



## **LOGAN DIVING & SALVAGE**

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### **FLAGLER BEACH PIER POST INCIDENT SAFETY INSPECTION HURRICANE IRMA SEPTEMBER 15 - 17, 2017**



PROFESSIONAL COMMERCIAL DIVING AND MARINE CONSTRUCTION SERVICES WERE REQUESTED TO INSPECT AND DOCUMENT EXISTING SUBSTRUCTURE CONDITIONS AT THE FLAGLER BEACH PIER, FLAGLER BEACH, FLORIDA, POST HURRICANE IRMA.

THE FLAGLER BEACH PIER IS A TIMBER PILE STRUCTURE LOCATED AT THE INTERSECTION OF 2ND. STREET AND FLORIDA A1A, FLAGLER BEACH, FLORIDA. ORIGINAL PIER CONSTRUCTION WAS COMPLETED IN 1928.

PIER SUBSTRUCTURE COMPOSITION IS COMPRISED OF 12" TO 14" DIAMETER (BUTT) TIMBER PILE BENTS SUPPORTING 12" X 12" TIMBER CAPS (RUNNING NORTH TO SOUTH). TRANSVERSE PILE CAPS SUPPORT LONGITUDINAL STRINGERS (RUNNING EAST TO WEST) WHICH ARE 4" X 12" PROVIDING THE SUBSTRUCTURE AND SUPERSTRUCTURE FOR TRANSVERSE 2" X 6" DECKING. PILE BENTS AND PILING ARE CONNECTED BY CROSS BRACING WHICH ARE 4" X 8" OR 4" X 6" TIMBERS BOLTED TO THE PILING DIAGONALLY AND PINNED IN THE MIDDLE WHERE THEY CROSS. ADDITIONAL CROSS BRACING CONSISTS OF A 4" X 8" HORIZONTAL X BRACE BETWEEN THE PILE BENTS DIRECTLY BELOW THE STRINGERS.

DIVERS UTILIZING SURFACE SUPPLIED DIVE GEAR WITH HARDWIRE COMMUNICATIONS INSPECTED THE SUBSEA STRUCTURE TIMBER PILING. INSPECTION WAS VISUAL AND ACCOMPLISHED BY DIVERS FAMILIAR WITH THIS TYPE OF PIER CONSTRUCTION AND CONFIGURATION.

PILE LAYOUT AND SEQUENCING WAS REFERENCED FROM DRAWINGS TITLED FISHING PIER- HURRICANE MATTHEW EMERGENCY SAFETY TEMPORARY REPAIRS DATED JANUARY 2017 SUPPLIED BY AND PREPARED BY MOTT MACDONALD.

THE RESULTS OF INSPECTION ARE AS FOLLOWS:

INSPECTION OF THE FISHING PIER SUBSTRUCTURE WAS COMPLETED WITH DIVERS FOR THE UNDERWATER PORTIONS AND MARINE CONSTRUCTION PERSONNEL WORKING BENEATH THE PIER FROM THE WATERLINE TO THE SUB DECK LEVEL.

SUBSTRUCTURE PILING INSPECTION REVEALED THE FOLLOWING:

40 PILES WERE FOUND TO HAVE GREATER THAN 50% OF THE PILE NOT TOUCHING THE CAP BEAM, 11 OF THOSE 40 PILES HAVE 100% OF THE PILE NOT TOUCHING THE CAP BEAM. 11 PILES ARE PROVIDING NO SUPPORT TO THE CAPS, STRINGERS AND DECK (SEE ATTACHED PILE INSPECTION SHEETS).

HEAVY SEAS AND CURRENTS EXPERIENCED DURING THE HURRICANE HAVE SCOURED OUT THE GROUND LINE, EXPOSING AND SUSPENDING PAST PILE JACKET REPAIRS FROM 0' TO 3'

49 PILES HAVE SCOUR RESULTING IN SUSPENDED PILE JACKETS. PREVIOUSLY BURIED SECTIONS OF PILING NOW ARE EXPOSED AND UNPROTECTED AGAINST MARINE BORERS.

ONE PILE WAS MOVING FREELY AT THE TOP (BENT 13 PILE C). A SECOND PILE WAS FOUND TO BE MOVING SLIGHTLY IN HEAVY SEAS (BENT 15 PILE D) (SEE ATTACHED PILE INSPECTION SHEETS).

DUE TO THE PILES MOVING OR "WORKING" DURING THE STORM, THE MAJORITY OF EPOXY SEALS ON EVERY PILE JACKET ARE BROKEN/CRACKED/FAILED, LEAVING AN ANNULAR SPACE OF TRAPPED SEAWATER.

THERE ARE AT LEAST 7 PILE THAT ARE DETERIORATED 60% OR MORE (SEE ATTACHED PILE INSPECTION SHEET). "DETERIORATED" REFERS TO THE PERCENTAGE OF THE SUBSTRUCTURE MEMBER THAT APPEARS WEAKENED BEYOND ITS USEFUL SERVICE LIFE.

**CAP AND STRINGER INSPECTION REVEALED THE FOLLOWING:**

THE CAP BEAMS WERE FOUND TO BE GENERALLY IN GOOD CONDITION. THERE ARE HOWEVER, 2 BEAMS DETERIORATED MORE THAN 60% (SEE ATTACHED PILE INSPECTION SHEETS).

**OVERALL SPECIFIC FINDINGS**

**BENT 13**

PILE C IS MOVING AND DOES NOT TOUCH CAP  
PILE E 90% PILE DOES NOT TOUCH CAP  
PILE B, G AND H 50% OF PILE DOES NOT TOUCH CAP  
SS STRAP ON PILE BAND C IS BROKEN  
PILE H HAS SUSPENDED JACKET

**BENT 14**

PILE B IS NOT TOUCHING CAP  
PILE H 50% OF PILE DOES NOT TOUCH THE CAP  
THE WEST FACE VERTICAL DIAGONAL X BRACE HARDWARE IS WORKING/LOOSE  
PILES B, D, F AND H HAVE SUSPENDED JACKETS

**BENT 15**

PILES D 100% OF PILE NOT TOUCHING THE CAP, PILE IS MOVING AT THE TOP, HARDWARE WORKING  
OUT OF TIMBER ON SS STRAPS  
PILE B 50% OF PILE DOES NOT TOUCH CAP  
PILES B, D, F AND H HAVE SUSPENDED JACKETS

**BENT 16**

PILE H HAS 50% NOT TOUCHING THE CAP  
PILES B, D, F AND H HAVE SUSPENDED JACKETS

**BENT 17**

PILE F AND H 50% OF PILE DOES NOT TOUCH THE CAP  
THE WEST FACE VERTICAL DIAGONAL X BRACE BROKEN  
PILES B, D, F AND H HAVE SUSPENDED JACKETS

**BENT 18**

THE SOUTH FACE VERTICAL DIAGONAL X BRACE BROKEN  
PILES B, D, F AND H HAVE SUSPENDED JACKETS

**BENT 19**

PILE B 100% OF PILE IS NOT TOUCHING THE CAP  
PILE F 70% OF PILE IS NOT TOUCHING CAP  
PILE H FAILED PILE TO CAP REPAIR  
HORIZONTAL X BRACE HARDWARE IS WORKING  
PILES B, F AND H HAVE SUSPENDED JACKETS

**BENT 20**

PILES F AND H HAVE SUSPENDED JACKETS

**BENT 21**

PILE H 90% OF PILE IS NOT TOUCHING CAP  
HORIZONTAL X BRACE HARDWARE IS WORKING  
PILES D, F AND H HAVE SUSPENDED JACKETS

**BENT 22**

PILES B, AND F HAVE SUSPENDED JACKETS

BENT 23

PILE B 50% OF PILE NOT TOUCHING CAP  
PILE H 60% OF PILE NOT TOUCHING CAP  
HORIZONTAL X BRACE HARDWARE IS WORKING  
PILE H HAS SUSPENDED JACKETS

BENT 24

PILE B HAS 50% NOT TOUCHING THE CAP  
PILES B, F AND H HAVE SUSPENDED JACKETS

BENT 25

PILE D 90% NOT TOUCHING THE CAP  
PILES B, D, F, AND H HAVE SUSPENDED JACKETS

BENT 26

PILES B, D, F, AND H HAVE SUSPENDED JACKETS

BENT 27

PILE B HAS 80% NOT TOUCHING THE CAP  
PILES B, F, AND H HAVE SUSPENDED JACKETS

BENT 28

APPEARS IN SERVICEABLE CONDITION

BENT 29

THE WEST FACE VERTICAL DIAGONAL X BRACE HARDWARE IS LOOSE

BENT 30

PILE D 50% OF PILE NOT TOUCHING CAP  
SS STRAP ON PILE D IS LOOSE  
PILE F EAST FACE VERTICAL DIAGONAL HARDWARE IS WORKING

BENT 31

APPEARS IN SERVICEABLE CONDITION

BENT 32

APPEARS IN SERVICEABLE CONDITION

BENT 33

PILE E SS STRAP MISSING HARDWARE  
PILE H 100% OF PILE NOT TOUCHING CAP  
THE EAST FACE VERTICAL DIAGONAL HAS NO HARDWARE ON PILE D  
THE WEST FACE VERTICAL DIAGONAL HAS NO HARDWARE ON PILE E  
PILES E AND G HAVE SUSPENDED JACKETS

BENT 34

PILE F HAS 80% OF PILE NOT TOUCHING THE CAP  
PILE H HAS 50% OF PILE NOT TOUCHING THE CAP  
HORIZONTAL X BRACE MISSING HARDWARE

BENT 35

PILE D 60% OF PILE NOT TOUCHING THE CAP  
THE HORIZONTAL X BRACES ARE 60% WASTED  
PILE F HAS A SUSPENDED JACKET

BENT 36

APPEARS IN SERVICEABLE CONDITION

BENT 37

PILE E 90% OF PILE NOT TOUCHING THE CAP  
PILE E IS 70% WASTED (TOP OF PILE SPLIT)  
PILE G 90% OF PILE NOT TOUCHING THE CAP

BENT 38

PILE H HAS 100% OF PILE NOT TOUCHING THE CAP  
PILE H HAS BROKEN SS STRAPS

BENT 39

APPEARS IN SERVICEABLE CONDITION

BENT 40

PILE E 100% OF PILE NOT TOUCHING CAP  
PILE F 90% OF PILE NOT TOUCHING CAP AND SS STRAP HARDWARE WORKING  
WEST FACE VERTICAL DIAGONAL X BRACE BROKEN

BENT 41

PILE G 90% OF PILE IS NOT TOUCHING CAP  
PILE H 80% NOT TOUCHING CAP

BENT 42

APPEARS IN SERVICEABLE CONDITION

BENT 43

PILE G 100% OF PILE IS NOT TOUCHING CAP  
PILE H 100% OF PILE IS NOT TOUCHING CAP  
PILE CAP 60% WASTED

BENT 44

PILE C SS STRAP MISSING HARDWARE  
WEST FACE VERTICAL DIAGONAL IS MISSING HARDWARE ON PILE D

BENT 45

PILE C 100% OF PILE IS NOT TOUCHING THE CAP  
PILE C SS STRAP HAS NO HARDWARE  
PILE E 100% OF PILE IS NOT TOUCHING THE CAP  
PILES D AND B ARE 50% DETERIORATED  
PILE F IS 80% DETERIORATED  
HORIZONTAL X BRACE HARDWARE 60% WASTED  
CAP IS 50% WASTED

BENT 46

PILE H 90% OF PILE NOT TOUCHING CAP  
HORIZONTAL X BRACE HARDWARE 90% WASTED  
CAP IS 80% WASTED

BENT 47

EAST FACE VERTICAL DIAGONAL MISSING HARDWARE ON PILE D  
CAP IS 50% WASTED

BENT 48

CAP IS 50% WASTED

BENT 49

APPEARS IN SERVICEABLE CONDITION

BENT 50

PILE D IS SEVERELY SPLIT ON THE EAST FACE 90% WASTED

PILE F IS 60% WASTED AND 20% OF PILE NOT TOUCHING CAP

PILE H IS 70% WASTED AND 20% OF PILE TOUCHING THE CAP

CAP 50% WASTED

**SYNOPSIS:**

**FISHING PIER**

HURRICANE DRIVEN ELEVATED SEAS AND CURRENT HAVE SCOURED OUT THE GROUND LINE REMOVING SAND BY APPROXIMATELY - 3' FROM THE BASELINE SET AFTER HURRICANE MATTHEW ALONG THE FISHING PIER, RESULTING IN LESS PILE EMBEDMENT DEPTH /BURIAL AND ALLOWING MORE MOVEMENT "WORKING" OF THE SUBSTRUCTURE.

**RECOMMENDATIONS:**

- 1) REMOVE AND REPLACE ALL MISSING, FAILED, LOOSE, CRACKED CROSS BRACING.
- 2) REPAIR ALL SUSPENDED EPOXY PILE JACKET REPAIRS BY INSTALLING PILE JACKET EXTENSIONS FROM THE LOWER SUSPENDED ELEVATION INTO THE EXISTING GROUND LINE - 3'.
- 3) JACK, SHIM, AND LEVEL ALL LOOSE PILES THAT ARE NOT TOUCHING PILE CAPS AND CARRYING DECK LOAD.
- 4) REPLACE ALL FAILED OR MISSING HURRICANE STRAPS AND HARDWARE.
- 5) APPLY 2-PART EPOXY IN ALL UPPER ELEVATION PILE JACKETS GAPS. INJECT OR FORCE EPOXY INTO THE ANNULAR SPACE FOR PERMANENT REPAIR.
- 6) INSTALL 3/4" GALVANIZED THROUGH BOLTS WITH 3/4" GALVANIZED OGEE WASHERS ON THE ENDS OF ALL STRINGERS INTO THE CORRESPONDING STRINGER ENDS TO BETTER TIE THEM TOGETHER AT EACH BENT.

/SCOTT C. ANDERSON/

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BENT 47 PILE D



BENT 13 PILE



BENT 13 PILE C



BENT 37 PILE E





BENT 45 PILE C AND E



BENT 17 TO 18 FAILED CROSS BRACING