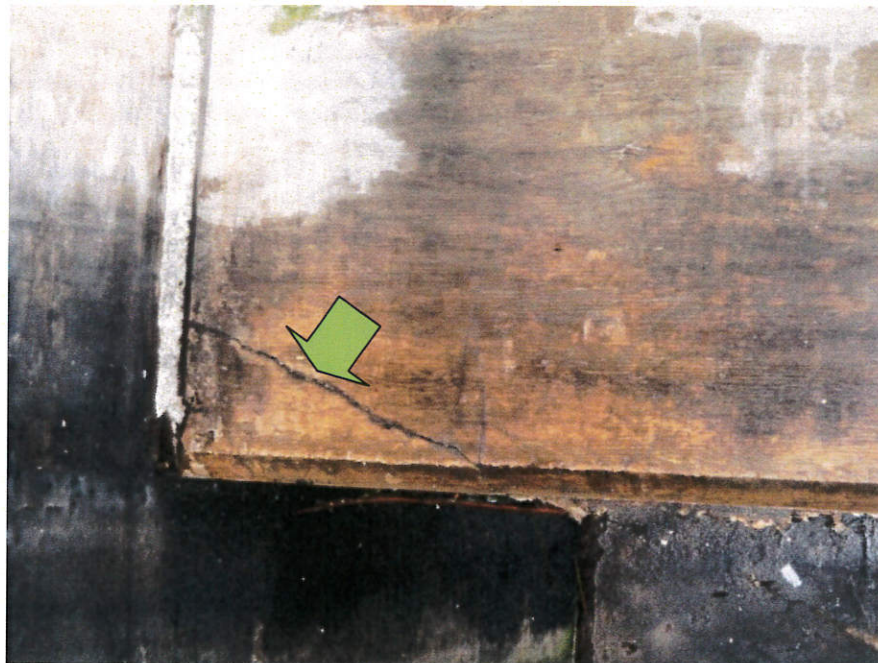


Photo 20: Early signs of deterioration - hairline cracks at Corner of pile caps typical.

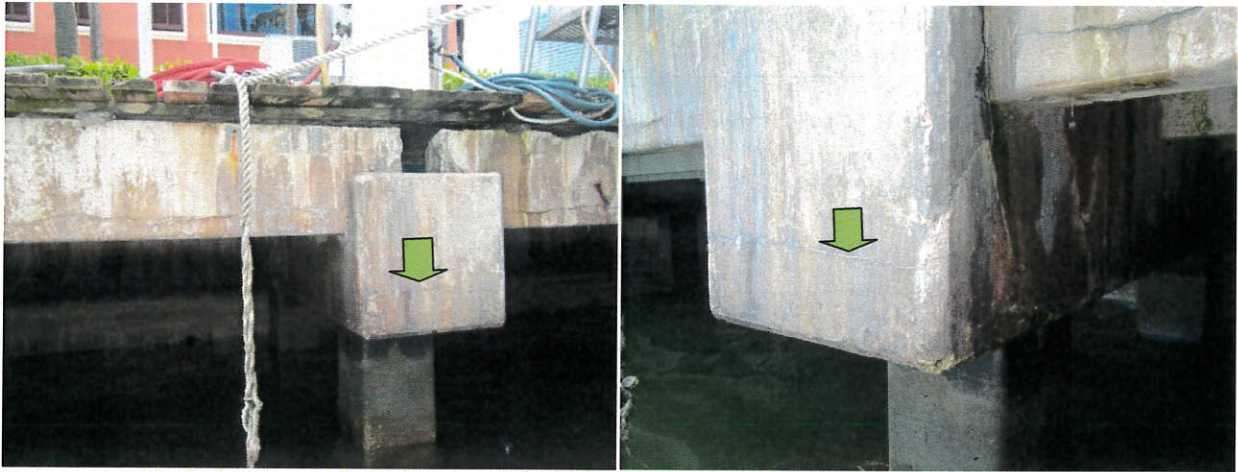


Photo 21: Early signs of deterioration - horizontal hairline crack across face of pile cap.



Photo 22: Vertical hairline crack parallel to expansion joint.

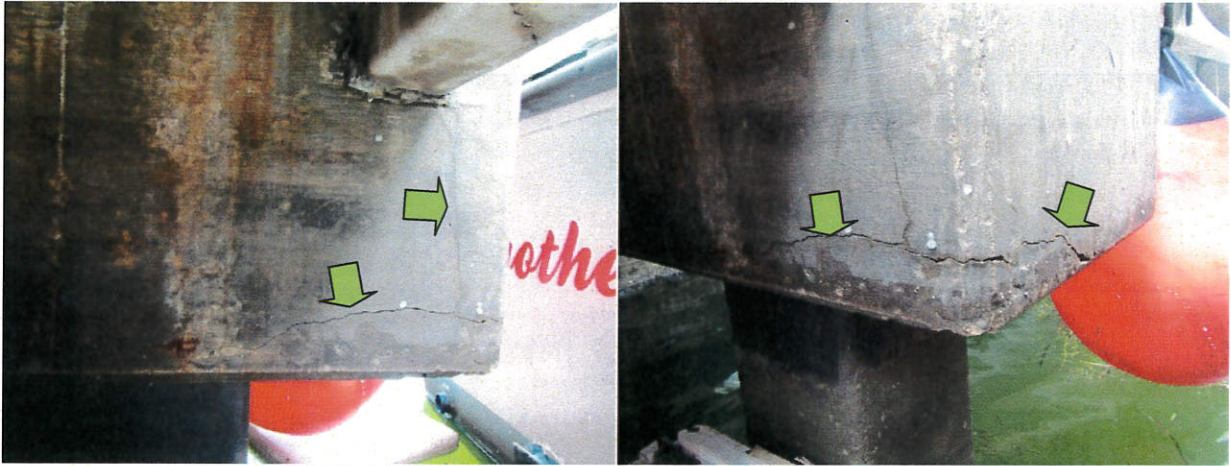


Photo 23: Vertical and hair line cracks at existing pile cap (typical).

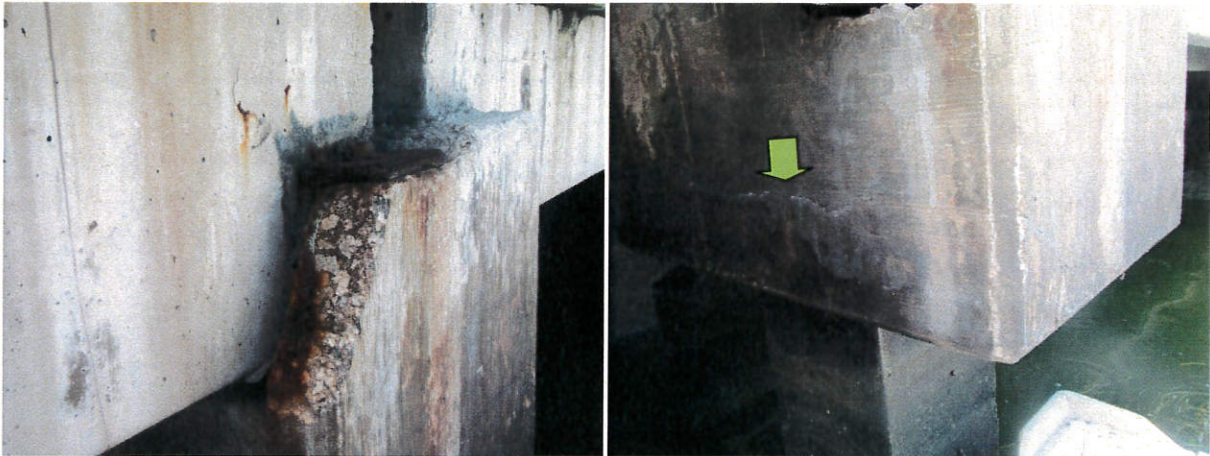


Photo 24: Concrete spall, exposed reinforcing (top of pile cap left).
Hair line crack across the face of pile cap. See photo #23 for side view.

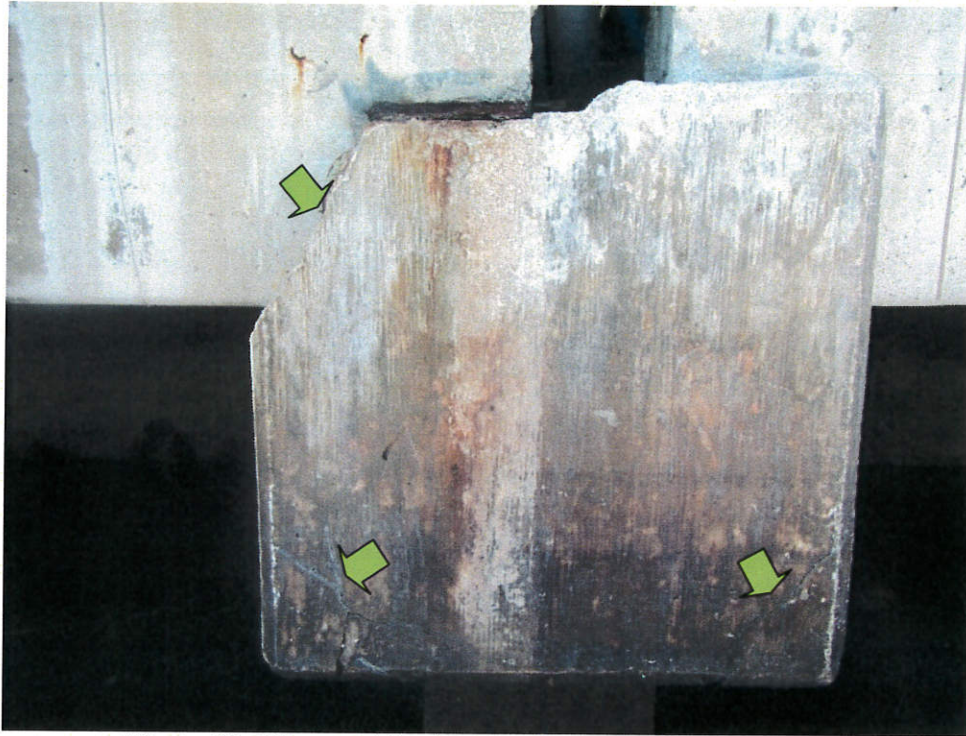


Photo 25: Pile cap side view, concrete spall, exposed steel (top arrow) And hairline cracks (bottom arrows).



Photo 26: Free standing concrete piles under concrete joists.



Photo 27: Center beam and piling (looking into northwest corner of boardwalk).

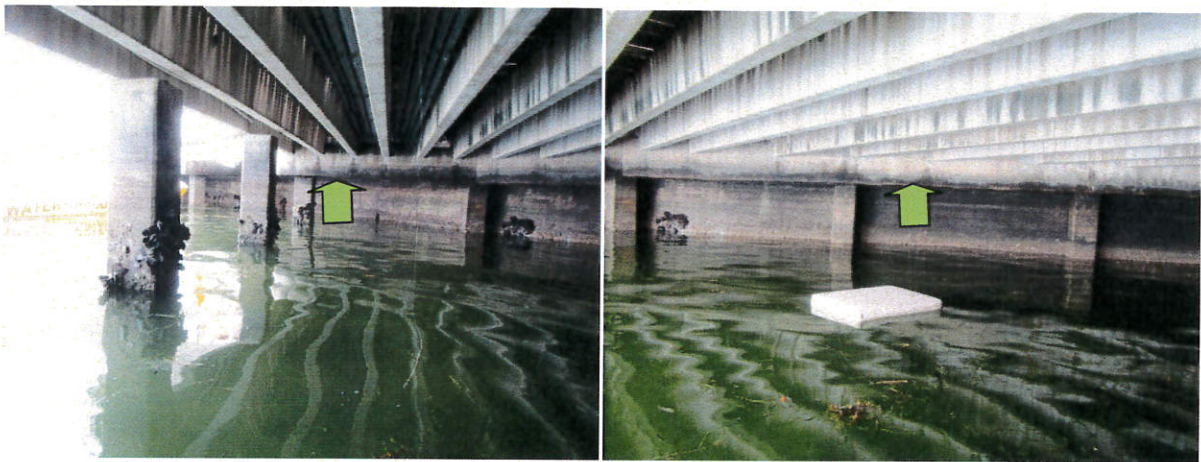


Photo 28: Southwest beam beyond (left photo), west beam abut to bulkhead through entire northwest corner of boardwalk (right photo).



Photo 29: End of north beam abut to bulkhead.



Photo 30: Exposed metal chair at underside of beam (left photo), concrete void and exposed reinforcing at top of concrete pile (right photo - northwest corner area).

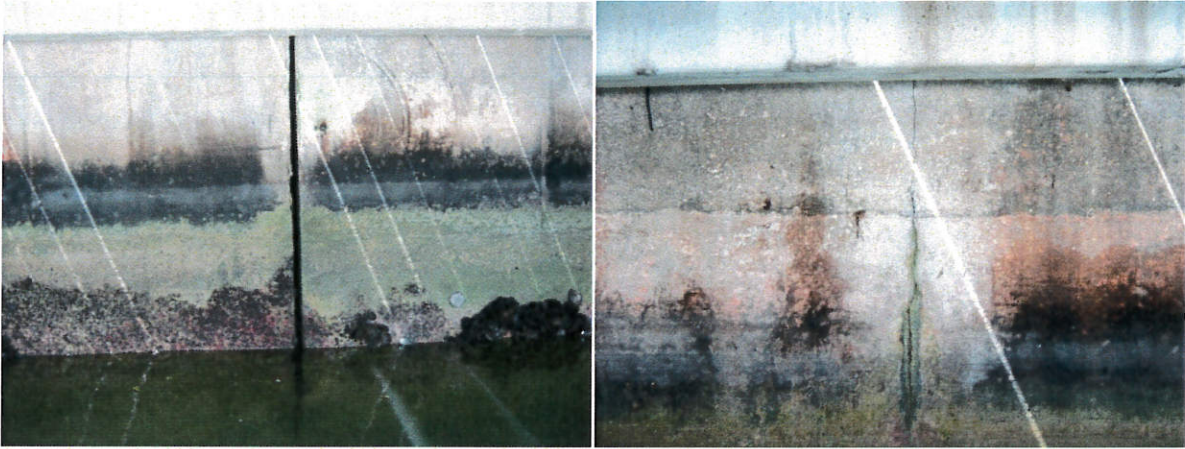


Photo 31: Loss of expansion joint material at expansion joint (left photo) typical. North face of bulkhead exhibited more hairline cracks typical (right photo).



Photo 32: Random honeycombing on pile caps through Entire boardwalk.



Photo 33: Corroded steel rods noted over the length of wall.



Photo 34: Existing concrete joists recessed into pile cap.



Photo 35: Vertical hairline crack to underside of pile cap.



Photo 36: North segment of bulkhead exhibited more marine growth than the rest of wall.

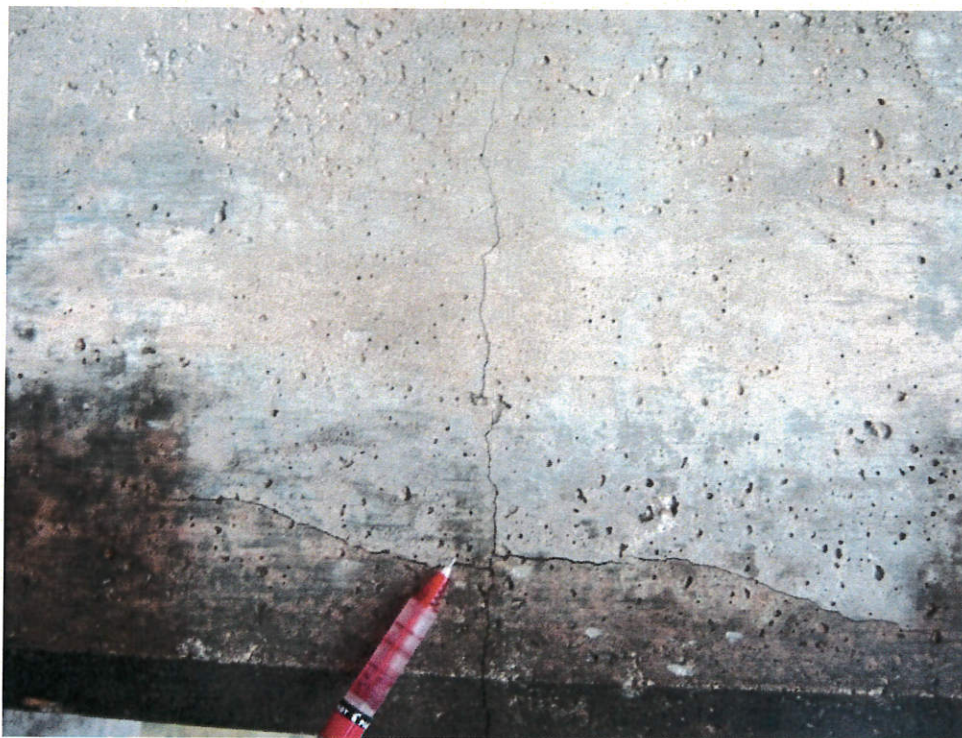


Photo 37: Hairline cracks merging at one location (lower portion of pile cap).

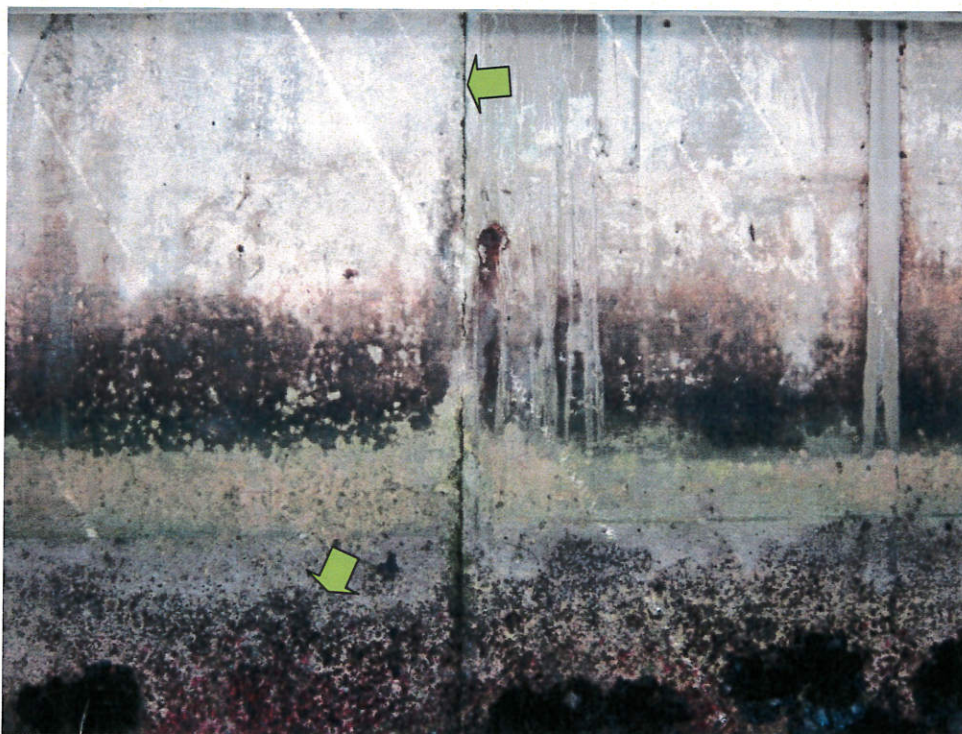


Photo 38: Cold joint throughout entire length of bulkhead (top arrow). Noticed bulkhead surface roughen caused by debris abrasion (lower portion of photo).





Photo 39: Top corner of pile cap failed (left). Precast concrete joist failed (right).



Photo 40: Below water line signs of abrasion (left). Horizontal hairline crack at top of concrete pile (right).



Photo 41: Northeast corner (Pier G) timber pile
Deterioration 50% cross section loss.

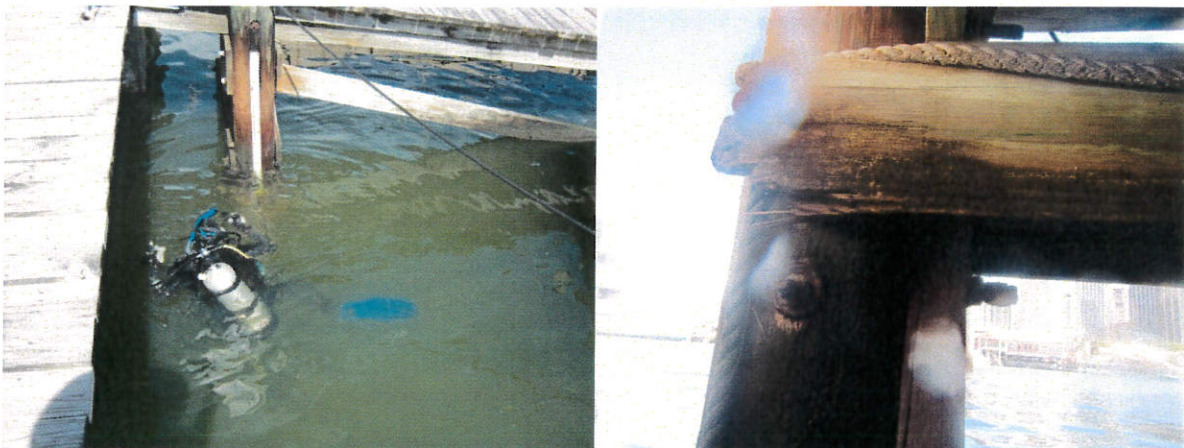


Photo 42: Timber finger pier: fender/mooring pile and Divers performing framing structural assessment (left). Missing diagonal bracing (right).



Photo 43: Corroded steel connection corroded and splinted cross bracing (left), horizontal brazing connection failed (right).

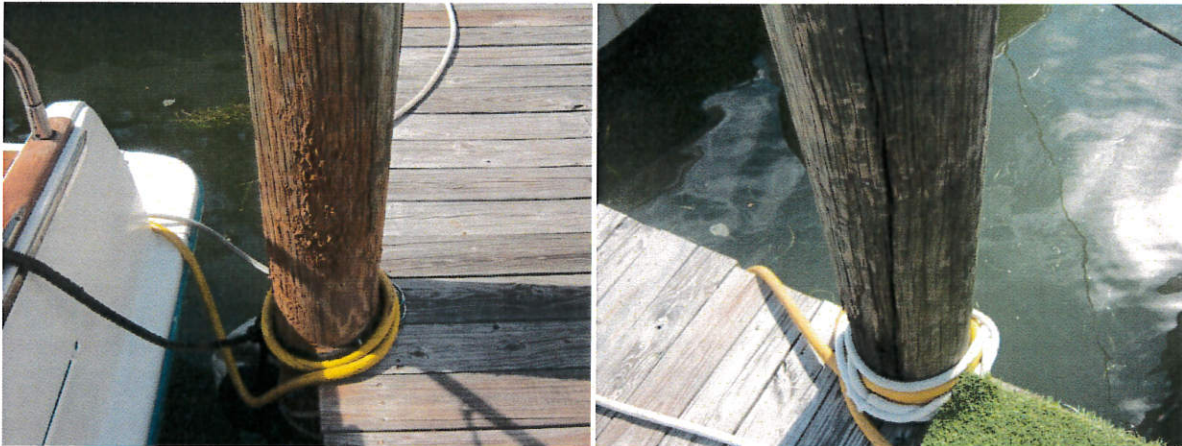


Photo 44: Fender pile exhibited heavy load impacts (left), vertical cracks exhibited on surface of fender pile.

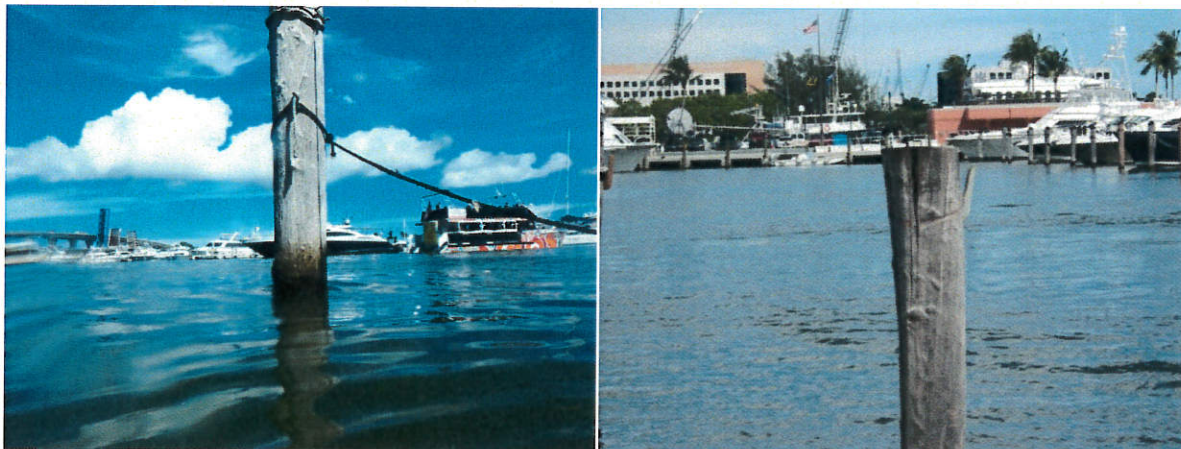


Photo 45: Mooring pile exhibited wide crack at top and missing plastic cap (right).



Photo 46: Pier G: couple of 18-inch x 18-inch piles exhibited up to 1/4-inch cracks.



Photo 47: Pier G: couple of 18-inch x 18-inch piles exhibited up to 1/4-inch cracks.



Photo 48: Pier G: sign of concrete piles repaired (left). Same pile, random hairline cracks at the top portion of concrete pile.



Photo 49: Pier G: Rough concrete surface worn.

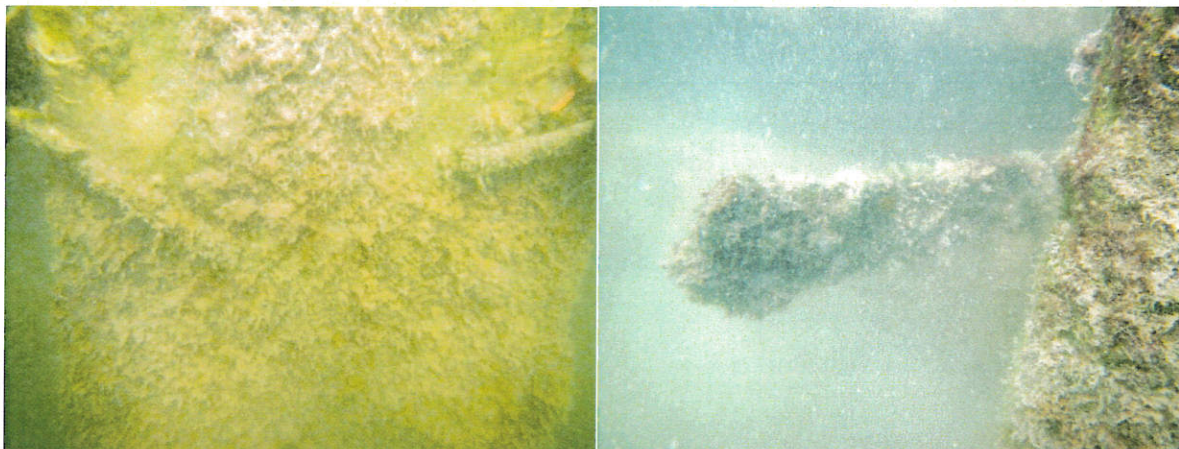


Photo 50: Pier G and South Concrete Pier: Random crib structure threaded rod deteriorated.

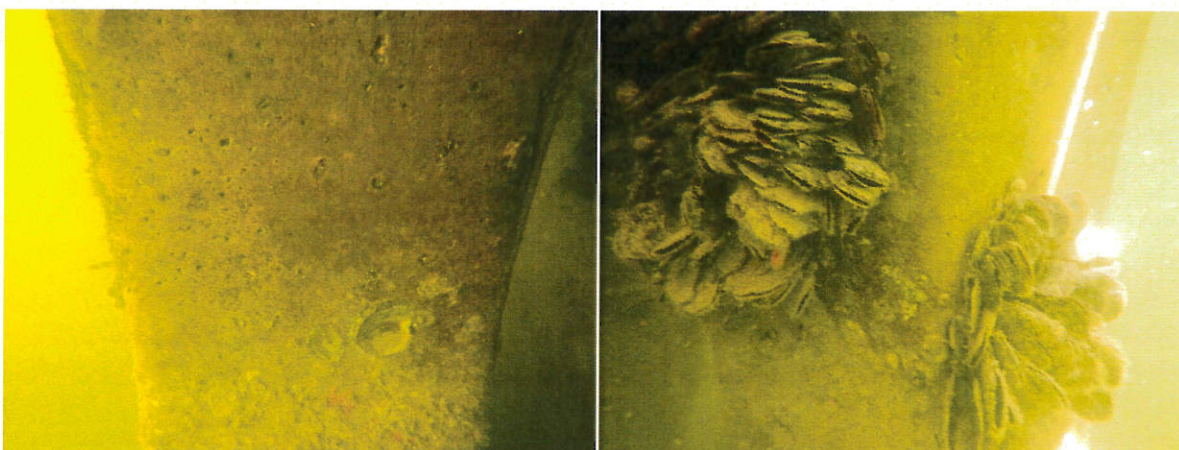


Photo 51: Below boardwalk piling - below water pile condition.

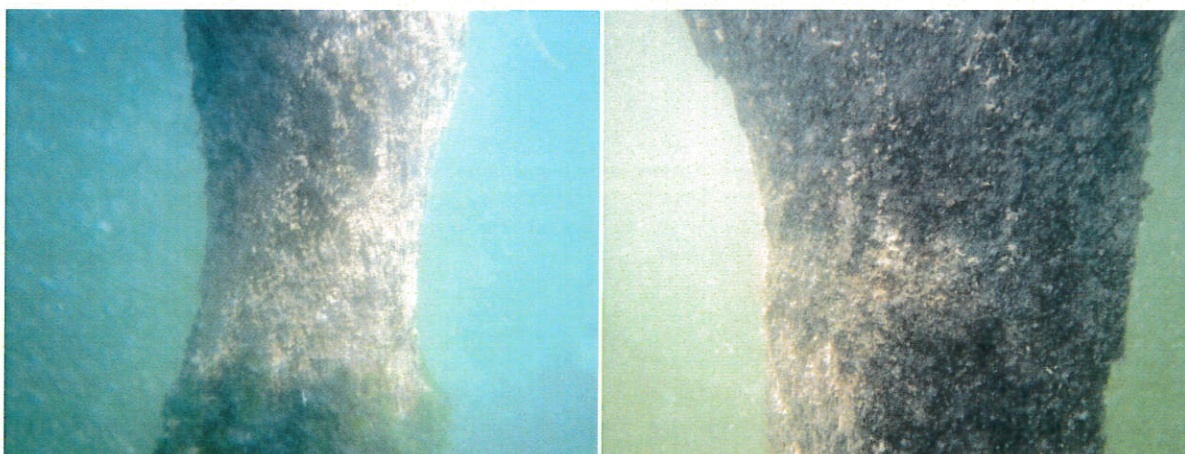


Photo 52: Timber mooring pile below water exhibited cross section loss and rot.

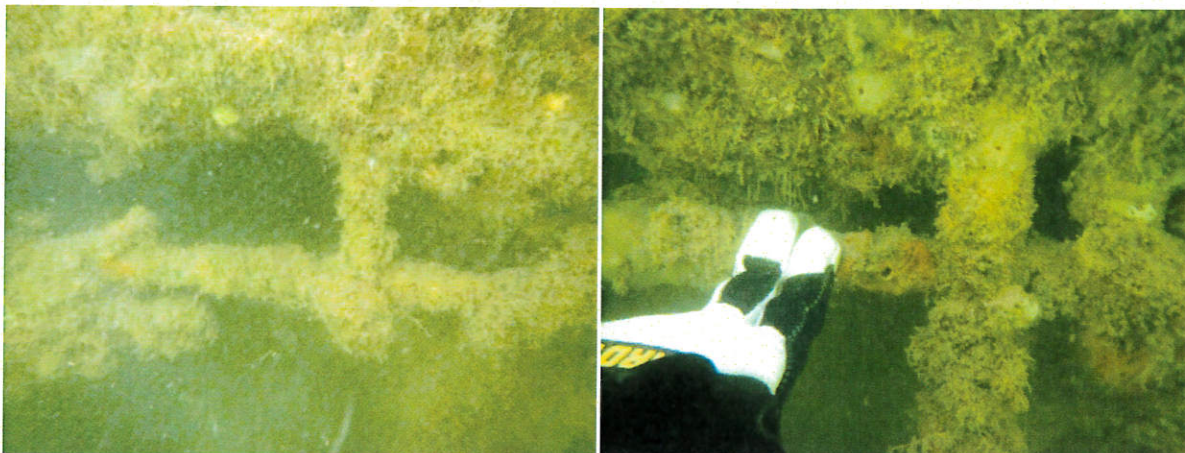


Photo 53: Random voids and exposed reinforcing at bottom of bulkhead.



Photo 54: Abandoned outfall and electrical conduits at bulkhead.



Photo 55: North Concrete Finger Pier (left). Minor concrete deterioration on few piles (right).

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This letter report was prepared in accordance with generally accepted waterfront facility assessment engineering practices. The assessment and recommendations submitted herein are based on the data obtained from the field observations. This report may not account for possible variations that may exist between the conditions observed due to limited underwater visibility and marine growth coverage.

Coastal Systems appreciates the opportunity to provide professional engineering services relative to the Miamarina Pier 5 Improvements Project. Should you have any questions or require additional information, please do not hesitate to contact me at (305) 669-8159 or aperez@coastalsystemsint.com.

Sincerely,
COASTAL SYSTEMS INTERNATIONAL, INC.
Florida EB # 7087

Andres Perez, P.E.
FL Reg. 66507
Engineering Department Head

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APPENDIX A



LEVELS OF UNDERWATER INSPECTION EVALUATION AND RATING SYSTEM

Level I Inspection: A close visual examination, or a tactile examination using large sweeping motions of the hand where visibility is limited. Although this effort is often referred to as a “swim-by” inspection, it must be detailed enough to detect obvious major damage or deterioration over-stress, or other severe deterioration. It should confirm the continuity of the full length of all members, and detect undermining or exposure of normally buried elements. This inspection also may include limited probing of the substructure and adjacent channel bottom.

Level II Inspection: A detailed inspection shows a required marine growth to be removed from portions of the structure. Cleaning is time-consuming, hence the need to base the inspection on a representative sampling of components. For piles, a 12-inch high band should be cleaned at designated locations, generally near the low waterline, at the mudline and midway between the low waterline and the mudline. On a rectangular pile, the marine growth removal should include at least three sides; on an octagonal pile, at least six sides; on a round pile, at least three-fourths of the perimeter. On large-diameter piles (3 ft or greater), 1-ft x 1-ft areas should be cleaned at four locations approximately equally spaced around the perimeter at each elevation. On large, solid-faced elements such as retaining structures, 1-ft x 1-ft areas should be cleaned at these three elevations. This inspection also should focus on typical areas of weakness such as attachment points and welds. It is intended to detect and identify damaged and deteriorated areas that may be hidden by surface biofouling. The thoroughness of cleaning should be governed by the tasks necessary to discern the condition of the underlying material. Removal of all biofouling staining is generally not required.

The Level II inspection is intended to detect and identify damaged and deteriorated areas, which may be hidden by surface biofouling. The thoroughness of cleaning should be governed by what is necessary to discern the condition of the underlying material. Removal of all biofouling staining is generally not needed.

Level III Inspection: A detailed inspection typically involving nondestructive or partially destructive testing, conducted to detect hidden or interior damage or to evaluate material homogeneity. Typical inspection and testing techniques include the use of ultrasonics, coring or boring, physical material sampling, and in situ hardness testing. This inspection is generally limited to key structural areas, areas that are suspect, and areas that may be representative of the underwater structure.

REFERENCE: Underwater Investigation Standard Practice Manual, American Society of Civil Engineers, Report No. 101, 2001.



ROUTINE CONDITION ASSESSMENT RATINGS

Rating		Description
6	Good	No visible damage, or only minor damage is noted. Structural elements may show very minor deterioration, but no overstressing is observed.
5	Satisfactory	Limited minor to moderate defects or deterioration are observed, but no overstressing is observed.
4	Fair	All primary structural elements are sound, but minor to moderate defects or deterioration is observed. Localized areas of moderate to advance deterioration may be present but do not significantly reduce the load-bearing capacity of the structure. Repairs are recommended, but the priority of the recommended repairs is low.
3	Poor	Advanced deterioration or overstressing is observed on widespread portions of the structure but does not significantly reduce the load-bearing capacity of the structure. Repairs may need to be carried out with moderate urgency.
2	Serious	Advanced deterioration, overstressing, or breakage may have significantly affected the load-bearing capacity of primary structural components. Local failures are possible and loading restrictions may be necessary. Repairs may need to be carried out on a high-priority basis with urgency.
1	Critical	Very advanced deterioration, overstressing, or breakage has resulted in localized failure(s) of primary structural components. More widespread failures are possible or likely to occur, and load restrictions should be implemented as necessary. Repairs may need to be carried out on a very high priority basis with Strong urgency.

- Ratings should reflect only damage that was likely caused by the event. Long-term or pre-existing deterioration such as corrosion damage should be ignored unless the structural integrity of the structure is immediately threatened.
- Ratings are used to describe the existing in-place structure compared with the structure when new. The fact that the structure was designed for loads that are lower than the current standards for design should have no influence on the ratings.

REFERENCE: Underwater Investigation Standard Practice Manual, American Society of Civil Engineers, Report No. 101, 2001



