Underwater Inspection of Marine Facilities

707 Sidney Pkwy, Port Orchard, WA 98366

Prepared by SDS Consultant
November 2020

TABLE OF CONTENTS

CONDITION RATING DESCRIPTIONS

Good - No visible damage, or only minor damage is noted. Structural elements may show very minor deterioration, but no overstressing is observed. No repairs are required.

Satisfactory - Limited minor to moderate defects or deterioration are observed, but no overstressing is observed. No repairs are required.

Fair - All primary structural elements are sound, but minor to moderate defects or deterioration is observed. Localized areas of moderate to advanced 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.

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.

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.

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.

Harper Pier Underwater Inspection

SE Southworth Dr, Port Orchard, WA 98366

Prepared by SDS Consultant
November 2020

Introduction

ln November 2020, Seattle Diving Services, LLC completed an underwater inspection of Harper Pier in Port Orchard Washington. The inspection was performed by a dive team under the direction of Seattle Diving Services, LLC.

Objective

The objective of this project is to provide a general description and assessment with recommendations for the outlined Harper Pier Pilot Piles. Visual, ultrasonic, and corrosion potential inspections were performed. The structures are generally covered in heavy marine growth and representative areas were cleaned using hand tools for closer examination. The photos within this report provide a visual representation of the typical underwater conditions and deterioration.

Observations

The pilings are generally covered in light marine growth and representative areas were cleaned using hand tools for UT & CP readings as well as closer visual examination. The photos within this report provide a visual representation of the typical underwater conditions and deterioration. The Galvanized steel pilings currently have no cathodic protection systems in place. Corrosion potential & ultrasonic thickness readings determined the sub-tidal zone of the pilings are suffering material loss as a result. The majority of the pile sub-tidal zones show loss of galvanized coating, pitting, and 80% iron oxidation coverage on the piling surfaces. (Photos 1-2) The material loss is most prevalent in the sub-tidal zone, the inter tidal zone has roughly 90% less corrosion & deterioration, & is virtually non-existent in the high tide and splash zones of the pilings. (Photos 3-4)

Assessments

Based on our underwater inspection, the underwater condition of the structure is Good due to isolated areas of minor deterioration. The deterioration noted in this report is considered minor and no load reductions are required as a result of the underwater structures. However, action should be taken to counter the effects of submerged corrosion of the steel piles.

Recommendations

Cathodic protection should be considered for all pilings supporting the Harper pier that have a sub-tidal zone. The sub tidal zone on every piling inspected was subject to advanced corrosion & deterioration. An impressed current cathodic protection system could be used, but could also become very costly. Alternatively,

anodes should be welded directly to the pilings in a manner which allows ease of future anode replacement saving the port costs in the long run.

Thickness readings were taken using a Tritex Multigauge 3000 Underwater Thickness Meter which was calibrated and tested on-site using a 0.500 testing block. CP Measurements were taken using a Polatrak CP Gun which was calibrated and tested on-site using a 0.500 testing block.

TABLE 1 – HARPER PIER PILOT PILES

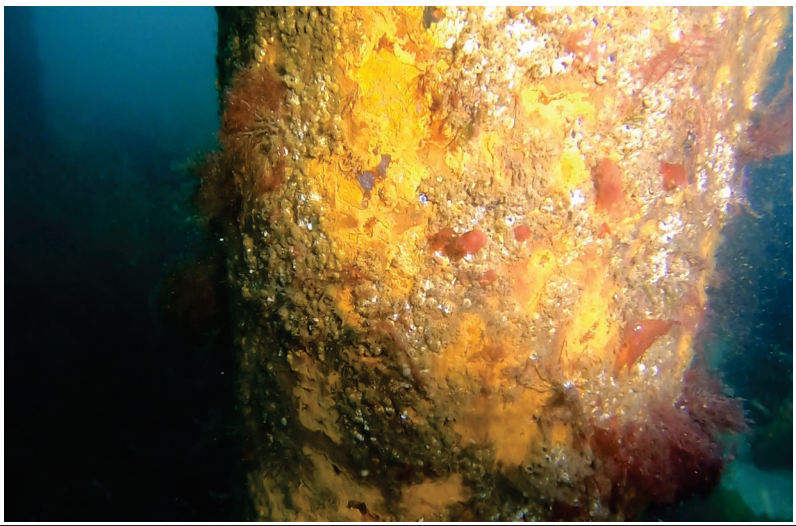
	THICKNESS MEASUREMENT				CP READING		
Location	**Waterline**	**Mid-Water**	**Seabed**	**Depth**	**Waterline**	**Mid-Water**	**Seabed**
C1	.470	.475	.480	6’	-660	-652	-655
C2	.475	.475	.470	8’	-654	-657	-653
C3	.480	.480	.475	11’	-664	-669	-667
C4	.485	.480	.455	14’	-678	-684	-681
C5	.480	.485	.470	15’	-681	-691	-680
C6	.480	.485	.470	15’	-687	-690	-686
P7	.480	.480	.480	16’	-685	-694	-693
P8	.510	.510	.465	18’	-691	-692	-690
P9	.505	.500	.455	19’	-707	-692	-690
P10	.505	.420	.480	20’	-702	-687	-688

Seattle Diving Services, LLC — Photographic log

Harper Pier	Pilot Piles	Photo 1

Client:
Port of Bremerton
Bremerton, Wa.98337

Description:
Advanced corrosion in submerged zone of pilot pile



Seattle Diving Services, LLC — Photographic log

Harper Pier	Pilot Piles	Photo 2

Client:
Port of Bremerton
Bremerton, Wa.98337

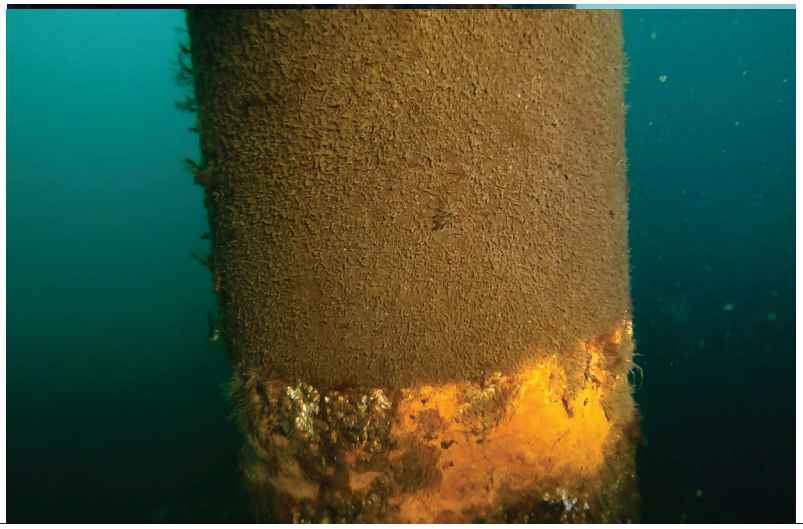
Description:
Advanced corrosion in submerged zone of pilot pile

Seattle Diving Services, LLC — Photographic log

Bremerton Underwater Inspection	Pilot Piles	Photo 3

Client:
Port of Bremerton
Bremerton, Wa.98337

Description:
Inter-tidal zone meets submerged zone of pile. Galanizing intact



Seattle Diving Services, LLC — Photographic log

Harper Pier	Pilot Piles	Photo 4

Client:
Port of Bremerton
Bremerton, Wa.98337

Description:
Splash/ high tide zone of pilot pile. Galvanizing intact.

Port Orchard Marina

707 Sidney Pkwy, Port Orchard, WA 98366

Prepared by SDS Consultant
November 2020

Introduction

ln November 2020, Seattle Diving Services, LLC completed an underwater inspection of the Marine Facilities of the Port Orchard Marina. The inspection was performed by a dive team under the direction of Seattle Diving Services, LLC.

Objective

The objective of this project is to provide a general description and assessment with recommendations of the underwater condition of the Floating Wave Attenuator (breakwater) and associated mooring connections and cathodic components, Level ll Cleaning & Assessment of Bridal Chain connections, Established Marina Steel Pilot Piles, and Assessment of all Shoreline Building and Approach Dock wood piles and supports.

Visual, ultrasonic, and corrosion potential inspections were performed. The structures are generally covered in heavy marine growth and representative areas were cleaned using hand tools for closer examination. The photos within this report provide a visual representation of the typical underwater conditions and deterioration.

Summary

The underwater portions of the substructure components were found to be in overall Fair condition due to the limited amount of deterioration. No evidence of major defect or failure critical to the integrity of the marina was observed. The conditions of the underwater inspection are based on Level I visual & tactile inspection from the high tide line to the seabed. The task also included Level II inspection of 14 bridle chains and thickness & corrosion potential readings of six steel pilot piles throughout the marina. Visual representation is provided of the general conditions and specified problem areas. The information contained within this report is based on the conditions at the time of inspection.

BREAKWATER

Observations

The structures are generally covered in moderate marine growth and representative areas were cleaned using hand tools for closer examination. The photos within this report provide a visual representation of the typical underwater conditions and deterioration.

The floating breakwater, associated mooring system, connections, and cathodic protection are generally in overall Fair condition with localized areas of moderate to advanced deterioration. The structures are generally covered in heavy marine growth. Representative areas were cleaned using hand tools for closer examination. The photos within this report provide a visual representation of the typical underwater conditions and deterioration.

The floating breakwater was observed to be in general overall satisfactory condition. Heavy marine growth covered the majority of the breakwater's surface. However, no cracking, spalling, severe corrosion, major damage, or deterioration due to over stressing was detected during the inspection. Floating breakwater mooring lines were found to be in overall Fair condition with localized areas of moderate deterioration. Heavy marine growth covered the majority of the mooring lines. However, the growth was minimal enough to conduct an adequate level I inspection and determine anode & mooring line condition. (See Photos 5-6).

Breakwater mooring lines were covered in heavy marine growth but was adequate enough for a level I visual & tactile inspection. The previous underwater inspection in 2018 showed remaining anode percentages identical to this year's underwater inspection. All anodes were zinc material and the surfaces had a yellowish tint. Upon physical examination (scraping and wiring brushing) of the anode surface, it exposed clean and active zinc material. This yellowish tint is a telltale sign that the anode material is not actively corroding. There are measures that can be taken to counter act this process,
this is the reasoning for anode percentages being identical to the 2018 inspection. (Photos 7-8).

Very little surface corrosion was observed on mooring chains & connections as previously installed anodes appear to be providing residual cathodic protection but this should be considered temporary. All mooring lines have anodes installed at the top, as close to the breakwater as possible, at the connection between the top chain and mooring rope thimble, and on the upper portion of each bottom chain. Anode conditions provided in TABLE 2.

Mooring line numbers 11, 20, 54, 68, & 70 were all observed to have advanced corrosion such as surface rust on the bottom chain and connections. (See Photos 9-10).

Assessments

Based on our underwater inspection, the underwater condition of these structures is Satisfactory due to isolated areas of minor deterioration. The deterioration noted in this report is considered minor and no load reductions are required as a result of the underwater structures.

Detailed examinations of the concrete cores and service life predictions determined that the concrete below low water has a remaining service life greater than 50 years, provided 1-2 inches of section loss can be tolerated. The detailed concrete examination and material service life prediction determined that concrete exposed to higher oxygen levels in the tidal and atmospheric zones may require rehabilitation to provide an extended service life.

Based on our underwater inspection, the floating breakwater, associated mooring systems, connections, and cathodic protection are generally in overall Fair condition due to localized areas of minor corrosion & deterioration.

The deterioration noted in this report is considered moderate and no load reductions are required as a result of the underwater structures. The detailed examination of the mooring lines and associated hardware determined that the identified bottom chains exposed to underwater electrolysis without cathodic protection requires rehabilitation to provide an extended service life.

Recommendations

No repairs are recommended to the underwater portions of the concrete piers. The fender system is progressively deteriorating and recommended it be replaced in the short term (0-10 years). Our estimate of the probable cost of construction is depicted in Table I and is based on in-kind replacement.

Mooring line numbers 11, 20, 54, 68, & 70 were all observed to have advanced corrosion on the bottom chain and connections. In-kind rehabilitation would involve one additional anode installed at the top of the bottom chain and include proper cleaning sufficient enough to ensure contact between the bottom chain and cathodic protection. These repairs need to be carried out with moderate urgency.

The Port is preparing to replace the Marina's current floating breakwater and mooring system. If the intended service life of the breakwater is more than two years, all breakwater anodes should be cleaned to expose active zinc material that will sufficiently provide cathodic protection to the mooring chains. If the intended service life is less than two years, all anodes below 25% remaining material should be replaced within the next two quarters. Bi-annual underwater inspection should continued for future planning.

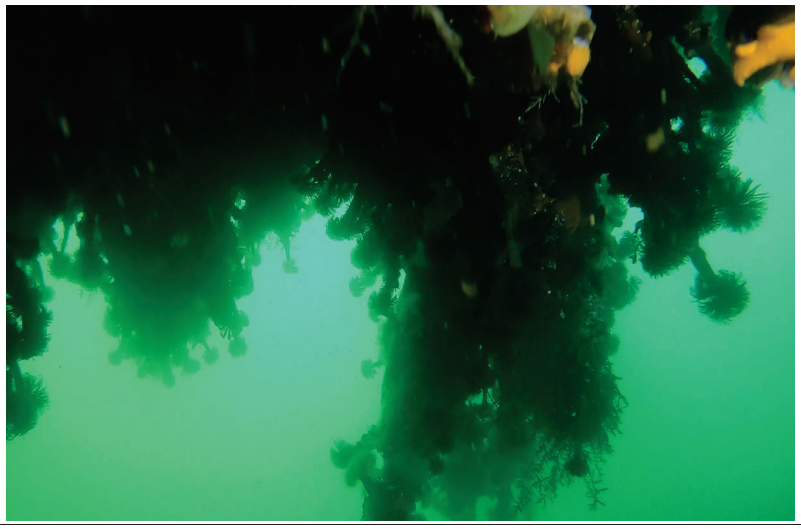
In addition, when the port constructs the new breakwater system, anodes should be cleaned at the time of inspection to prevent calcification which makes the material inactive rendering them useless. Aluminum anodes should be considered for the new breakwater as they will corrode more efficiently and better protect the mooring chains.

Seattle Diving Services, LLC — Photographic log

Port Orchard Marina	Floating Breakwater	Photo 5

Client:
Port of Bremerton
Bremerton, Wa.98337

Description:
Typical marine growth conditions beneath the breakwater



Seattle Diving Services, LLC — Photographic log

Port Orchard Marina	Floating Breakwater	Photo 6

Client:
Port of Bremerton
Bremerton, Wa.98337

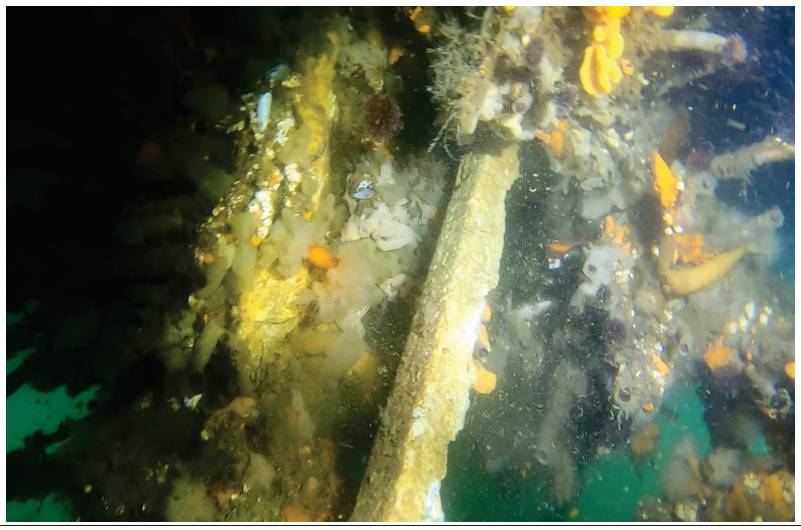
Description:
Typical marine growth conditions on mooring lines

Seattle Diving Services, LLC — Photographic log

Port Orchard Marina	Floating Breakwater	Photo 7

Client:
Port of Bremerton
Bremerton, Wa.98337

Description:
Top chain anode with calcified outer layer



Seattle Diving Services, LLC — Photographic log

Port Orchard Marina	Floating Breakwater	Photo 8

Client:
Port of Bremerton
Bremerton, Wa.98337

Description:
Top chain anode with calcified outer layer

Seattle Diving Services, LLC — Photographic log

Port Orchard Marina	Floating Breakwater	Photo 9

Client:
Port of Bremerton
Bremerton, Wa.98337

Description:
Advanced surface corrosion on bottom chain

Seattle Diving Services, LLC — Photographic log

Port Orchard Marina	Floating Breakwater	Photo 10

Client:
Port of Bremerton
Bremerton, Wa.98337

Description:
Advanced surface corrosion on bottom chain

BRIDAL CHAINS

The objective of this task was to provide a Level II cleaning and assessment with recommendations of the underwater condition of the (14) bridle chains on the floating wave attenuator (breakwater) and associated cathodic components.

Observations

The floating breakwater's bridle chain systems and cathodic protection are generally in overall Fair condition with localized areas of advanced deterioration. The structures are generally covered in heavy marine growth and representative areas were cleaned using hand tools for closer examination. The photos within this report provide a visual representation of the typical underwater conditions and deterioration.

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Thirteen bridal chain systems were listed for level II inspection. Fourteen bridal chain systems were found, three of which were disconnected. Mounting brackets for bridle chain 35 was subject to advanced deterioration and pad eye bracket failure. (Photo 11) The originating cause behind the failure is suspected to be ordinary wear from the 1" shackle connecting the 1/2" long-link bridle chain to the bracket. Under the influence of waves, currents, and galvanic corrosion these two components had worn and failed. Bridle bracket 11 had similar deterioration but

failed at the top chain link connecting the bridle chain to the pad eye on the bridle bracket. (Photo 12 & 13) The lower connection of these bridle chains were still

connected to the mooring lines and were found to have advanced deterioration. (Photo 14) Minor issue findings include missing cotter pins and seizing wire for lower bridle connections of bridle numbers 42 & 59.

All other bridle brackets, chains, and associated hardware was in satisfactory condition with minor but typical deterioration. (See Photo 15 & 16) All bridle chains have one anode installed at the top of the chain as close to the bracket as possible. Anode conditions provided in TABLE 2.

Assessments

Based on our underwater inspection, the bridle chains, connections, and cathodic protection are generally in overall Fair condition due to localized areas of advanced deterioration. The deterioration noted in this report is considered moderate and no load reductions are required as a result of the underwater structures. The detailed examination of the identified bottom chains, bridal chains, and associated hardware determined that areas of the mooring system exposed to wave action and areas exposed to underwater electrolysis without cathodic protection requires rehabilitation to provide an extended service life. Repairs need to be carried out with moderate urgency.

Recommendations

The bridle chain 35 has a bracket that has deteriorated to a point of failure. This bracket and associated bridle chain should be considered for in-kind replacement as soon as possible. Bridle bracket 11 is subject to advanced deterioration. If the intended life expectancy of the breakwater is more than two years, this bracket should also be replaced. If the intended life expectancy is less than two years, the existing bracket will be sufficient to continue it’s intended purpose. Bridle chain 11 will also need to be replaced regardless or bracket replacement. New cathodic protection will need to be installed on the bridle chain only.

Seattle Diving Services, LLC — Photographic log

Port Orchard Marina	Bridal Chains	Photo 11

Client:
Port of Bremerton
Bremerton, Wa.98337

Description:
Bridal bracket 35
pad eye failure

Seattle Diving Services, LLC — Photographic log

Port Orchard Marina	Bridal Chains	Photo 12

Client:
Port of Bremerton
Bremerton, Wa.98337

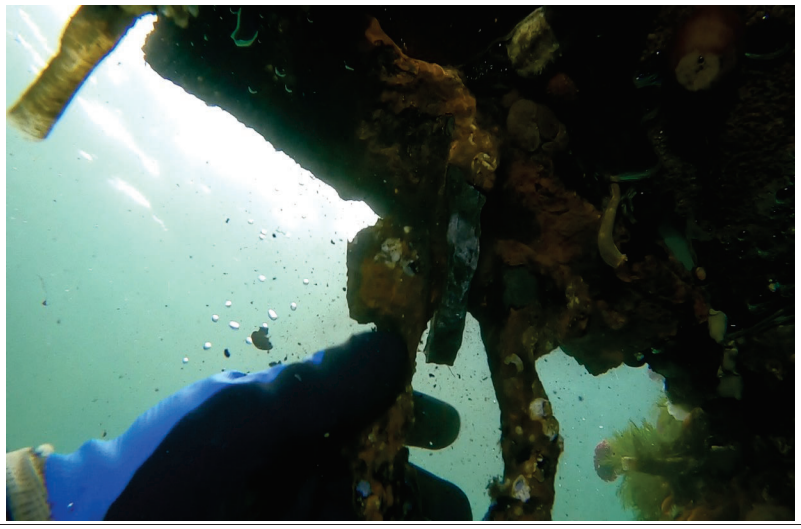
Description:
Bridal bracket 9
& chain failure

Seattle Diving Services, LLC — Photographic log

Port Orchard Marina	Bridal Chains	Photo 13

Client:
Port of Bremerton
Bremerton, Wa.98337

Description:
Bridal bracket 9
& chain failure



Seattle Diving Services, LLC — Photographic log

Port Orchard Marina	Bridal Chains	Photo 14

Client:
Port of Bremerton
Bremerton, Wa.98337

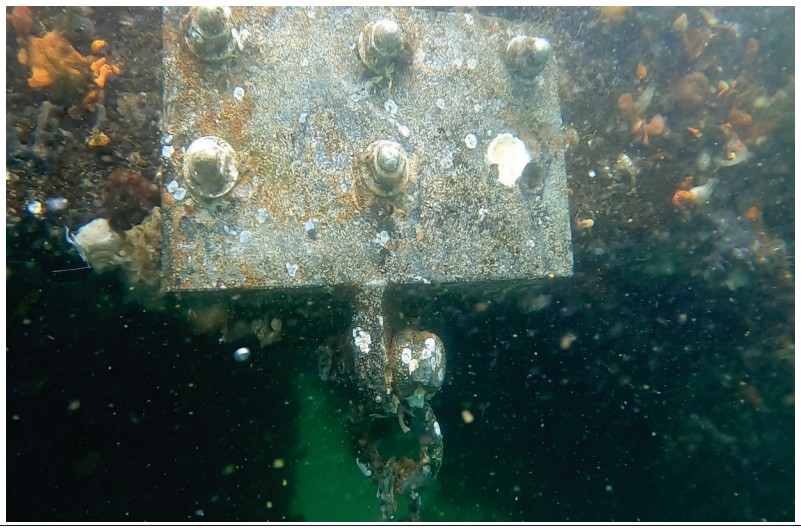
Description:
Advanced corrosion
at bottom of bridal
chain 9

Seattle Diving Services, LLC — Photographic log

Port Orchard Marina	Bridal Chains	Photo 15

Client:
Port of Bremerton
Bremerton, Wa.98337

Description:
Typical bridle bracket post cleaning



Seattle Diving Services, LLC — Photographic log

Port Orchard Marina	Bridal Chains	Photo 16

Client:
Port of Bremerton
Bremerton, Wa.98337

Description:
Typical bridal bracket condition

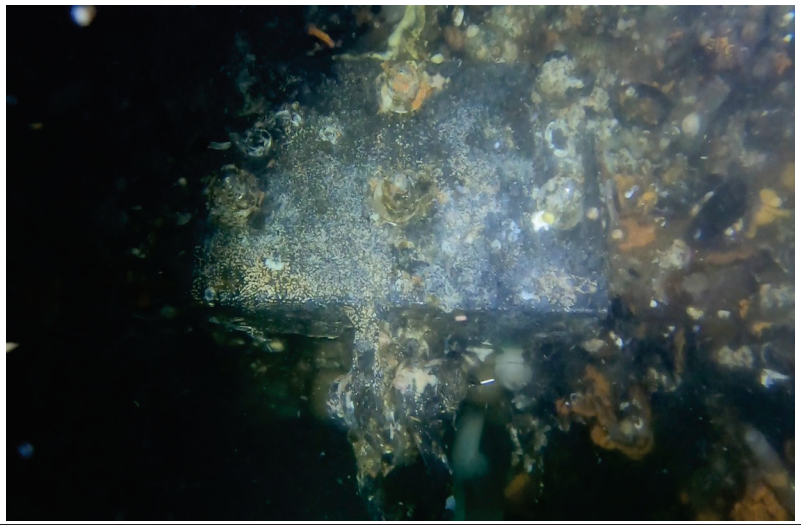


TABLE 2 ANODE PERCENTAGES Page 22

Mooring Line #	Top Chain %	Connection %	Bottom Chain %
1	60	50	60
2	50	60	60
3	60	60	80
Bridle 3	60	N/A	N/A
4	80	60	60
5	80	60	60
6	20	70	60
7	70	60	80
8	60	60	60
9	80	60	90
Bridle 9	70	N/A	N/A
10	60	70	90
11	70	60	90
Bridle 11	N/A	N/A	N/A
12	70	50	60
13	90	90	60
14	70	60	60
15	50	60	60
16	70	60	80
17	60	60	60
Bridle 17	60	N/A	N/A
18	50	60	60
19	60	60	60
Bridle 19	60	N/A	N/A
20	80	60	80
21	60	60	60
22	60	50	60
23	60	60	60
24	70	60	60
25	40	90	40

26	30	40	90
27	40	40	50
Bridle 27	60	N/A	N/A
28	60	30	60
29	80	60	90
30	70	50	90
31	60	60	40
32	50	70	70
33	70	70	70
Bridle 33	60	N/A	N/A
34	70	40	50
35	40	60	50
Bridle 35	70	70	70
36	90	90	60
37	60	60	60
38	70	70	40
39	50	30	90
40	30	80	60
41	70	50	70
42	80	40	70
Bridle 42	40	N/A	N/A
43	60	40	20
44	70	70	60
Bridle 44	80	N/A	N/A
45	50	40	70
46	70	70	70
47	80	0	40
48	70	70	90
49	90	70	80
50	70	50	90
Bridle 50	50	N/A	N/A
51	50	70	60
52	60	50	90
Bridle 52	40	N/A	N/A

53	50	50	40
54	70	80	0
55	60	60	90
56	80	90	90
57	50	50	80
58	50	70	90
59	40	20	50
Bridle 59	0	N/A	N/A
60	60	50	70
61	70	50	70
Bridle 61	30	N/A	N/A
62	70	60	60
63	50	50	70
64	50	50	60
65	60	50	60
66	70	50	70
67	10	70	60
68	10	50	60
69	50	70	60
70	50	0	90
71	60	60	90
72	60	60	80

PILOT PILES

The objective of this project is to provide a general description and assessment with recommendations for the (6) outlined Pilot Piles. Visual, ultrasonic, and corrosion potential inspections were performed. The structures are generally covered in heavy marine growth and representative areas were cleaned using hand tools for closer examination. The photos within this report provide a visual representation of the typical underwater conditions and deterioration.

Observations

The six pilot piles are generally in overall sound condition with extensive areas of moderate deterioration. The deterioration was most severe at the inter-tidal and submerged zones of the piles.

The two pilings located on B-dock as well as D-44 were all subject to advanced corrosion and deterioration in the inter-tidal submerged zones. Moderate iron oxidation began at the highest point of the inter-tidal zone and became progressively more prevalent toward the submerged zone. Submerged zones of the piles showed 100% iron oxidation coverage with advanced surface deterioration. (Photos 17-18) Anodes less than 10% remaining material and were covered in growth, or an outer calcification layer, rendering them inactive. Pile thickness and corrosion potential readings provided in TABLE 3.

The two pilings on Located on C-dock as well as D-32 were all of similar condition. Galvanized coating at the splash and high point of the inter-tidal zones is still effective and in good condition. Minor corrosion at the inter-tidal zone and minor/ moderate corrosion in the submerged zones of the pilings. This corrosion is considered typical with moderate surface rust observed. (Photos 19-20) Anodes less than 10% remaining material and were covered in growth, or an outer calcification layer, rendering them inactive. Pile thickness and corrosion potential readings provided in TABLE 3.

Assessments

Based on our underwater inspection, the underwater condition of these structures is Fair due to extended areas of moderate deterioration. The deterioration noted in this report is considered moderate and no load reductions are required as a result of the underwater structures. Detailed visual and thickness examinations of the pilot piles determined that the submerged zones require future rehabilitation to provide an extended service life.

Recommendations

Piling anodes were 10% remaining or less and all anodes should be replaced within the next two quarters. In addition, all of the pilot pile anodes were covered in a thick layer of calcification, marine growth, or both. When a “fresh” or active layer of anode material begins to calcify, it will harden and allow marine growth to latch on. Eventually covering the entire surface of the anode preventing the piling anodes from corroding properly. In turn providing no cathodic protection for the pilings and increasing surface deterioration. In the previous inspection report it was noted that some of the anode cable systems had failed due to tidal fluctuation causing the cable to break.

To ensure proper cathodic protection for the piles, it is recommended that all anodes be cleaned and inspected annually. A major benefit of the current anode system is that divers are not required for inspection or replacement of the cable or anodes as it all can be done from the docks allowing staff to monitor and clean these anodes if the port chooses to do so.

TABLE 3 – PORT ORCHARD PILOT PILES

	THICKNESS MEASUREMENT				CP READING		
Location	**Waterline**	**Mid-Water**	**Seabed**	**Depth**	**Waterline**	**Mid-Water**	**Seabed**
B-1	.485	.425	.410	16’	-678	-684	-684
B-6	.515	.515	.510	22’	-713	-711	-687
C-32	.425	.430	.440	35’	-660	-668	-665
C-17	.520	.525	.500	23’	-715	-701	-669
D-32	.490	.330	.385	38’	-658	-670	-669
D-44	.485	.485	.480	40’	-662	-675	-657

Seattle Diving Services, LLC **Photographic log**

Port Orchard Marina	Pilot Piles	Photo 17

Client:
Port of Bremerton
Bremerton, Wa.98337

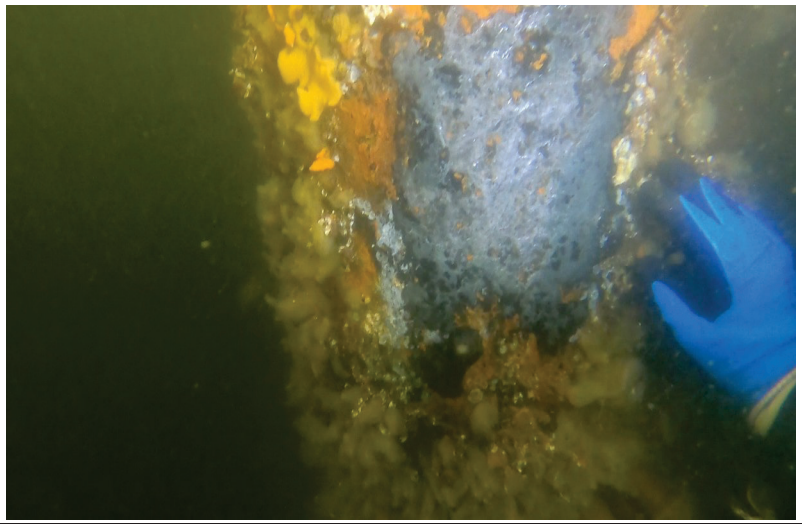
Description:
Submerged zone of B-6 with 100% surface rust coverage

Seattle Diving Services, LLC — Photographic log

Port Orchard Marina	Pilot Piles	Photo 18

Client:
Port of Bremerton
Bremerton, Wa.98337

Description:
Mid-water of pile B-1 post cleaning for U/T & C/P readings



Seattle Diving Services, LLC — Photographic log

Port Orchard Marina	Pilot Piles	Photo 19

Client:
Port of Bremerton
Bremerton, Wa.98337

Description:

Inter-tidal zone of pile C-17, typical conditions

Seattle Diving Services, LLC		Photographic log
Port Orchard Marina	Pilot Piles	Photo 20

Client:
Port of Bremerton
Bremerton, Wa.98337

Description:
High tide zone of pile D-44, typical surface conditions

SHORELINE BUILDINGS & APPROACH DOCKS

Introduction

The objective of this project is to provide a general description and assessment with recommendations for the Shoreline Buildings & Approach Docks. The structures are generally covered in heavy marine growth and representative areas were cleaned using hand tools for closer examination. The photos within this report provide a visual representation of the typical underwater conditions and deterioration.

Observations

The building and approach dock timber piles and supports are generally in overall sound condition with limited areas of minor defects/ deterioration.

A-Dock approach dock pilings were in Good condition with one 4”x12” Cross bracing support in Fair condition due to moderate rot and borer holes towards the bottom of one of the beams. (Photo 21)

B/C approach dock pilings were in Good condition. The sister pile on the north-east corner of the approach dock was observed to have 4 cracks, 1/2” wide ranging from 1’-6’ in length. This pile also had one 2” borer hole located two feet above the mudline. This piling is considered to be in fair condition. (Photo 22) In addition, what appear to be a few communications lines were hanging freely below the gangway and in the water. These were unsupported and not attached to the gangway with the rest of the utility and power lines. (Photo 23)

D-dock approach piles and supports are overall in Good condition. The south-east timber pile was noted to have a 3/16” crack on the south facing side beginning from the top of the pile running 2’ down vertically. This damage is considered minor and probable cause was during installation of the crossbracing. Associated pile cap stringer was noted to have a 1/8” wide, 5’ long crack running from

the east end of the stringer to the middle of the stringer. This damage is also considered minor. All cross bracing and supports are in good condition. There is one 2’x8’ cross member in good condition that appears to be un-treated. (Photo 24)

G-dock approach piles and supports are generally in overall satisfactory condition with limited areas of moderate deterioration. The two pilings in the south-west corner of the approach dock have minor cracking 3/16” wide running vertically from the mudline and ranging 2’-6’ in length. Extensive rot and deterioration was observed on one of the 4”x12” cross bracing supports second closest to the shoreline. The affected area is the lower 2’ of the cross member in the lower tidal zone. Severe cracking was observed on the submerged portion of the North-eastern most piling. The crack was between 1”-2” in width and 12’ in overall length. The crack ran vertically from the mudline to the waterline at low tide and this pile is considered to be in Poor Condition. (Photo 25) North-West batter/ support piling was observed to have minor cracking on the submerged portion of

the pile. No further underwater rot or deterioration was observed however, topside visual inspection determined an estimated 50% material loss on pile cap. (Photo 26) Western most piling, second from the north is considered to be in Poor condition as there were multiple defects observed. One 1”x2” borer hole was discovered 10’ above the mudline with moderate deterioration from marine action. A 2’x1’ section of the pile was found to have extensive deterioration from marine insects including borer holes. The affected area is 8’ above the mudline and the remaining area of the pile below this section was also subject to extensive cracking and the beginnings of deterioration from marine action. (Photo 27)

All shoreline building wood piles were found to be in satisfactory condition with little to no minor cracking. None of the wood piles were subject to moderate or extensive damage from rot or borer holes. One 4”x12” treated beam used for cross bracing underneath the marina office was subject to extensive rot and deterioration, affected area is 1-1/2’ in length. There are multiple cross members and cross bracing below the restroom building. Multiple wood supports appear to be untreated and are showing signs of surface rot. The wood was green and color and was relatively soft when probed. In addition, one of the boards covering the bathroom building’s insulation and piping was missing. It is assumed that there is being maintenance being performed but there was hot water free flowing from from the underside of the building, running into the Puget sound. (Photo 28)

Assessments

Based on our underwater inspection, the underwater condition of this structures is Fair due to isolated areas of deterioration. The deterioration noted in this report is considered moderate however, load reductions are required as a result of the underwater structures. The piles were observed to be creosote treated, they are likely 30 years or older. The detailed inspection determined that wood piles and supports in the tidal & submerged zones require future rehabilitation to provide an extended service life.

Recommendations

The timber piles are estimated to have approximately 10- 20 years of useful life remaining before replacement or similar repair should be considered. The outlined pilings subject to rot and marine borer holes should be considered for piling encapsulation within the next year, or sooner if conditions worsen. All damaged wood cross bracing and supports should be monitored considered for repair if

conditions worsen. All non-treated lumber used for cross bracing and supports should be replaced with treated timber within 1-3 years. Continued bi-annual inspection should considered for future planning.

Seattle Diving Services, LLC **Photographic log**

Port Orchard Marina	Shoreline Building & Approach Docks	Photo 21

Client:
Port of Bremerton
Bremerton, Wa.98337

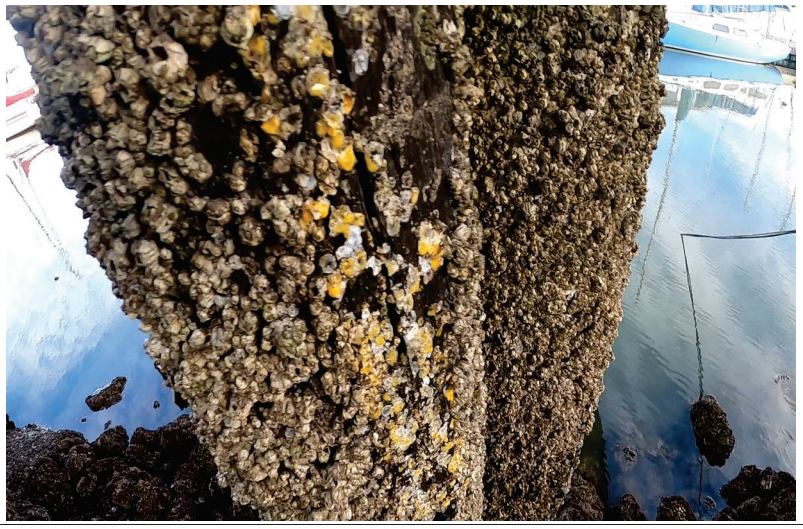
Description:
Approach dock A 4'x12' cross supprts with moderate marine borer action towards bottom

Seattle Diving Services, LLC **Photographic log**

Port Orchard Marina	Shoreline Building & Approach Docks	Photo 22

Client:
Port of Bremerton
Bremerton, Wa.98337

Description:
Support pile under B Approach dock with Moderate cracking

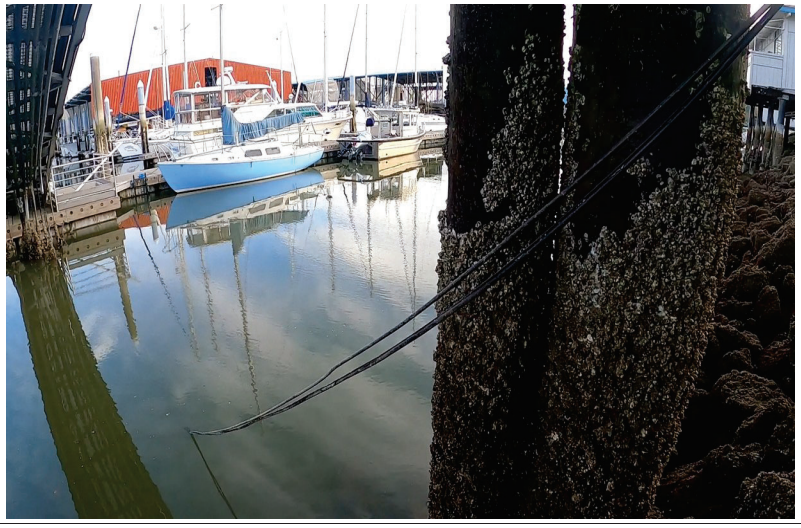


Seattle Diving Services, LLC — Photographic log

Port Orchard Marina	Shoreline Building & Approach Docks	Photo 23

Client:
Port of Bremerton
Bremerton, Wa.98337

Description:
Communications or similar cable hanging unsupported below B approach dock



Seattle Diving Services, LLC — Photographic log

Port Orchard Marina	Shoreline Building & Approach Docks	Photo 24

Client:
Port of Bremerton
Bremerton, Wa.98337

Description:
Untreated support member below G approach dock

Seattle Diving Services, LLC — Photographic log

Port Orchard Marina	Shoreline Building & Approach Docks	Photo 25

Client:
Port of Bremerton
Bremerton, Wa.98337

Description:

NE support piling for G approach dock. Cracking beginning at mudline

Seattle Diving Services, LLC — Photographic log

Port Orchard Marina	Shoreline Building & Approach Docks	Photo 26

Client:
Port of Bremerton
Bremerton, Wa.98337

Description:

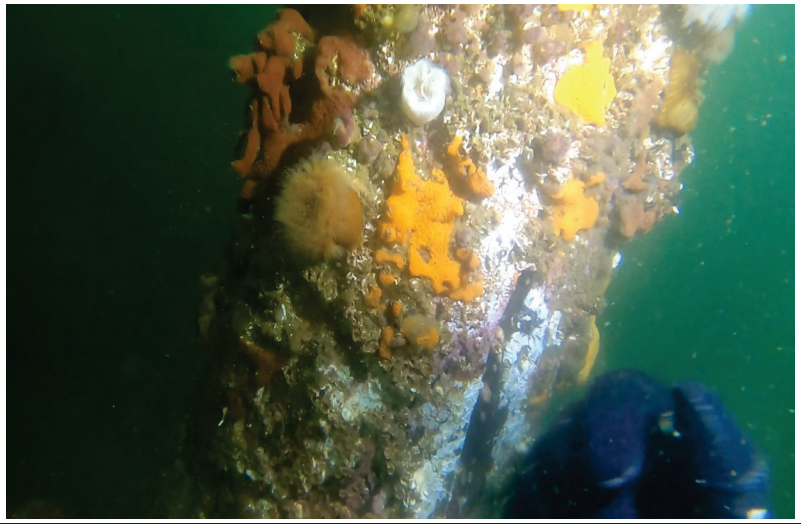
NW batter support Pile, G apporach dock 50% material loss on pile cap

Seattle Diving Services, LLC — Photographic log

Port Orchard Marina	Shoreline Building & Approach Docks	Photo 27

Client:
Port of Bremerton
Bremerton, Wa.98337

Description:
G approach dock western pile, second from north. Cracklng & borer damage



Seattle Diving Services, LLC — Photographic log

Port Orchard Marina	Shoreline Building & Approach Docks	Photo 28

Client:
Port of Bremerton
Bremerton, Wa.98337

Description:
Loose board and running hot water flowing from bathroom building

Port of Bremerton Underwater Inspection of Marine Facilities

120 Washington Beach Ave. Bremerton, WA 98337

Prepared by SDS Consultant

November 2020

Introduction

During November 2020, Seattle Diving Services, LLC completed an underwater inspection of the Marine Facilities of the Port Orchard Marina & the Port of Bremerton. The inspection was performed by a dive team under the direction of Seattle Diving Services, LLC, and included a visual and tactile inspection of the Marina's Breakwater Mooring Systems, Pilot Piles, Shoreline Structures, and the USS Turner Joy's Mooring System.

Summary

The underwater portions of the substructure components were found to be in overall Satisfactory condition due to the limited amount of deterioration. No evidence of major defect or failure critical to the integrity of the marina was observed. The conditions of the underwater inspection are based on Level I visual & tactile inspection from the high tide line to the seabed. The task also included visual inspection, ultrasonic thickness testing & corrosion potential readings of ten steel pilot piles throughout the marina. Visual representation are provided of the general conditions and specified problem areas. The information contained within this report is based on the conditions at the time of inspection.

USS TURNER JOY - MOORING SYSTEM

Objective

The objective of this project is to provide a general description and assessment with recommendations of the underwater condition of the bow anchors, chains, floats, cathodic protection components, & rear bridle connection of the USS Turner Joy. The structures are generally covered in moderate marine growth and representative areas were cleaned using hand tools for closer examination. The photos within this report provide a visual representation of the typical underwater conditions and deterioration.

Observations

The mooring systems are in generally satisfactory condition overall with limited areas of advanced deterioration & corrosion. The deterioration is generally concentrated at the upper half of the mooring systems.

The upper portions of the mooring systems showed accelerated deterioration due to ordinary wear under the influence of waves, currents, electrochemical corrosion and action from the motion of the floats. Surface rust and severe deterioration was observed on all hardware from the submerged portion of the bow chains to the upper portion of the bottom heavy chains. No anodes were present at these locations where corrosion and iron oxidation was the most prevalent. (See photos 29-30)

Minor corrosion was present throughout the rest of the heavy chain resting on bottom as well as the anchors. A-1, A-2, & A-3 anchor flukes were dug into the seabed. Anchor flukes on Anchor A-4 were not dug into the seabed. However, the heavy chain laying on bottom was partially buried indicating no signs of shifting or movement. All bottom chains for all mooring lines were partially buried indicating secure anchoring for the Turner Joy, there are no obvious signs of shifting or movement of the anchoring system. The only anodes found were on bottom chains near the anchors on lines 1,2, & 3. All remaining anode percentages 50% or less. (See Photo 31)

The splash zone of the bow chains showed typical but minor marine corrosion with minimal paint chipping, peeling, and rust. The mooring floats themselves had similar corrosion at the splash zone and underwater portions. (Photo 32)

Seattle Diving Services, LLC — Photographic log

Port of Bremerton	USS Tuner Joy	Photo 29

Client:
Port of Bremerton
Bremerton, Wa.98337

Description:
Advanced corrosion & detertioration on upper section of Mooring system

Seattle Diving Services, LLC — Photographic log

Port of Bremerton	USS Tuner Joy	Photo 30

Client:
Port of Bremerton
Bremerton, Wa.98337

Description:
Advanced corrosion at bow chain, float, & clump weight connection point

Seattle Diving Services, LLC — Photographic log

Port of Bremerton	USS Tuner Joy	Photo 31

Client:
Port of Bremerton
Bremerton, Wa.98337

Description:
Typical anode & heavy chain condition

Seattle Diving Services, LLC — Photographic log

Port of Bremerton	USS Tuner Joy	Photo 32

Client:
Port of Bremerton
Bremerton, Wa.98337

Description:
Typical bow chain condition at splash zone, light corrosion

It was noted during the inspection that the shackle pin seizing wire on mooring line 2 (the only mooring with the float still attached) was coming undone due to typical wave action over multiple years of use. This float also had a cable at the top of the float securing it to the bow chains and acting as a fail safe.

Mooring line floats 1, 3, & 4 had broke free since the last inspection and were tied up to the Turner Joy's floating dock. The chain for these floats are still attached and chain conditions varied from fair to good and are in usable condition. All float shackles have seizing wire or cotter pins that are either missing or coming apart. In addition, all shackles that are currently being used are 1" galvanized bolt-type shackles in fair condition but appear to be the cause of failure and the reason the floats continue to break free. The bolt-type shackles allow the shackle pin to spin, and over time under repetitive wave action, currents, and tension, force the bolt nut to slowly loosen and become free. (Photo 33-34)

The rear bridle connections consist of three pivoting brackets allowing for tidal fluctuations between the fixed piles and the USS Turner Joy stern. Brackets, bolts and connections to the concrete pile cap were covered in heavy barnacle growth and appear to be in good, secure condition. Typical but minor surface corrosion was found on brackets and bolts. The USS Turner Joy has a male pivot bracket welded directly to the hull that mates up to the female bracket on the steel bridle. Both brackets were in good condition with no marine growth and relativley little iron oxidation on the surface. Also found were hardened clumps of grease resting on the side of the bracket pins with little fresh grease on the pins themselves. Bolts joining the two halves of the bridal were subject to advanced corrosion and deterioration as they are in the splash zone of the bracket and subject to the most electrochemical corrosion. No anodes are currently installed. (Photos 35-36)

Assessments

Based on our underwater inspection, the underwater condition of the USS Turner Joy's Mooring System is Satisfactory due to isolated areas of moderate deterioration and repetitive float failure. The deterioration noted in this report is considered moderate and no load adjustments are required as a result of the underwater structures. Detailed examinations of the bottom heavy chain and anchors were observed to be in good condition due to their limited amount of corrosion. The detailed examination of the floats, concrete stabilizers, and top end hardware determined that mooring system exposed to higher oxygen levels, wave action, and underwater electrolysis requires immediate rehabilitation to provide an extended service life.

Seattle Diving Services, LLC — Photographic log

Port of Bremerton	USS Tuner Joy	Photo 33

Client:
Port of Bremerton
Bremerton, Wa.98337

Description:
Failed bolt-type shackles found resting on clump weight

Seattle Diving Services, LLC — Photographic log

Port of Bremerton	USS Tuner Joy	Photo 34

Client:
Port of Bremerton
Bremerton, Wa.98337

Description:
Float A1 bolt type shackle seizing wire coming undone

Seattle Diving Services, LLC — Photographic log

Port of Bremerton	USS Tuner Joy	Photo 35

Client:
Port of Bremerton
Bremerton, Wa.98337

Description:
Advanced corrosion on rear bridle connection

Seattle Diving Services, LLC — Photographic log

Port of Bremerton	Pilot Piles	Photo 36

Client:
Port of Bremerton
Bremerton, Wa.98337

Description:
Typical marine growth & corrosion condition on rear bridle pivot brackets

Recommendations & Repairs

The top end of the mooring systems are progressively deteriorating and recommended they be protected from corrosion by installing sacrificial anodes where the bow chains, clump weights, and floats connect. There is not only severe surface corrosion signs of deterioration. If no immediate action is taken, corrosion will accelerate causing chain link failure which will be a costly repair. Anodes should be installed at this location, and anodes further down the system should be replaced if under 50% material remains.

The USS Turner Joy serves as the breakwater for the northern end of Bremerton Marina. The vessel's mooring systems are exposed to unique and harsh currents from Sinclair Inlet. Three of the mooring floats had broken free since the last inspection and this is a reoccurring problem. The most common cause appears to be simply the bolt-type shackles being used. It was evident during the 2018 & 2020 inspections that these bolt-type pins will eventually work themselves free. All bolt-type shackles should be changed out to screw pin anchor shackles and seized properly with stainless wire. In addition, the cable secure the top of float A-2 appears to limiting the amount of swing and movement of the float and associated hardware. It also acts a a fail safe in the event a shackle were to come undone. Cables should be installed on the top of each float to the bow chain.

The rear bridle connections appear to be in good condition. It is unknown when the last time the pins were greased or how often they are greased. These connections should be cleaned of marine growth and greased. If they are not already part of a maintenance schedule, they should be placed on one.

FLOATING WAVE ATTENUATOR (BREAKWATER)

The objective of this project is to provide a general description and assessment with recommendations of the underwater condition of the Floating Wave Attenuator (breakwater) and associated mooring connections and cathodic components. The structures are generally covered in heavy marine growth. Representative areas were cleaned using hand tools for closer examination. The photos within this report provide a visual representation of the typical underwater conditions and deterioration.

Observations

The floating breakwater, associated mooring system, connections, and cathodic protection are generally in overall Satisfactory condition with limited areas of minor deterioration.

The breakwater floats were covered in heavy marine growth with at least 90% growth coverage. The breakwater was observed to be in general, overall good condition. Heavy marine growth visually obstructed the level I inspection and thorough tactile methods had to be used. However, no cracking, spalling, severe corrosion, major damage, or deterioration due to over stress was detected during the inspection.

Engineering plans call for cathodic protection (one 30 lb. zinc anode) be installed on four locations on each mooring line. Aluminum anodes were installed, one at each top chain to cable connection, two directly on the wire rope, one towards the top & one towards the bottom, and one at the bottom chain. In general, the majority of anodes had more than 50% material remaining. However all anodes were covered in a thick calcification layer, heavy marine growth, or both. Preventing the anodes from corroding properly & efficiently. When cleaned with hand tools, selected anodes showed roughly 25% inactive material at the anode surface. (Photos 37-38)

In both the 2018 & 2020 inspections anodes were chosen at random for scraping to reveal true anode remaining percentages. Anode depletion on these anodes were around 20% material loss since the last inspection. All of the anodes scraped in 2018 had a thin layer of calcification which was easily removed by hand and had little to no marine growth. Anodes not chosen for scraping during the 2018 inspection had a significant calcification layer and in most cases, a layer of marine growth preventing proper corrosion, rendering the anodes inactive.

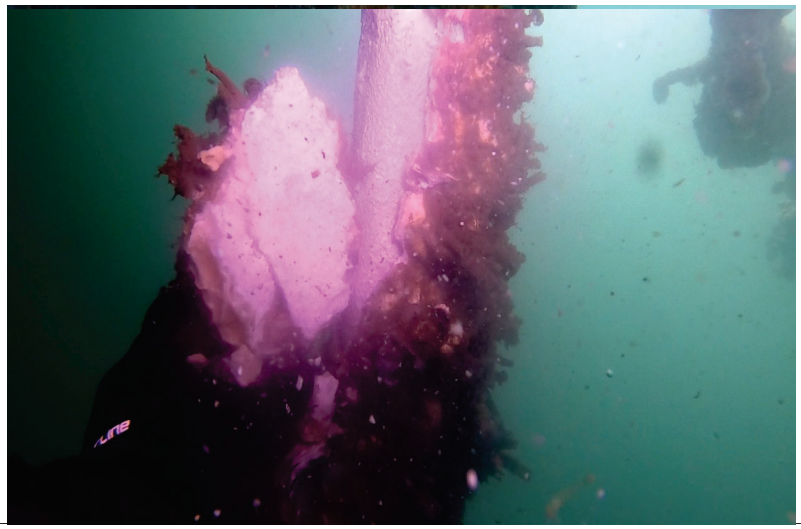
Almost all of the recently replaced anodes (anodes above 50% life remaining) were found to have nuts secure the anode u bolt to the mooring lines becoming loose. Under repetitive wave action, stress, & currents, the anodes had become progressively more loose over time, causing them to detach from the structures. There was even one anode detached and resting on the sea-bed. (Photo 39) However, the loosely attached anodes do appear to be providing sufficient cathodic protection.

Seattle Diving Services, LLC — Photographic log

Port of Bremerton	Floating Wave Attenuator	Photo 37

Client:
Port of Bremerton
Bremerton, Wa.98337

Description:
Removing anode outer calcifcation & marine growth layer exposing active metal

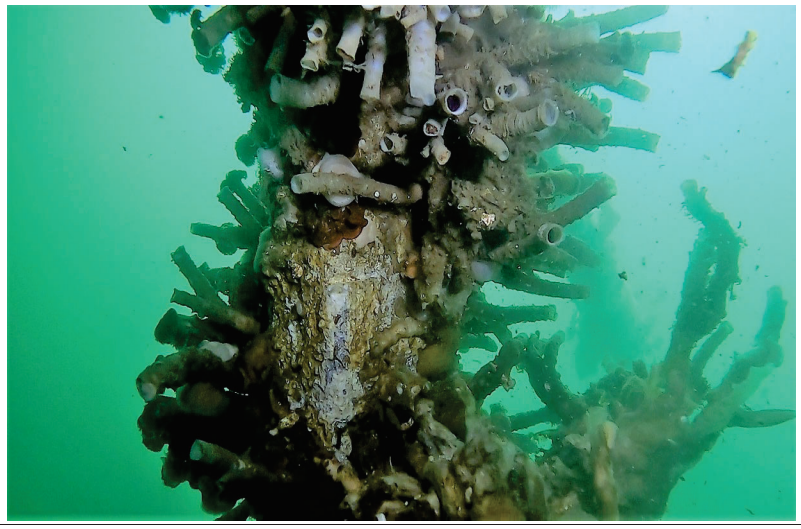


Seattle Diving Services, LLC — Photographic log

Port of Bremerton	Floating Wave Attenuator	Photo 38

Client:
Port of Bremerton
Bremerton, Wa.98337

Description:
Typical anode condition, completely encased in heavy marine growth preventing anode depletion



Seattle Diving Services, LLC		Photographic log
Port of Bremerton	Floating Wave Attenuator	Photo 39
Client: Port of Bremerton Bremerton, Wa.98337		
Description: Anode hardware failure disconnected & laying on seabed		

Heavy marine growth obstructed views of the top chain sections as the majority of the chains were covered in large groups of tube-worm colony's in up to 8’ in diameter. Marine growth was thick enough at the time to limit capabilities of an adequate level I visual inspection, tactile methods had to be used. Inspection divers dug through tube worm growth to access anodes and assess by “feel” how much material was left. In most cases, it was not possible to get a visual on the anodes at the top chain connection. (Photo 40-41) It became present during the inspection that most of the top chain anodes had either completely depleted or had become detached from the mooring lines, providing no immediate protection for the top chains. Little to no surface corrosion was observed as anodes further down the mooring lines appear to be providing residual protection but this should be considered temporary.

Mooring line 19 had no cathodic protection remaining and showed advanced corrosion including surface iron oxidation along the top chain, entire cable, and most of the bottom chain. (Photo 42-43) Mooring line numbers 6S, 20N, & 37 were observed to have minor corrosion such as surface rust on the bottom chain sections, anchor, and connections. (Photo 44) Mooring line numbers 21, 22, & 31N were observed to have minor corrosion such as surface rust on the top chain sections and connections. (Photo 45) The majority of top chain sections with

opposing mooring lines showed signs of fretting & minor wear caused from tide fluctuations and wave action from movement of the breakwater. (See Photo 46)

The majority of the anodes were found to be in fair condition. Anode conditions provided in TABLE 4.

Assessments

Based on our underwater inspection, the floating breakwater, associated mooring systems, connections, and cathodic protection are generally in overall Fair condition due to localized areas of minor deterioration. The deterioration noted in this report is considered minor and no load reductions are required as a result of the underwater structures.

The detailed examination of the cathodic protection components determined that the identified lines exposed to underwater electrolysis without cathodic protection requires rehabilitation and repair to provide an extended service life.

Seattle Diving Services, LLC **Photographic log**

Port of Bremerton	Floating Wave Attenuator	Photo 40

Client:
Port of Bremerton
Bremerton, Wa.98337

Description:
Typical marine growth condition at top chain & cable connection & anode location. Tube worm colony 8' in diameter.

Seattle Diving Services, LLC — Photographic log

Port of Bremerton	Floating Wave Attenuator	Photo 41

Client:
Port of Bremerton
Bremerton, Wa.98337

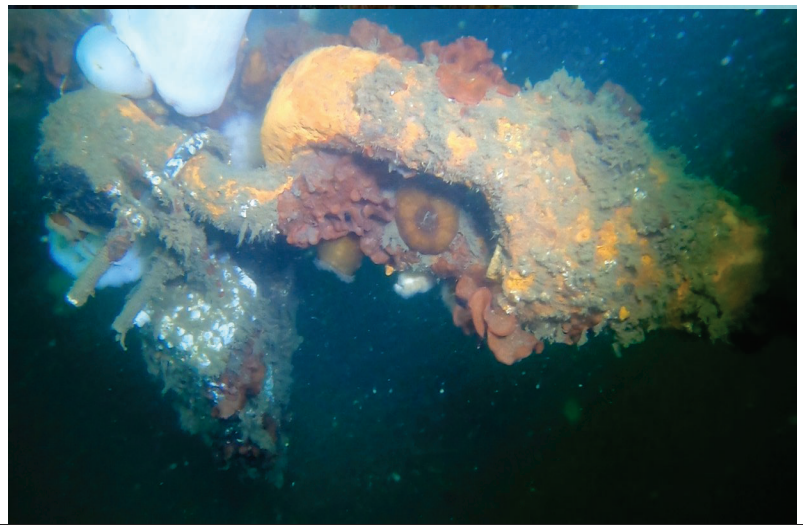
Description:
Typical chain to cable Connection point & anode location encased in heavy marine growth

Seattle Diving Services, LLC — Photographic log

Port of Bremerton	Floating Wave Attenuator	Photo 42

Client:
Port of Bremerton
Bremerton, Wa.98337

Description:
Advanced surface corrosion at bottom cable to chain section of mooring line 19



Seattle Diving Services, LLC — Photographic log

Port of Bremerton	Floating Wave Attenuator	Photo 43

Client:
Port of Bremerton
Bremerton, Wa.98337

Description:
Advanced surface corrosion at mid cable section of mooring line 19

Seattle Diving Services, LLC — Photographic log

Port of Bremerton	Floating Wave Attenuator	Photo 44

Client:
Port of Bremerton
Bremerton, Wa.98337

Description:
Moderate surface corrosion at bottom chain section of mooring line 37

Seattle Diving Services, LLC — Photographic log

Port of Bremerton	Floating Wave Attenuator	Photo 45

Client:
Port of Bremerton
Bremerton, Wa.98337

Description:
Moderate surface corrosion at top cable socket on mooring line 31N

Seattle Diving Services, LLC — Photographic log

Port of Bremerton	Floating Wave Attenuator	Photo 46

Client:
Port of Bremerton
Bremerton, Wa.98337

Description:
Typical top chain section with minor abrasion from opposing mooring line

TABLE 4 – BREMERTON MOORING LINE ANODE PERCENTAGES

Mooring Line #	Top Chain Anode %	Cable Anode %	Bottom Chain Anode %
1S	60	60/70	60
1N	20	50/50	50
2	30	40/50	50
3	50	40/40	30
4	0	50/60	60
5	30	60/70	70
6S	0	50/40	40
6N	60	50/50	30
7	0	20/30	60
8	30	50/70	40
9	20	60/70	60
10	0	60/70	60
11	30	60/60	60
12	30	50/70	60
13	10	60/60	60
14	10	60/60	60
15	40	70/80	30
16	50	60/60	60
17S	70	80/70	50
17N	70	70/70	60
18	10	80/70	50
19	0	0/0	60
20S	0	70/30	0
20N	0	70/30	0
21	0	60/60	70
22	0	60/60	0
23	10	60/60	60
24	0	60/60	60
25	10	60/60	60
26	10	60/60	60

27	10	60/60	60
28	10	60/60	60
29	10	60/60	60
30	10	60/60	60
31S	10	70/60	40
31N	0	70/70	40
32	50	70/60	60
33	0	60/60	60
34	0	50/50	50
35	0	60/60	60
36S	0	70/70	50
36N	0	70/70	0
37	40	60/70	0
38	10	60/60	60
39	50	50/60	60
40	10	60/60	60
41	60	50/60	60
42	60	60/60	60
43	50	50/60	60

Recommendations

There has been a significant increase of marine growth on the upper portion of the moorings since the 2018 inspection making it increasingly difficult to provide accurate inspections of the top chain to cable connections, which is also the installation point for the top anodes. In addition, all anodes no matter the location have built up a calcification and marine growth layer over time. All anodes and top cable to chain connections should be cleaned at the time of inspections to ensure proper anode depletion and accurate visual inspection.

Mooring line number 19 was observed to have relatively severe corrosion in comparison to the rest of the mooring system. Mooring lines 6S, 20N, 21, 22 31N, & 37 were observed to have Minor corrosion on the top or bottom chains. In-kind rehabilitation would involve one anode installation on the corresponding chain section and include proper cleaning sufficient enough to ensure contact between

the bottom chain and cathodic protection. These repairs should be carried out with moderate urgency.

All anodes 50% or below should be considered for replacement within the next two quarters. All mooring line sections missing anodes should be considered for installation within the same time frame.
Mooring lines and cathodic protection components should continue to be inspected bi-annually.

In addition, all of the pilot pile anodes were covered in a thick layer of calcification, marine growth, or both. When a “fresh” or active layer of anode material begins to calcify, it will harden and allow marine growth to latch on. Eventually covering the entire surface of the anode preventing the piling anodes from corroding properly. In turn providing no cathodic protection for the pilings and increasing surface deterioration. To ensure proper cathodic protection for the piles, it is recommended that all anodes be cleaned and inspected annually. A major benefit of the current anode system is that divers are not required for inspection or replacement of the cable or anodes as it all can be done from the docks allowing staff to monitor and clean these anodes if the port chooses to do so.

(3.0) SOUTH SIDE WAVE ATTENUATOR WALL

The objective of this project is to provide a general description and assessment with recommendations for the underwater & topside of the wave attenuator on the south side of the marina.

Observations
The structures are generally covered in moderate marine growth and representative areas were cleaned using hand tools for closer examination. The photos within this report provide a visual representation of the typical underwater conditions and deterioration.

The concrete is generally in overall sound condition with limited areas of minor deterioration. Twenty – 4”x7” areas on the north-side of the wave attenuator wall were subject to cracking and spalling. These areas are suspected to be “pick-points” during installation as they are all in the same locations on each wall, same

dimensions, and there is some minor rust staining coming through the concrete protective patches. (See Photo 47) All patches are on the north-side of the wall section, just above the high tide line.

The H-Pilings are in overall fair condition, deterioration was most severe just above the high tide line, in the splash zone. (See Photo 48) In addition, all wall supporting components welded to the H-Pilings were subject to accelerated deterioration. This form of corrosion is common and is caused when two dissimilar and joined together and submerged. One metal will corrode faster than the other and in this case, it is the wall bracing and supports. The H-Pilings themselves have typical-moderate deterioration. (See Photos 49)

Seattle Diving Services, LLC **Photographic log**

Port of Bremerton	South Side Wave Atennuator Wall	Photo 47

Client:
Port of Bremerton
Bremerton, Wa.98337

Description:
Typical concrete patch in splash zone with minor rust coming through

Seattle Diving Services, LLC — Photographic log

Port of Bremerton	South Side Wave Atennuator Wall	Photo 48

Client:
Port of Bremerton
Bremerton, Wa.98337

Description:
Typical H-plie in splash zone, minor surface corrosion and delamination

Seattle Diving Services, LLC — Photographic log

Port of Bremerton	South Side Wave Atennuator Wall	Photo 49

Client:
Port of Bremerton
Bremerton, Wa.98337

Description:
Typical H-pile & welded bracket corrosion in inter-tidal zone

Assessments

Based on our underwater inspection, the underwater condition of this structures is Satisfactory due to isolated areas of deterioration. The deterioration noted in this report is considered moderate however, no load adjustments are required as a result of the underwater structures. The detailed inspection determined that concrete in the tidal & atmospheric zones and the H-Pilings located in the tidal & submerged zones of the structure require future rehabilitation to provide an extended service life.

Recommendations

The concrete patches on the North-side of the wave attenuator wall have minor cracking and spalling. It is recommended the failing patches be removed and new patches be installed. The wall support welded to the H-Pilings are progressively deteriorating and recommended that cathodic protection be installed on each H-Piling. Repairs should be carried out within the next year.

BREMERTON MARINA PILOT PILES (10-Piles)

The objective of this project is to provide a general description and assessment with recommendations for the (10) outlined Pilot Piles. Visual, ultrasonic, and corrosion potential inspections were performed. The structures are generally covered in heavy marine growth and representative areas were cleaned using hand tools for closer examination. The photos within this report provide a visual representation of the typical underwater conditions and deterioration.

Observations

The ten pilot piles are generally in overall sound condition with limited areas of minor deterioration. The deterioration was most severe just above the high tide line. (See Photo 50) Little to no delamination was noted for all but two pilot pile coatings. Pilings E-49 & E-46 were observed to have moderate surface rust throughout the submerged zones of the piles. (See Photos 51-52) This form of corrosion is common and although moderate, should be considered when planning future rehabilitation. Pilings A-26 & A-15 had anodes installed with piling A-26 anode damaged & disconnected. (See Photo 53) Piling A-15 anode had a 40% service life remaining. All other pilings did not have cathodic protection installed.

Assessments

Based on our underwater inspection, the underwater condition of these structures is Good due to isolated areas of minor deterioration. The deterioration noted in this report is considered minor and no load reductions are required as a result of the underwater structures. Detailed visual and thickness examinations of the pilot piles determined that the tidal & submerged zones may require future rehabilitation to provide an extended service life. However, no major defects were discovered.

Recommendations

Piling A-26 anode cable was broken and the anode disconnected. The cable & anode should be repaired and replaced as soon as possible. Pilings E-49 & E-26 did not have cathodic protection installed and there was moderate surface rust in the submerged zone of the piles. Anode installation should be considered within the next year for pilings on E-dock.

(5.0) BREMERTON READINGS & MEASUREMENTS

Thickness readings were taken using a Tritex Multigauge 3000 Underwater Thickness Meter which was calibrated and tested on-site using a 0.500 testing block. CP Measurements were taken using a Polatrak CP Gun which was calibrated and tested on-site using a 0.500 testing block. Both gauges are 2018 models and are the go-to units in the sub-sea inspection industry.

Bremerton Pilot Piles

	THICKNESS MEASUREMENT				CP READING		
Location	**Waterline**	**Mid-Water**	**Seabed**	**Depth**	**Waterline**	**Mid-Water**	**Seabed**
A-26	.385	.365	.365	18’	-714	-720	-723
A-15	.365	.365	.390	27’	-711	-736	-722
B-44	.385	.390	.390	22’	-724	-738	-730
B-45	.390	.370	.385	28’	-712	-707	-718
C-49	.570	.560	.575	22’	-699	-677	-672
P-35	.575	.575	.575	29’	-672	-675	-675
D-39	.580	.585	.585	32’	-684	-687	-686
E-49	.580	.580	.580	27’	-660	-661	-661
P-2	.580	.580	.575	67’	-686	-687	-686
E-26	.535	.575	.575	32’	-670	-670	-671

Seattle Diving Services, LLC — Photographic log

Port of Bremerton	Pilot Piles	Photo 50

Client:
Port of Bremerton
Bremerton, Wa.98337

Description:
Typical coating delamination & surface corrosion at splash zone

Seattle Diving Services, LLC — Photographic log

Port of Bremerton	Pilot Piles	Photo 51

Client:
Port of Bremerton
Bremerton, Wa.98337

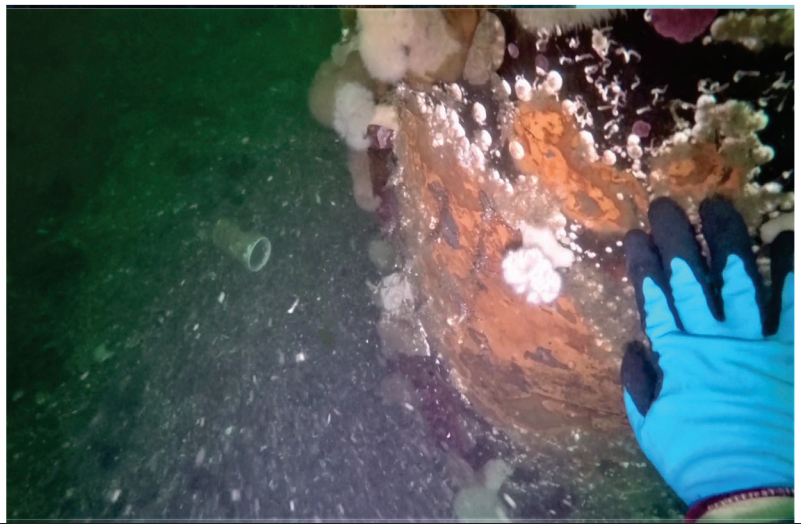
Description:
Moderate surface corrosion & deterioration on pilot pile E-49

Seattle Diving Services, LLC — Photographic log

Port of Bremerton	Pilot Piles	Photo 52

Client:
Port of Bremerton
Bremerton, Wa.98337

Description:
Moderate surface corrosion & deterioration on pilot pile E-26

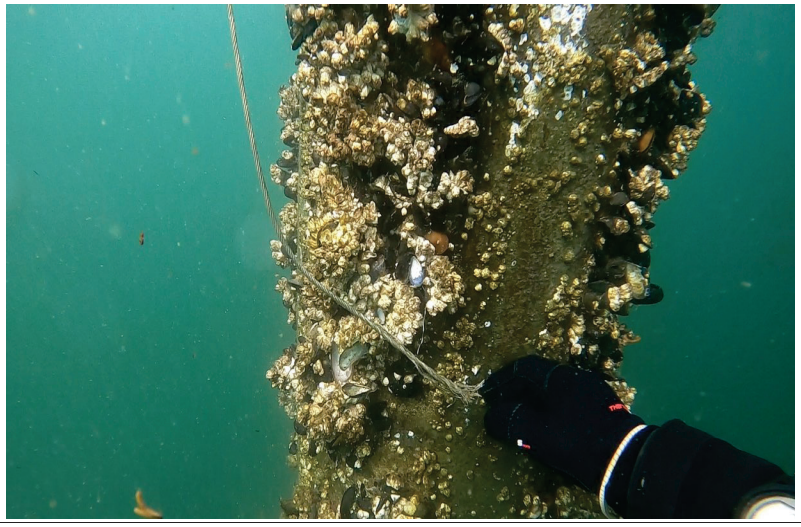


Seattle Diving Services, LLC — Photographic log

Port of Bremerton	Pilot Piles	Photo 53

Client:
Port of Bremerton
Bremerton, Wa.98337

Description:
Broken anode cable on pilot pile A-26



END OF REPORT