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PORT HARDY SEAGATE PIER

INSPECTION REPORT

PREPARED FOR:

PREPARED BY:

ONSITE Engineering Ltd.

June 30, 2016

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1.0 INTRODUCTION

On April 27th and 28th, 2016, Onsite Engineering Ltd. (OEL) and Pacificus Biological Services Ltd (Pacificus) conducted an inspection of the Seagate Pier in Port Hardy, BC. The OEL representatives consisted of Jeremy Araki, P.Eng. and Matthew Dickie, EIT. The Pacificus representatives included David Pratt, Ryan Sirges, Tristan Gale, and Adam Harding.

1.1 SCOPE OF WORK

The pier inspection was limited to the pier approach, pier head, gangway and 2 floats. Float 3, buildings, and any other additional structures were excluded from the inspection. OEL inspected the pier components above the current low water at the time and Pacificus inspected the submerged portion of piles and bracing.

1.2 REFERENCE MATERIAL

Prior to the inspection the following documents were provided to OEL:

- Inspection of the general condition of the Municipal Steel Pre-fabricated building located on the Seagate Dock (Coast Guard Building), August 2013.
- Underwater assessment of the Seagate Loading/Unloading Float, Fisherman's Wharf Loading/Unloading Float, Seaplane Float and the Seine Float Anchoring System, August 2010.
- Seagate Approach Inspection, March 2007.
- Port Hardy Wharf and Floats Underwater Inspection, June 1998.

2.0 PROCEDURES

The inspection was performed with a top down approach, visually inspecting the asphalt surfacing, decking, stringers, cap beams, piles and bracing. Sounding/coring of various components was completed where necessary. Where coring occurred a 3/8" hole was drilled to the center of the component. The resulting hole was then plugged with a wooden dowel, soaked in end treatment (a precaution to prevent an opening to provide a pathway for rot to enter the component).

The site was accessed by truck, foot and skiff and site equipment included 2 ipads, 25' tape measure, 100' measuring tape, axe, hammer, and cordless drill with 5/8" drill bit. The precision of all measurements referenced herein are affected by the equipment used and ability to measure the actual component in the field.

The components from bent -1 to 13 were inspected from land during low tide. Components from bents 14 to 58 were inspected by skiff and divers. The skiff was used to inspect components from the low water line at the time to the underside of the decking, using the fluctuation of the tides to access the various component at different elevations. Divers were used to inspect the portion of the pier below water, which included visually inspecting piles and bracing, and prodding the components, connections, and mudline of the piles to estimate section loss due to rot (Appendix 2.0).

3.0 GEOMETRY

The Seagate pier consists of the pier approach, pier head, gangway and 3 floats. All structural components on the underside of the pier consist of creosote treated wood. The decking is made of creosote treated lumber and is surfaced with asphalt. All components are referenced by their associated pile column letter and bent number. The pier components and reference system can be seen in Figure 3.0.1.

3.1 PIER APPROACH

The pier approach is 26' wide and spans 370' from bent -1 to the pier head at bent 38 and can be seen in Figure 3.0.1. The structure consists of decking, supported by stringers, supported by cap beams, supported by piles. Depending on their location, the piles are restrained by various bracing members as shown in Figure 3.0.1.

Typical approach component dimensions are shown in table 3.1.1:
Table 3.1.1. Typical approach component dimensions.

Component	Dimensions
Decking	4" x 12" Typically Spanning18"
Outside Stringers	12" x 13.5" Typically Spanning10'
Internal Stringers	6" x 13.5" Typically Spanning 10'
Cap Beams	12" x 13.5" Typically Spanning 8'
Cross Bracing (North/South Bents -1 to 12)	6" x 8" (Length Varies With Pile Height)
Cross Bracing (North/South Bents 13 to 26)	6" x 8" x 12'
Cross Bracing (North/South Bents 26 to 36)	6" x 8" x 24'
Cross Bracing (East/West)	6" x 8" x 24'
Horizontal Bracing (East/West)	6" x 8" x 12' or 24'
Posts/Piles	Range from 11" to 16"+ Diameter (Typically on a 8' by 10' Grid)

3.2 PIER HEAD

The pier head is 72' wide and spans 200' from bent 38 to bent 58 and can be seen below in figure 3.2.1. and 3.2.1. The structure consists of decking, supported on stringers, supported on cap beams, supported on piles. Depending on where, the pier approach piles are restrained by various bracing members and can be seen in Figure 3.0.1.

Typical pier head component dimensions can be seen in table 3.2.1:

Table 3.2.1. Typical pier head component dimensions

Component	Dimensions
Decking	2” x 6” (On Edge) Typically Spanning18”
Outside Stringers	12” x 13.5” Typically Spanning10’
Internal Stringers	6” x 13.5” Typically Spanning 10’
Cap Beams	12” x 13.5” Typically Spanning 8’
Cross Bracing (North/South Bents 26 to 36)	6” x 8” x 24’
Cross Bracing (East/West)	6” x 8” x 24’
Horizontal Bracing (East/West)	6” x 8” x 12’ or 24’
Horizontal Bracing (North/South)	6” x 8” x 24’
Piles	Range from 11” to 16”+ Diameter (Typically 8’ by 10’ Grid)
Batter Piles	Range from 11” to 16” Diameter
Fender Piles	Range from 11” to 16” Diameter

3.3 FLOATS

There are three timber floats on the south side of the approach pier that are accessed from the pier via a metal gangway. The gangway extends from the pier approach down onto a 14’ by 42’ timber float (Float 1), which is connected to a 14’ by 100’ float (Float 2) (Sutton, 1998). Float 1 is moored to a four pile dolphin on the southern end and is fastened to Float 2. Float two is has been built around 2, 6-pile dolphins and is fastened to Float 1. The third float was gated at the time of the inspection and was not included in the inspection. Floats 1 and 2 can be seen in figure 3.3.1.

4.0 RESULTS

The inspection revealed a number of issues with components on both the pier approach and pier head. Miscellaneous issues indirectly affecting pier components included minor cracking of asphalt on the pier approach, significant deterioration of asphalt on pier head (Figure 4.0.1.), lack of lashing around fender pile dolphins, and inadequate lamppost bracing (Figure 4.0.2.).

4.1 BEARING PILES/POSTS

In general, the piles are in good condition. The only recurring issues with the bearing piles were splitting and checking, an example of which can be seen in figure 4.1.1. Table 4.1.1 summarizes all issues with piles, concerns associated with individual piles can be seen in (Appendix 4.1.1.) In addition to splitting/checking there was a missing pile, a hollow pile, a loose pile, and a cracked concrete post base.

Table 4.1.1. Summary of bearing pile condition.

Section	Condition	Number of Components Affected
Pier Approach	Split	13
Pier Head	Split	12
	Loose Pile	1
	Rotten Pile	1

All connections between batter piles and bearing piles are intact; however, significant corrosion was noted on approximately 50% of these connections.

Inspection of piles below the waterline indicated very little cross sectional loss due to rot. The percent section loss varies from 0 to 5% with a median of 1% section loss (Appendix 2.0).

4.2 BRACING

Numerous cross/horizontal bracing members were missing bolts (corroded and failed), cracked, or rotten. Table 4.2.1 summarizes all issues with bracing. Appendix 4.2.1 outlines all issues with cross bracing that runs along bents. Appendix 4.2.2 outlines all issues with cross bracing that runs along pile columns. Appendix 4.2.3 outlines all issues with horizontal bracing. An example of broken bracing can be seen in figure 4.2.1.

Table 4.2.1. Summary of bracing condition.

Section	Member Type	Condition	Number of Components Affected
Pier Approach	Cross Bracing Running Along Bents	Rotten/Missing	12
		Split	2
		Missing Bottom Bolt	3
	Cross Bracing Running Along Pile Columns	Rotten	3

	Horizontal Bracing	Rotten	3
Pier Head	Cross Bracing Running Along Bents	Rotten	3
		Split	2
		Missing Bottom Bolt	49
	Cross Bracing Running Along Pile Columns	Rotten	4
		Missing Bottom Bolt	1
	Horizontal Bracing	Rotten	13
		Missing Bolt/Blocking	8
		Braced to Wrong Pile	1

4.3 CAP BEAMS

There were 7 problem cap beams identified during the inspection. Issues included crushed ends and rot. Table 4.3.2 outlines all cap beam issues found during the inspection. Figure 4.3.1. shows an example of a rotten cap beam. It should be noted that problem cap beams only occur at exposed ends and at the bents that are at the ends of the building located on the pier head. It is likely that the encountered issues are the result of exposing the caps to excessive moisture/weather.

Table 4.3.1. Issues associated with cap beams on pile bents.

Section	Bent #	Condition	Recommendation	Comment
Pier Head	42	Split	Fishplate	End Over Pile J Split
	45	End Crushed, Rest Of Beam Suspect	Fishplate	End Over Pile J Crushed, Remaining portion Damp But Not Rotten
	46	End Crushed, Rest Of Beam Suspect	Fishplate	End Over Pile J Crushed, Remaining portion Damp But Not Rotten
	47	Suspect	Fishplate	Beam Damp But Not Rotten.
	54	Rotten	Fishplate	Beam Rotten From Piles D to J, Remainder in Fair Condition
	57	Crushed	Fishplate	End Crushed Over Pile A
	58	Rotten	Closure	No Mooring On Eastern End Of Pier Until Bent Replaced

4.4 STRINGERS

Inspection of stringers on the pier approach and pier head revealed very little signs of damage away from the edges of the pier. The only stringer damage observed occurred on the edges of the pier head at bents 39 and 58. A table outlining where stringer damage occurred can be seen in table 4.4.1.

Table 4.4.1. Issues associated with stringers on pile bents.

Section	Bent #	Number Of Stringers Affected	Condition	Recommendation	Comment
Pier Head	39	3	Cracked and Crushed	Replace	End Over Pile G Cracked, Next Stringer To the South Cracked, Stringer Over Pile F Crushed
	58	8	Rotten, Cracked and Crushed	Replace	8 Problem Stringers Identified on Bent, Include Rotten, Crushed and Cracked Stringers

4.4 BENT 58

Many of the major issues encountered occurred at bent 58. Overall bent 58 is in poor condition and requires considerable work to ensure this portion of the pier functions adequately. Issues present at bent 58 include a mooring cleat fastened through only the pier decking, 8 problem stringers (rotten/crushed/cracked), a rotten cap beam, a hollow pile, a missing pile, a split pile and rotten fender piles which are not lashed.

4.5 FLOATS

Timber floats 1 and 2 were inspected and found to be in generally good condition and require only minor improvements. The Northeastern corner of Float 2 sits low in the water. Other concerns regarding wear occur at the connections between the two floats and around the dolphins that hold float 2 in place.

5.0 LOAD RATING

OEL completed a load analysis for vehicular traffic on the pier approach and head and mooring load on the pier head. Vehicle loading generally follows CAN/CSA-S6 and the BCL-625 design vehicle was used for axle loading. Obviously, the maximum sized vehicle will also be governed by the geometry of the pier. Mooring forces were calculated using a 60m long, 9m high (above water) vessel. A maximum 1m high wave with 0.75kPa wind pressure combined load was used as the limiting condition.

The pier pile caps and beams are capable of withstanding the 140kN maximum axle load associated with a BCL-625 design vehicle. Due to vehicle tracking, the actual maximum sized vehicle is likely limited to a three axle truck. However, a tractor/trailer may be able to back on and drive off of the structure on the north side of the pier head. Design values and factors of safety are all from CAN/CSA-S6 and CAS/CSA-O86 and were not reduced to achieve these ratings.

The analysis of the above mentioned vessel was completed using the assumption that the deck of the pier head provides adequate transverse stiffness, and the internal bracing is fully functional. Further, only the piles in the nearest half of the pier head were assumed for resistance, although the entire pier head is required to provide overturning resistance given the very shallow pile penetration (reported as 4'-6' by the contractor). Ignoring the batter piles, the structure is not quite capable of safely housing the design vessel. Therefore, the batter piles, and their connection at the top, are of utmost importance to achieve the full mooring load capacity. Further, the suggested repair to the bracing and batter pile bolts herein are critical to the applicability of this load rating. No global factor of safety was applied to this rating. However, in our experience, the wood strength values from the above CAN/CSA references contain a healthy factor of safety when applied to full logs (rather than small dimensional lumber for which they are tabulated). Further, our assumption in wind loading for the above vessel was very conservative. These points, combined with the past performance of the structure and the upcoming repairs, give confidence in the ability of the structure to safely moor large vessels.

Until the end of the pier head is repaired, the signage for no mooring should remain. Further, it is suggested that, in the event of a large storm, only one large vessel should be moored to the pier head.

6.0 RECOMMENDATIONS

Immediately, the mooring cleat on bent 58 should be removed and the pier head should be signed to ensure no mooring of vessels on the Eastern end of the pier. Before mooring is permitted on the eastern end of the pier head, bent 58 must be replaced. Bent replacement will require a row of new piles, driven inside the old piles, and a new cap beam should be placed on the new piles. The stringers and decking between bents 57 and 58 may require replacement at this time to facilitate driving piles.

Internal cap beams should be repaired by fishplating identified problem cap beams and the supporting piles the caps rest on. This will allow the stringers to be supported by the fishplate rather than the existing cap beam. The fishplating, banding and stringer replacement program should be implemented at the same time to further utilize the same system.

Bracing and bolt replacement should occur at the same time as both will require the same tools and may be restricted by tidal access. All bolts at the tops of the batter piles must be replaced. Where deterioration is noted in the batter pile or the vertical pile around the connection, an alternate location for the connection must be found (i.e. the next pile in, or connecting the batter pile to the cap beam). These batter piles are critical to the performance of the pier.

Asphalt sealing is a high priority as it protects all components below the deck. It should be noted that special attention should be paid to the seal around the coast guard building as problems with cap beam rot appear to be a direct result of water ingress around the building. Asphalt sealant is an acceptable medium for repairs to both asphalt cracks and the sealant around the coast guard building.

The current system used to anchor the lampposts is ineffective. The current C-channel bracing used should be replaced with 10”x20”x1/2” steel plating or 20” long 10” C-channel. If C-channel is used it is important that the flange is facing down when installed. This proposed “C” channel orientation is to prevent the flanges from cutting into the stringers it braces against as the bolts are tightened.

The fender piles should be lashed. This can be done from the pier deck by using a hiab to tighten/install lashing.

Only minor work is required on the floats. The excess clearance around the dolphins float 2 is secured by should be reduced by building up the inside of their opening with creosote treated timbers to reduce play in both the north/south and east/west directions to 2”. The connection between floats 1 and 2 should be reduced to allow for a maximum of 4” of play. The foam billet under the northeast corner should be replaced.

A summary of the proposed repairs, their priority and their expected costs can be seen in table 6.0.1. It should be stressed that all hardware used in repairs should be galvanized or stainless steel, all timbers/piles be creosote treated, and all newly installed stringers, cap beams, and piles have their exposed ends covered with flashing to prevent rot.

Table 6.0. Summary of recommendations, priority and expected cost to rectify issues identified during Seagate pier inspection.

Project #	Timing	Repair	Additional Timing Information	Number Of Components Affected	Estimated Cost ($)*
N/A	N/A – Repairs In Progress	Replace Float Billet	N/A – Repairs In Progress	1	N/A – Repairs In Progress
	N/A – Repairs In Progress	Reduce Play Around Float Dolphins	N/A – Repairs In Progress	2	N/A – Repairs In Progress
1	Immediately	Remove Mooring Cleat on Eastern End Of Pier	Minor Repair, No Significant Benefit Completing Repair Concurrently With Other Repairs. Should Occur Immediately To Reduce Risk Of Damage To Pier.	1	$450
1	Immediately	Sign "No Mooring At End Of Pier"	Minor Repair, No Significant Benefit Completing Repair Concurrently With Other Repairs. Should Occur Immediately To Reduce Risk Of Damage To Pier.	Signs have been posted on the end of the pier head	N/A – Signage installed
1	0-1 years	Seal Asphalt	Minor Repair, No Significant Benefit Completing Repair Concurrently With Other Repairs. Repair Should Precede Repairs To Structural Components Below Deck To Maximize Lifespan of New Members and Reduce the Rate Of Further Deterioration Of Existing Members.	Approx. 280lm	$2,870
1	0-1 Years	Repair Bracing	Major Repair, Repairing All Bracing at Once Will Best Utilize Having Construction And Staging Equipment On Site. Additional Efficiencies Are Expected If Coupled With the Banding, Fishplating, Stringer Replacement Program.	Replace Bracing Bolt –60 Replace Batter Bolt – 30 Replace 12' Member – 7 Replace 24' Member – 48	$68,860
2	0-2 Years	Lash Fender Piles	Minor Repair, No Significant Benefit Completing Repair Concurrently With Other Repairs.	49	$11,990
3	0-3 Years	Banding, Fishplating, Replace Stringer	Major Repair, Completing All Banding, Fishplating, Stringer Replacement At Once Will Best Utilize Having Construction And Staging Equipment On Site. Additional Efficiencies Are Expected If Coupled With the Bracing Repair Program.	Bands – 22 Fishplate End – 6 Fishplate Entire Beam – 4 Replace 10" of Stringer - 3	$114,180
3	0-5 Years	Re-Anchor Lamppost	Minor Repair, No Significant Benefit Completing Repair Concurrently With Other Repairs.	4	$1,030
4	0-5 Years (longer if you also close the end of the pier to traffic)	Replace Bent 58	Major Repair, Will Require Considerable Work And Special Equipment Onsite	Entire Bent	$132,275
*Cost Estimate Excludes Taxes and Mobilization Costs					

A qualified registered professional should complete construction inspections during the commencement of the bent 58 replacement program, the bracing program, and the banding, fishplating, and stringer replacement program. All repairs should be inspected by a qualified registered professional upon completion.

Sincerely,
Onsite Engineering Ltd.

Matthew Dickie, EIT
Project Engineer

Reviewed by:

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
J. C. P. ARAKI
29756
JUN 30 2016

Jeremy Araki, P. Eng
Supervising Engineer

FIGURE 3.0.1. Diagram showing pier dimensions, component configurations and the alpha/numeric bent/pile identification system used for the Seagate pier inspection.

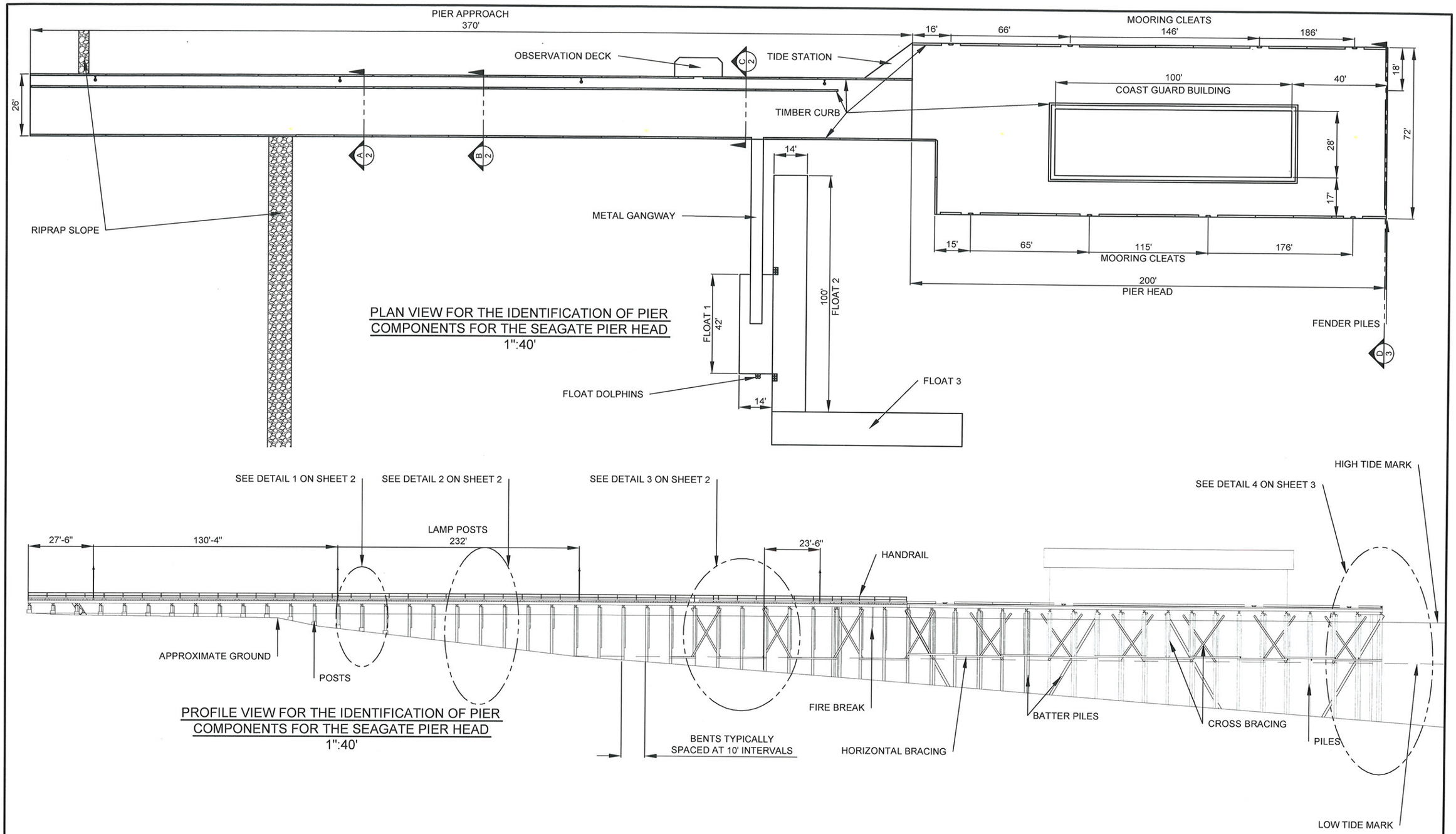

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FIGURE 3.0.1. DIAGRAM SHOWING PIER DIMENSIONS, COMPONENT CONFIGURATIONS AND THE ALPHA/NUMERIC BENT/PILE IDENTIFICATION SYSTEM USED FOR THE SEAGATE PIER INSPECTION.

DWG No:1439-1-SEAGATEPIER- 001

SHEET: 1 OF 4

DESIGN BY: N/A
DESIGN DATE: N/A
REVIEWED BY: N/A
DRAWN BY: MATTHEW DICKIE, EIT
SITE VISIT: ONSITE ENGINEERING LTD.
SITE VISIT DATES: APRIL 27/28, 2016
FILE NAME: SEAGATEPIER.DWG
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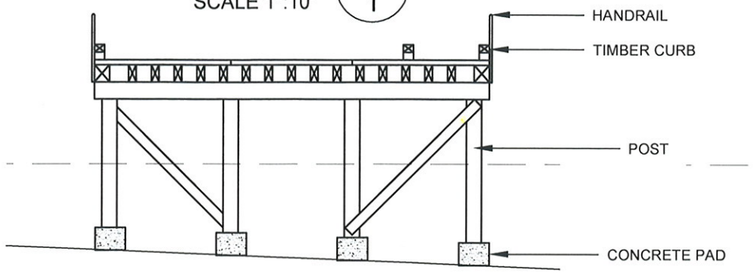

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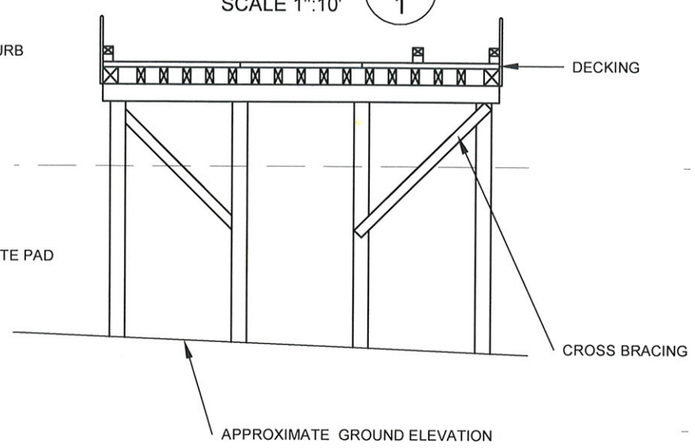

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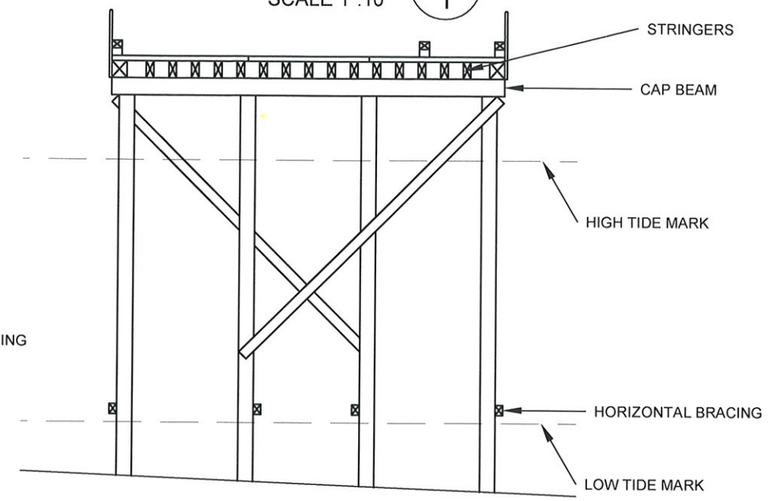

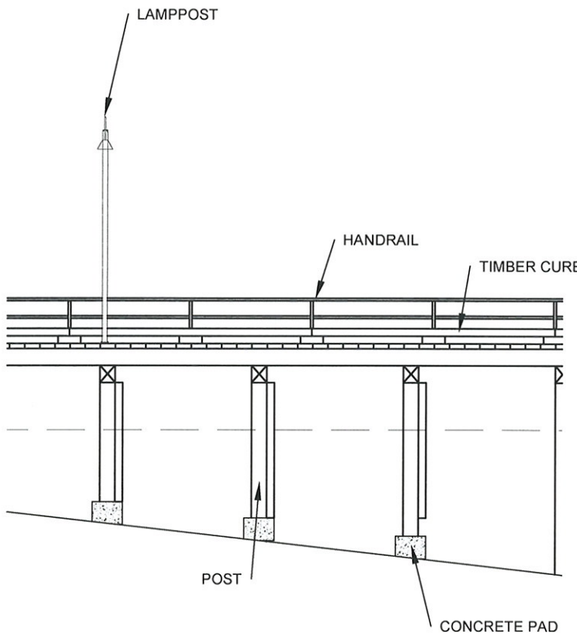

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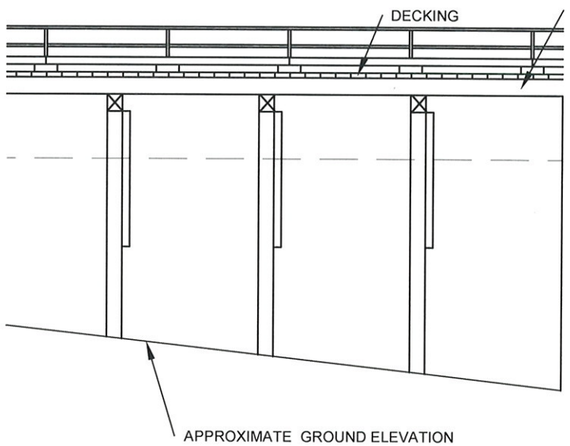

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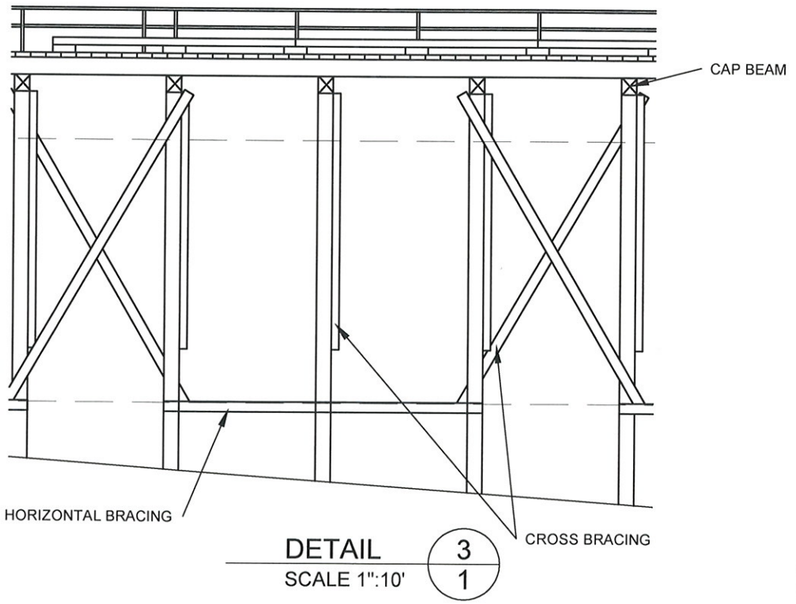

DETAIL
SCALE 1":10'
3
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FIGURE 3.0.1. DIAGRAM SHOWING PIER DIMENSIONS, COMPONENT CONFIGURATIONS AND THE ALPHA/NUMERIC BENT/PILE IDENTIFICATION SYSTEM USED FOR THE SEAGATE PIER INSPECTION.

DWG No:1439-1-SEAGATEPIER- 002

SHEET: 2 OF 4

DESIGN BY: N/A
DESIGN DATE: N/A
REVIEWED BY: N/A
DRAWN BY: MATTHEW DICKIE, EIT
SITE VISIT: ONSITE ENGINEERING LTD.
SITE VISIT DATES: APRIL 27/28, 2016
FILE NAME: SEAGATEPIER.DWG
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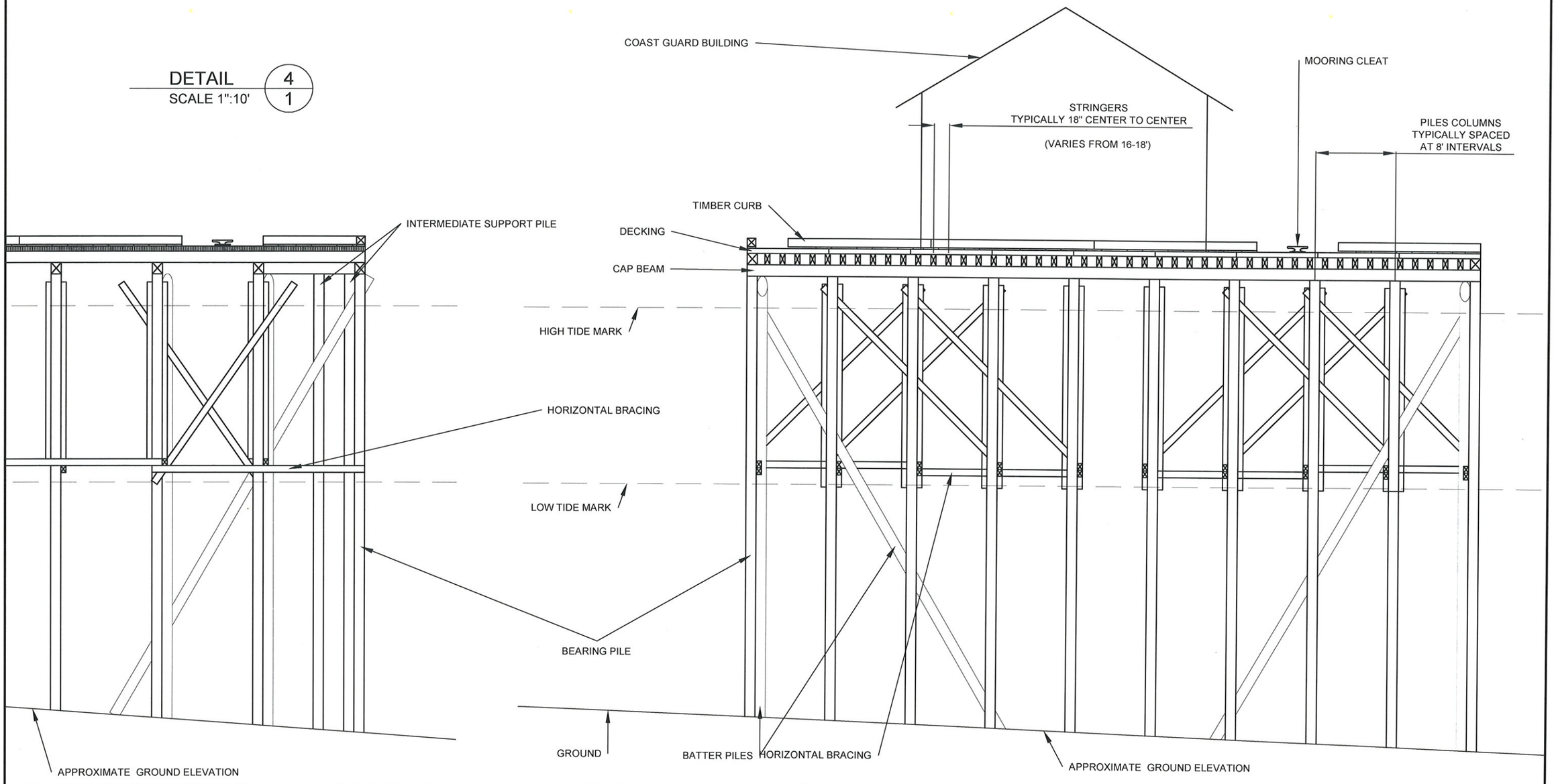

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DWG No:1439-1-SEAGATEPIER-003

SHEET: 3 OF 4

DESIGN BY: N/A
DESIGN DATE: N/A
REVIEWED BY: N/A
DRAWN BY: MATTHEW DICKIE, EIT
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SITE VISIT DATES: APRIL 27/28, 2016
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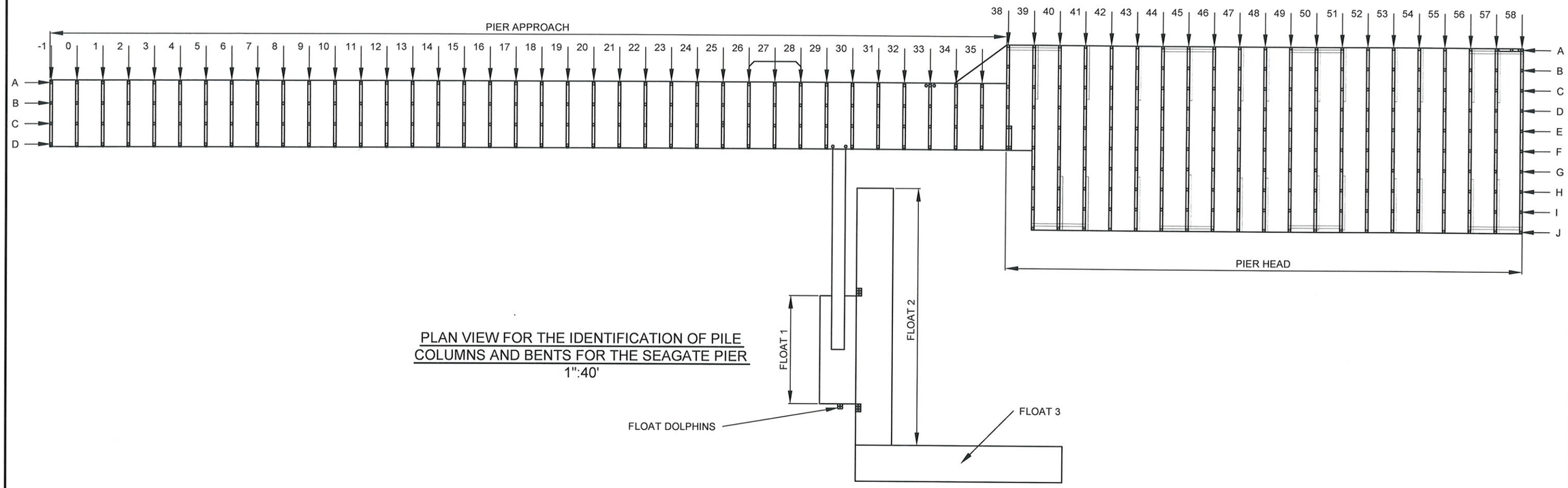

PLAN VIEW FOR THE IDENTIFICATION OF PILE COLUMNS AND BENTS FOR THE SEAGATE PIER
1":40'

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COASTAL OPERATIONS
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FIGURE 3.0.1. DIAGRAM SHOWING PIER DIMENSIONS, COMPONENT CONFIGURATIONS AND THE ALPHA/NUMERIC BENT/PILE IDENTIFICATION SYSTEM USED FOR THE SEAGATE PIER INSPECTION.

DWG No:1439-1-SEAGATEPIER- 004

SHEET: 4 OF 4

DESIGN BY: N/A
DESIGN DATE: N/A
REVIEWED BY: N/A
DRAWN BY: MATTHEW DICKIE, EIT
SITE VISIT: ONSITE ENGINEERING LTD.
SITE VISIT DATES: APRIL 27/28, 2016
FILE NAME: SEAGATEPIER.DWG
SCALE: AS NOTED
REVISION NUMBER:
REVISION DATE:
ALL MEASUREMENTS IN INCHES UNLESS OTHERWISE NOTED.

	Figure 3.1.1. View of pier approach from shore. Photo April 27, 2016
	Figure 3.2.1. View of Southeast corner of pier head. Photo April 28, 2016
	Figure 3.2.2. View of Northwest corner of pier head. Photo April 28, 2016

	Figure 3.3.1. View of the timber floats from the pier head. Photo April 28, 2016
	Figure 4.0.1. View of deteriorated asphalt on pier head. Photo April 27, 2016
	Figure 4.0.2. View of inadequate bracing that anchors lampposts to pier approach. Photo April 27 2016

	Figure 4.1.1. An example of a typical split post top at post 6A. Photo April 27, 2016
	Figure 4.2.1. An example of a typical broken cross brace at pile 32D Photo April 27 2016
	Figure 4.3.1. Cap beam 54 showing signs of rot. Photo April 27, 2016

APPENDIX 2.0. PACIFICUS FIELD NOTES.

Seagate Wharf Piling Inspection
*all others given as percent loss of load-bearing pile
*fender piles given as fraction of piles in grouping rotted out

Piling #	% loss or number of fenders compromised	
15A	1	
15B	1	
16A	3	
16B	1	
16C	0	
16D	0	
17A	1	
17B	1	
17C	0	
17D	0	
18A	1	
18B	1	
18C	0	
18D	0	
19A	1" X 2" bore hole	
19B	1	
19C	1	
19D	0	
20A	1	
20B	1	
20C	4	
20D	0	
21A	0	
21B	5	
21C	0	
21D	1	
22A	1	
22B	1	
22C	0	
22D	0	
23A	0	
23B	1	
23C	0	
23D	0	
24A	1	
24B	cross member bolt rusted	

Piling #	% loss or number of fenders compromised	
24C	0	
24D	0	
25A	0	
25B	cross member bolt rusted	
25C	0/0	
25D	1	
26A	1	
26B	1, cross member bolt missing, cross member is loose	
26C	0	
26D	0	
27A	1	
27B	1	
27C	0	
27D	0	
28A	1	
28B	1	
28C	0	
28D	0	
29A	1	
29B	3	
29C	0	
29D	0/2	
30A	1	
30B	1	
30C	0	
30D	0/0	
31A	1	
31B	1	
31C	2	
31D	0	
32A	5	
32B	1	
32C	1	
32D	0	
33A	1/1/1	
33B	1	
33C	0	
33D	0	
34A	1	
34B	1	

Piling #	% loss or number of fenders compromised	
34C	0	
34D	1	
35B	3	
35C	0	
35D	0	
36A	1	
36B	0	
36C	1/1	
36D	2/1	
36E	2	
36F	2	
36A-F	0/4	*fender*
39A-F	0/3	*fender*
39A	0	
39B	3	
39C	1/1	
39D	0/0	
39E	0	
39F	0	
39G	0	
39H	2	
39I	5	
39J	2	
39J-F	0/3	*fender*
40A-F	0/4	*fender*
40A	1	
40B	1	
40C	0	
40D	0	
40E	0	
40F	0	
40G	0	
40H	0	
40I	1	
40J	1	
40J-F	0/4	*fender*
41A-F	0/3	*fender*
41A	0	
41B	0	
41C	3/0	

Piling #	% loss or number of fenders compromised	
41D	2	
41E	2	
41F	0	
41G	0	
41H	0	
41I	3	
41J	0	
41J-F	0/3	*fender*
42A-F	0/3	*fender*
42A	1	
42B	3	
42C	2	
42D	1	
42E	1	
42F	2	
42G	2	
42H	1	
42I	2	
42J	2	
42J-F	0/3	*fender*
43A-F	0/3	*fender*
43A	1	
43B	1	
43C	0/3	
43D	0	
43E	0	
43F	1	
43G	0	
43H	0/0	
43I	0	
43J	0	
43J-F	0/3	*fender*
44A-F	0/3	*fender*
44A	2	
44B	2	
44C	2	
44D	5	
44E		
44F	0	
44G	1	

Piling #	% loss or number of fenders compromised	
44H	2	
44I	0	
44J	2	
44J-F	0/3	*fender*
45A-F	0/3	*fender*
45A	1	
45B	1	
45C	0/0	
45D	1	
45E	0	
45F	0	
45G	0	
45H	0/0	
45I	0	
45J	0	
45J-F	0/3	*fender*
46A-F	0/3	*fender*
46A	0	
46B	5	
46C	2	
46D	1	
46E	2	
46F	2	
46G	3	
46H	3	
46I	1	
46J	0	
46J-F	0/3	*fender*
47A-F	0/4	*fender*
47A	0	
47B	3/0	
47C	0/0	
47D	0/0	
47E	1	
47F	3	
47G	0	
47H	0/0	
47I	0	
47J	0	
47J-F	0/3	*fender*

Piling #	% loss or number of fenders compromised	
48A-F	0/5	*fender*
48A	2	
48B	1	
48C	1	
48D	0	
48E	2	
48F	3	
48G	2	
48H	1	
48I	2	
48J	1	
48J-F	0/3	*fender*
49A-F	0/3	*fender*
49A	2	
49B	1	
49C	1	
49D	1	
49E	0	
49F	0	
49G	0	
49H	3	
49I	0	
49J		
49J-F	0/3	*fender*
50A-F	0/5	*fender*
50A	2	
50B	2	
50C	1	
50D	2	
50E	4	
50F	2	
50G	2	
50H	1	
50I	2	
50J	3	
50J-F	1/4	*fender*
51A-F	0/3	*fender*
51A	0	
51B	0	
51C	0	

Piling #	% loss or number of fenders compromised	
51D	1	
51E	1	
51F		
51G	3	
51H	1	
51I	0	
51J	1	
51J-F	0/3	*fender*
52A-F	0/5	*fender*
52A	2	
52B	2	
52C	2	
52D	3	
52E	4	
52F	1	
52G	2	
52H	1	
52I	2	
52J	3	
52J-F	0/3	*fender*
53A-F	0/3	*fender*
53A	1	
53B	0	
53C	1	
53D	1	
53E	0	
53F	3	
53G	1/1	
53H	1	
53I	2	
53J	0	
53J-F	0/3	*fender*
54A-F	0/5	*fender*
54A	1	
54B	2	
54C	1	
54D	1	
54E	1	
54F	2	
54G	1	

Piling #	% loss or number of fenders compromised	
54H	1	
54I	1	
54J	1	
54J-F	0/3	*fender*
55A-F	0/3	*fender*
55A	1	
55B	1	
55C	1	
55D	1	
55E	1	
55F	1	
55G	1	
55H	0	
55I	0	
55J	0	
55J-F	0/4	*fender*
56A-F	0/5	*fender*
56A	2	
56B	2	
56C	1	
56D	2	
56E	1	
56F	1	
56G	2	
56H	1	
56I	1/2	
56J	1	
56J-F	0/3	*fender*
57A-F	0/4	*fender*
57A	0	
57B	0	
57C	1	
57D	1	
57E	0	
57F	1	
57G	0	
57H	1	
57I	1	
57J	1	
57J-F	0/3	*fender*

Piling #	% loss or number of fenders compromised	
58A	2	
58B	2	
58C	3 - hollow?	
58D	1	
58E	1	
58F	1	
58G	2	
58H	1	
58I	1	
58J	2	
End-A	0/7	*fender*
End-B	0/3	*fender*
End-C	0/5	*fender*
End-D	0/3	*fender*
End-E	0/3	*fender*
End-F	0/3	*fender*
End-G	0/4	*fender*
End-H	0/3	*fender*
End-I	0/5	*fender*
End-J	0/8	*fender*
CG Float N	0/6	*group*
CG Float SW	0/4	*group*
CG Float SE	0/6	*group*

APPENDIX 4.1.1. ISSUES ASSOCIATED WITH BEARING PILES.

Section	Bent #	Pile ID	Issue	Repair	Comment
Pier Approach	6	A	Split	Band	Split But Solid
	11	C	Split	Band	
	12	C	Minor Split	Band	
	16	D	Split	Band	
	17	A	Checked	Band	
	21	A	Split	Band	
	22	B	Split	Band	
	22	C	Split	Band	
	24	C	Minor Check	Monitor	
	26	D	Checked	Band	
	28	D	Checked	Band	
	31	A	Severely Split	Band	
	32	A	Minor Check	Band	
Pier Head	39	H	Split	Band	
	39	J	Split	Band	Replace Band With Heavier Band
	40	A	Severely Split	Install Fishplating	Split And Banded, Existing Banding Ineffective
	43	A	Severely Split	Install Fish Plating Or Replace	Banded and Split, Existing Banding Ineffective, Split Extends 2+m From Top.
	43	J	Split	Band And Install Fishplating	
	44	A	Split	Band	Replace Band With Heavier Band
	47	H	Split	Band And Replace Bolts	Replace Band With Heavier Band, Replace Bolts
	47	I	Split	Band	
	51	D	Pile Loose	Add Horizontal Bracing	Add Horizontal from 51D to 52D
	51	F	Split	Band	
	51	I	Split	Band	
	53	J	Severely Split	Band Or Install Fishplating	
	58	C	Rotten	Replace	Pile Is Hollow
	58	G	Split	Band	

Section	Bent #	Pile ID	Issue	Repair	Comment
	58	I	Missing	Replace	

APPENDIX 4.2.1. ISSUES ASSOCIATED WITH CROSS BRACING ALONG BENTS.

Section	Bent #	From Pile "_" To Pile "_"	Issue	Other Issue	Repair	Comment
Pier Approach	12	C-D	Missing		Replace	
	15	C-D	Missing		Replace	
	16	A-B	Rotten		Replace	
	17	A-B	Rotten		Replace	
	18	A-B	Rotten		Replace	
	19	C-D	Missing		Replace	
	21	A-B	Split		Replace	
	24	B-D	Loose Bottom Bolt		Replace Bolt	
	25	B-D	Loose Bottom Bolt		Replace Bolt	
	26	B-D	Loose Bottom Bolt	Split	Replace	
	29	A-C	Rotten		Replace	
	31	A-C	Rotten		Replace	
	31	B-D	Rotten		Replace	
	32	B-D	Rotten		Replace	
	33	B-D	Rotten		Replace	
	35	A-C	Rotten		Replace	
Pier Head	40	B-D	Loose Bottom Bolt		Replace Bolt	
	40	D-B	Loose Bottom Bolt	Split	Replace	
	40	G-I	Loose		Replace	

Section	Bent #	From Pile "_" To Pile "_"	Issue	Other Issue	Repair	Comment
			Bottom Bolt		Bolt	
	41	B-D	Loose Bottom Bolt		Replace Bolt	
	41	D-B	Checked		Replace	
	41	F-H	Loose Bottom Bolt		Replace Bolt	
	41	J-H	Loose Bottom Bolt		Replace Bolt	
	42	A-C	Loose Bottom Bolt		Replace Bolt	
	42	F-H	Loose Bottom Bolt		Replace Bolt	
	42	G-I	Loose Bottom Bolt		Replace Bolt	
	42	J-H	Loose Bottom Bolt		Replace Bolt	
	43	A-C	Loose Bottom Bolt		Replace Bolt	
	43	D-B	Loose Bottom Bolt		Replace Bolt	
	43	F-H	Loose Bottom Bolt		Replace Bolt	
	43	G-I	Loose Bottom Bolt		Replace Bolt	
	43	J-H	Loose Bottom Bolt		Replace Bolt	
	44	B-D	Loose Bottom Bolt		Replace Bolt	
	44	F-H	Loose Bottom Bolt		Replace Bolt	
	44	J-H	Loose Bottom Bolt		Replace Bolt	
	45	G-I	Loose Bottom Bolt		Replace Bolt	
	46	A-C	Rotten		Replace	
	46	B-D	Rotten		Replace	
	46	E-C	Loose Bottom Bolt		Replace Bolt	
	46	F-H	Loose Bottom Bolt		Replace Bolt	
	46	G-I	Loose Bottom Bolt		Replace Bolt	

Section	Bent #	From Pile "_" To Pile "_"	Issue	Other Issue	Repair	Comment
	46	I-G	Loose Bottom Bolt		Replace Bolt	
	46	J-H	Loose Bottom Bolt		Replace Bolt	
	47	B-D	Loose Bottom Bolt		Replace Bolt	
	47	E-C	Loose Bottom Bolt		Replace Bolt	
	47	G-I	Loose Bottom Bolt		Replace Bolt	
	47	J-H	Loose Bottom Bolt		Replace Bolt	
	48	E-C	Rotten		Replace	
	48	F-H	Loose Bottom Bolt		Replace Bolt	
	48	G-I	Loose Bottom Bolt		Replace Bolt	
	48	I-G	Loose Bottom Bolt		Replace Bolt	
	48	J-H	Loose Bottom Bolt		Replace Bolt	
	49	B-D	Loose Bottom Bolt		Replace Bolt	
	49	D-B	Loose Bottom Bolt		Replace Bolt	
	49	F-H	Loose Bottom Bolt		Replace Bolt	
	50	D-B	Loose Bottom Bolt		Replace Bolt	
	50	F-H	Loose Bottom Bolt		Replace Bolt	
	50	G-I	Loose Bottom Bolt		Replace Bolt	
	51	B-D	Loose Bottom Bolt		Replace Bolt	
	51	I-G	Loose Bottom Bolt		Replace Bolt	
	52	B-D	Loose Bottom Bolt		Replace Bolt	
	53	E-C	Loose Bottom Bolt		Replace Bolt	
	54	B-D	Loose Bottom Bolt		Replace Bolt	

Section	Bent #	From Pile "_" To Pile "_"	Issue	Other Issue	Repair	Comment
	54	F-H	Loose Bottom Bolt		Replace Bolt	
	55	A-C	Loose Bottom Bolt		Replace Bolt	
	55	E-C	Loose Bottom Bolt		Replace Bolt	
	55	F-H	Loose Bottom Bolt		Replace Bolt	
	56	B-D	Loose Bottom Bolt		Replace Bolt	
	57	B-D	Rotten		Replace	Broken Off
	57	E-C	Loose Bottom Bolt		Replace Bolt	
	57	G-I	Loose Bottom Bolt		Replace Bolt	

APPENDIX 4.2.2. ISSUES ASSOCIATED WITH CROSS BRACING ALONG PILE COLUMNS.

Section	From Bent"_" To Bent "_"	Pile ID	Issue	Repair
Pier Approach	27-28	B	Rotten	Replace
	27-28	C	Rotten	Replace
	33-34	B	Rotten	Replace
Pier Head	44-45	E	Rotten	Replace
	44-45	F	Rotten	Replace
	44-45	I	Rotten	Replace
	47-48	H	Rotten	Replace
	57-58	H	Loose Bolt	Replace Bolt

APPENDIX 4.2.3. ISSUES ASSOCIATED WITH HORIZONTAL BRACING.

Section	From Bent "_" to "_"		From Pile "_" to "_"		Issue	Repair
Pier Approach	26	27	C	C	Rotten	Replace
	31	33	D	D	Rotten	Replace
	34	36	B	B	Rotten	Replace
Pier Head	39	40	J	J	Rotten	Replace
	47	49	J	J	Rotten	Replace
	49	51	E	E	Loose Bolt	Replace
	50	50	H	J	Loose Bolt	Replace bolt
	50	52	A	A	Loose Bolt	Replace Bolt
	50	51	J	J	Rotten	Replace
	51	51	I	J	Rotten	Replace
	52	53	H	H	Loose Bolt	Replace Blocking And Bolt
	52	53	J	J	Blocking Rotten	Replace Blocking And Bolt
	50	52	I	I	Rotten	Replace
	52	52	H	J	Rotten	Replace
	53	53	I	I	Blocking Rotten	Replace Blocking and Bolt
	54	54	H	J	Missing	Replace
	53	55	D	D	Rotten	Replace
	56	56	H	J	Loose Bolt	Replace Bolt
	56	57	A	A	Loose Bolt	Replace Bolt
	58	58	H	J	Missing	Replace
	57	58	I	I	Braced to Old Pile	Brace to New Pile