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CRESCENT CITY HARBOR DISTRICT  
CITIZENS DOCK DAMAGE SURVEY  
Crescent City, CA

Above Water Condition Survey and Concept Repair

June 27, 2011

Job Number: 2011-022

Prepared	WOM
Checked	TWT
Approved	TWT

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# 1 Introduction

Ben C. Gerwick, Inc. was retained by Stover Engineering and the Crescent City Harbor District to perform an above water structural survey of Citizens Dock in Crescent City, CA. This report describes the findings of the survey conducted during May 2011 and the conceptual repairs needed to restore the original operational capacity. The report includes deficiencies identified, recommended repairs, rough order of magnitude estimated cost of repairs, and recommended ongoing maintenance practices.

## 1.1 Background

Citizens Dock is a timber structure that is used for off loading and transfer of fish and crab. The Y-shaped dock consists of a timber trestle connected to two timber piers. The timber structure was first opened in 1950 with a Fish Wharf and Lumber Wharf. Some repairs and improvements were made in 1964 following the Alaska Earthquake. A fire damaged the west end of the west wharf in the past and it was shortened up to the area now occupied by the Ice House. The timber deck on the 2 wharves and approach trestle was replaced by a permanent concrete deck in 1988.



**Figure 1-1: Crescent City Harbor and Citizens Dock**

## 1.2 Scope of Work

The following tasks have been outlined for performing and completing the Condition Survey of Citizens Dock

1. Perform a post event condition survey above and below deck of the pier piling, fender piles, deck beams, mooring hardware, fender system and camels, and vessel access ladders.
2. Identify deficiencies from the condition survey.
3. Recommend conceptual repairs.
4. Provide Rough-Order-of-Magnitude Costs for Recommended Repairs.

## 1.3 Condition Survey Team

The condition survey team consisted of Wayne Mac Donell, P.E. and Sam Woodruff of Ben C. Gerwick, Inc.. The inspections were carried out above the deck on foot and below the deck by boat where access was possible.

## 1.4 Conclusions

The assessment provided is based on maintaining the structures' capacity as designed. Gerwick has not performed any structural analysis of the structures to confirm the adequacy of existing designs for the current operational loadings imposed on the structures. The ability to perform a thorough inspection was limited by the timeframe for completion and access to various portions of the terminal.

Fender piles and vertical piling make access beneath the deck at the majority of the west and east ends of the wharf is difficult to achieve. The observations made at the locations where access was possible were fairly consistent, which leads the team to believe that these conditions are likely typical of areas that were inaccessible. The damage at inaccessible areas and below the waterline were not surveyed and may have additional damage that could be detected with an underwater survey or during future repairs.

Based on a visual survey Gerwick has the following recommendations:

1. The damaged fender piling should be replaced. The fender piling have been damaged due to recent impact and abrasion from vessels, or debris during the March 2011 Tsunami.
2. The timber chocks supporting the fender piles at the deck level need to be replaced. These chocks were also damaged during the recent tsunami and are necessary for safe operation of the existing timber fender pile system.
3. The mooring hardware and ladders should be repaired and replaced respectively. The items were damaged during the recent tsunami and are necessary for safe mooring and access for vessels using Citizens Dock.

4. The vertical timber piles suffering from loss of section should be repaired. A detailed inspection, including underwater will be required to locate all affected piles. These piles are critical for the vertical support and operation of the approach trestle and wharves .

In the following sections additional information on the surveys performed and the methodology used to perform the survey is provided. The conditions encountered are described with also described with photographs.

## 2 Facility Description & Construction

Citizens Dock was constructed by the citizens of Crescent City to support the local fishing and lumber markets in northern California and southern Oregon. The Y-shaped dock is located off of Citizens Dock Road from Highway 101. The timber approach trestle provides access to the west and south wharves.

The timber structure was first opened in 1950 with a Fish Wharf and Lumber Wharf. Some repairs and improvements were made in 1964 following the Alaska Earthquake. The present structure no longer has a Lumber Wharf, but has a West Wharf instead. A fire damaged the west end of the west wharf in the past and it was shortened up to the area now occupied by the Ice House. The timber deck on the two wharves and approach trestle was replaced by a permanent concrete deck in 1988.

The dock is composed of an approach trestle, west wharf, and south wharf. All structures are pile supported and constructed of timber piles, timber beams, and concrete decking.

### 2.1 Approach Trestle

The approach trestle is 260 foot long by approximately 34 foot wide structure that spans the existing Harbor seawall and connects to the West and South wharves.

The approach trestle is a timber framed structure that is pile supported. The 13" Ø timber piles support 12x14 timber cap beams which run in the transverse direction from north to south. Stringers are 4x14 timber members spaced at 18" on-center (oc) aligned longitudinally and originally supported 4x12 decking. However, in 1988, the decking was replaced with a 4,000 psi concrete deck supported on a metal deck pan. The timber pile bents are spaced at approximately 10-ft centers. Each bent has three vertical timber piles spaced at approximately 7-ft centers. Every bent has a batter pile; alternative bents have a pile in the northern direction, or southern direction. The concrete deck has a center drain that is continuous along the length of the trestle.

### 2.2 South Wharf

The west wharf is 210 foot long by approximately 62 foot wide structure that was formerly known as the Fish Wharf.

The south wharf is a timber framed structure that is pile supported. The 13" Ø timber piles support 12x14 timber cap beams which run in the transverse direction from east to west. Stringers are 4x14 timber members at 18" oc aligned longitudinally and originally supported 4x12 decking. However, in 1988, the decking was replaced with a concrete deck supported on a metal deck pan. The timber pile bents are spaced at approximately 10-ft centers. Each bent has nine vertical timber piles spaced at approximately 7.625-ft centers. Every bent has a batter pile; alternative bents have a pile in the east direction, or west direction. The concrete deck has area drains are intermittent locations along the length of the wharf.

The south wharf does not have timber fender piles, but instead, has a hanging timber fender. The vertical fender timbers only extend to about -4' MLLW. These timbers are supported by 3 horizontal walers bolted to the outer row of vertical piles. The vertical main fender timbers are bolted to the walers with horizontal chocks between to keep piles in place. These chocks prevent boats from rubbing the fender timber off the wharf.

## **2.3 West Wharf**

The west wharf is 260 foot long by approximately 40 foot wide structure that supports the Ice House and was formerly known as the Lumber Wharf.

The west wharf is a timber framed structure that is pile supported. The 13" Ø timber piles support 12x14 timber cap beams which run in the transverse direction from north to south. Stringers are 4x14 timber members spaced at 18" oc aligned longitudinally which originally supported 4x12 decking. However, in 1988, the decking was replaced with a concrete deck supported on a metal deck pan. The timber pile bents are spaced at approximately 10-ft centers. Each bent has six vertical timber piles spaced at approximately 8-ft centers. Every bent has a batter pile; alternative bents have a pile in the northern direction, or southern direction. The concrete deck has intermittent areas drains along the length of the wharf.

## **2.4 Mooring Hardware**

The wharves have heavy duty mooring cleats bolted through the timber edge beams at the edge of the wharves and trestle. This allows vessels to moor along either side of the trestle and wharves.

## **2.5 Fenders**

A continuous fender system runs along the water side face of the approach trestle and west wharf. It is a combination of timber fenders, wales, and camels. The south wharf has a different fender system and is described in the above section.

### **2.5.1 Timber Fender Piles.**

Timber piles are used as fenders along the waterside faces of the trestle and wharves. They are driven into the harbor mud and sand and are supported at the deck level of the structures. The timber chocks and wales provide support for the fender pile at approximately the deck level..

### **2.5.2 Camels**

The floating camels consist of a capped horizontal pipe with rubber tires and supported at various locations along the length of the wharf with chain and shackle to the existing fender piles. The camels provide a wear strip for vessels (trawlers and boats) along the water elevation of the fender system.



## **2.6 Miscellaneous Items**

### **2.6.1 Access Ladders**

At approximately every tenth bent a steel access ladder is provided for access from vessels to the trestle or wharf. These ladders have steel flat bars and round rungs and are bolted to the deck and braced to the vertical piles.

### 3 Observed Conditions

The following section documents the conditions observed during the above water survey. Not all portions of the structure were inspected due to limited access below deck because of closely spaced piling and fender pile obstructions. Descriptions of pile conditions are limited to observable pile lengths from EL -2 (MLLW) to the top of the pile. The two day above water survey conducted from above deck and below deck is described in the following section. Ratings classifications used are taken from the MOTEMS Audit Manual which is described in the Appendix.

#### 3.1 Approach Trestle

In general the Approach Trestle is in satisfactory condition although repairs are recommended.

The appendices include both photographs (B3 - B10) and drawings (SK-2) that provide a visual evidence of damage and relative location for future survey and repair documentation. A brief summary of the noted damage is summarized below.

Timber piles were in satisfactory condition throughout the approach trestle. At some locations there was damage due to marine borer penetration and tsunami impact and abrasion. The borer and fungal damage is most apparent at the locations in the tidal zone. The tsunami damage was also visible in the tidal zone with damage to face of piling and support locations at wales and chocks. Three fender piles had Major or Severe damage.

The cap beams are typically in satisfactory condition. At a few locations they have poor bearing support at butt joints supported by the piles. A few instances were observed of pile splits because of the caps resting on the outer pile edge. Some caps had damage at the channel side face of the wharf due to vessel impacts, but this is localized and did not appear to affect the load carrying capacity of the members.

Stringers are in satisfactory condition. No significant damage was noted. Some water staining was observed at areas adjacent to drains and these areas should be monitored for fungal damage.

The concrete layer is worn, but generally intact. There are several locations where the surface is cracked. The metal pan had signs of corrosion near deck drains and along waterside edges, but that would be expected and did not seem to impair the capacity of the concrete deck.

There is concrete float debris from the recent tsunami that is wedged between vertical piles and should be removed. The debris may cause additional damage to vertical load bearing piles that could affect the capacity of the trestle to support vehicle traffic. The plans show the location of the tsunami debris.

#### 3.2 South Wharf

In general the South Wharf is in satisfactory condition although repairs are recommended.

The appendices include both photographs (B17-B24) and drawings (SK-4) that provide a visual evidence of damage and relative location for future survey and repair documentation. A brief summary of the noted damage is summarized below.

Timber piles were in fair condition throughout the south wharf except at some locations there was damage due to marine borer penetration. The borer and fungal damage is most apparent at the locations in the tidal zone. Ten vertical piles had Major or Severe damage.

The cap beams are typically in satisfactory condition. At the west end, the cap beams and stringers have experienced fire damage that appears to be limited to the surface of the timbers. Future corings could determine the extent of damage and reduction in capacity. A few instances were observed of pile splits because of the caps resting on the outer pile edge. Some caps had damage at the channel side face of the wharf due to vessel impacts, but this is localized and did not appear to affect the load carrying capacity of the members.

Stringers are in satisfactory condition. No significant damage was noted. Some water staining was observed at areas adjacent to drains and these areas should be monitored for fungal damage.

The concrete layer is worn, but generally intact. There are several locations where the surface is cracked. The metal pan had signs of corrosion near deck drains and along waterside edges, but that would be expected and did not seem to impair the capacity of the concrete deck.

The south wharf fender system is sufficiently intact down to, and including, the 2nd waler level. At the lower 3rd walers level almost all the horizontal chocks on the lower part of the hanging vertical fender timbers are rotten and hollow from marine borers. These damaged fender parts should be replaced as maintenance funds become available.

### **3.3 West Wharf**

In general the West Wharf is in satisfactory condition although repairs are recommended.

The appendices include both photographs (B11-B15) and drawings (SK-4) that provide a visual evidence of damage and relative location for future survey and repair documentation. A brief summary of the noted damage is summarized below.

Timber piles were in satisfactory condition throughout the west wharf. At some locations there was damage due to marine borer penetration and tsunami impact and abrasion. The borer and fungal damage is most apparent at the locations in the tidal zone. The tsunami damage was also visible in the tidal zone with damage to face of piling and support locations at wales and chocks. One vertical pile had Major or Severe damage. Ten fender piles had Major or Severe damage.

The cap beams are typically in satisfactory condition. At a few locations they have poor bearing support at butt joints supported by the piles. A few instances were observed of pile splits because of the caps resting on the outer pile edge. Some caps had damage at the channel side face of the wharf

due to vessel impacts, but this is localized and did not appear to affect the load carrying capacity of the members.

Stringers are in satisfactory condition. No significant damage was noted. Some water staining was observed at areas adjacent to drains and these areas should be monitored for fungal damage.

The concrete layer is worn, but generally intact. There are several locations where the surface is cracked. The metal pan had signs of corrosion near deck drains and along waterside edges, but that would be expected and did not seem to impair the capacity of the concrete deck.

### **3.4 Mooring Hardware**

The cleat and the hardware connections appeared to be in satisfactory condition and replacement is not recommended at this time. However, the cleats should be observed during a mooring to determine if bolt elongation, or timber bearing damage has occurred.

### **3.5 Fenders**

The fender systems (fender piles, chocks, and wales) appeared to be in fair condition and should be monitored for future damage. The replacement of fender piles and chocks is recommended and is discussed in each of the various wharf structure sections.

### **3.6 Miscellaneous Items**

#### **3.6.1 Access Ladders**

The Access Ladders generally appeared to be in satisfactory condition, but two ladders should be replaced for safe access to the Access Trestle.

## 4 Recommendations

The following relates the recommendations for repairs based on our preliminary condition assessment survey. We have estimated the extent of typical damage, where noted, and extrapolated those observations to locations which were not accessible.

The purpose of the survey was to develop an estimate of the extent and degree of damage to the existing structures. From this estimate of damage we have developed recommendations for repair, and possible upgrades to the facility.

### 4.1 Approach Trestle

In general the Approach Trestle is in satisfactory condition although repairs are recommended.

The damaged timber fender piles and associated chocks should be replaced in-kind to restore the original capacity to the fender system. Due to environmental concerns, creosoted timber piles and chocks are no longer permitted in California. However, if permitted, Douglas Fir piles ACZA treated piles and chocks would be the most economical replacement option and provide protection from marine borers. The use of ACZA treated piles have been approved on a case by case basis. Fiberglass reinforced Plastic Piles are a more expensive replacement option and are more difficult to drive and fit with chocks.

The steel ladders should be replaced in-kind, or with fiberglass ladders to provide some protection from the corrosive salt spray.

The concrete float debris from the recent tsunami that is wedged between vertical piles and should be removed.

### 4.2 South Wharf

In general the South Wharf is in satisfactory condition although repairs are recommended.

The damaged timber piles should be repaired with a fiberglass sleeve to restore the original vertical load carrying capacity to the wharf. Due to restricted access and expense, the existing piles cannot be replaced with treated timber piles. However, we have successfully used fiberglass sleeves with a grout mix to restore the vertical capacity of the timber pile. The installation requires additional underwater survey to determine the extent of damage. The typical repair consists of a fiberglass sleeve installed approximately 2-ft into the mud/sand and grouted with a cement grout to fill voids and restore vertical capacity of piling.

The damaged timber fender system and associated chocks should be replaced in-kind to restore the original capacity to the fender system. Douglas Fir ACZA treated timbers and chocks would be the most economical replacement option and provide protection from marine borers. Fiberglass reinforced plastic timber structural members may be an option, but would need to be engineered to determine that the original fender system capacity was being provided for the vessel berthing.

Fiberglass reinforced plastic timber members are a more expensive replacement option and are more difficult to drill and fit with bolts, but may offer a longer life. These damaged fender parts should be replaced as maintenance funds become available.

### **4.3 West Wharf**

In general the West Wharf is in satisfactory condition although repairs are recommended.

The damaged timber fender piles and associated chocks should be replaced in-kind to restore the original capacity to the fender system. Due to environmental concerns, creosoted timber piles and chocks are no longer permitted in California. However, if permitted, Douglas Fir piles ACZA treated piles and chocks would be the most economical replacement option and provide protection from marine borers. The use of ACZA treated piles have been approved on a case by case basis. Fiberglass reinforced Plastic Piles are a more expensive replacement option and are more difficult to drive and fit with chocks.

### **4.4 Mooring Hardware**

The cleat and the hardware connections appeared to be in satisfactory condition and replacement is not recommended at this time. However, the cleats should be painted and surveyed on an annual basis to monitor condition.

### **4.5 Fenders**

The fender systems (fender piles, chocks, and wales) appeared to be in fair condition and should be repaired as discussed for each of the associated wharves. The fender system should also be surveyed on an annual basis to monitor condition and potential damage.

### **4.6 Miscellaneous Items**

#### **4.6.1 Access Ladders**

The Access Ladders generally appeared to be in satisfactory condition, but two ladders should be replaced for safe access to the Access Trestle.

## **5 Cost Estimates**

### **5.1 Mobilization**

A mobilization cost of \$130,000 for a remote location requiring a derrick barge for timber fender pile replacement. We have assumed that all fender pile and associated pile repairs would be completed in one mobilization to the Crescent City Harbor.

### **5.2 Underwater Inspection of Timber Piles to be Repaired**

We estimate the cost to perform a detailed underwater inspection to locate additional pile damage below the waterline using three commercially trained divers would be approximately \$75,000.

The underwater condition survey could also be completed in tandem with the vertical pile repairs for a potential cost savings; however, it would be prudent to procure additional fiberglass sleeve lengths to be able to implement any additional damage repair that could be discovered during the underwater survey.

### **5.3 Design of Repairs for Vertical Piles and Timber Wales**

We estimate the cost to develop detailed construction repair plans and general notes would be approximately \$32,500. Permitting costs and Bid and Construction Assistance would be additional and would be dependent on required assistance for the Harbor District.

### **5.4 New Timber Fender Piles**

Replacement of the broken timber fender piles (13 piles) and associated chocks and timber framing will be dependent derrick barge access and pile driving equipment required for installation. The required lead time for treated timber piles and chock members is between six and eight weeks approximately.

### **5.5 Pier Timber Pile Sleeves**

Furnish and installation of grouted fiberglass sleeves (11) is dependent on the availability of trained divers and pumping requirements for the grout installation. The timber piles must be cleaned and all marine life removed for correct application of the fiberglass sleeve and grouted annulus. Typically the split sleeve is opened and assembled around piles in approximately 5-ft sections for the required damage depth plus an additional depth for protection. High currents and winds can affect the handling of the sleeves, but the protected conditions at the dock should allow for easy installation.

## **5.6 Mooring Hardware and Ladder Repairs**

The mooring hardware cleats should be painted to avoid additional corrosion. The furnishing and installation of either steel ladders (2), or fiberglass ladders, and associated bracing is a nominal cost and could be completed by the District Maintenance staff during their regular maintenance cycles.

## **5.7 Camels and Timber Fender Waler Repairs**

The camels and timber fender walers systems should be surveyed and repaired as needed. The existing camels and fenders are presently performing fair for the dock, but will continue to experience wear and tear due to their location in the wave and tidal zones. The District should budget maintenance funds to eventually replace all camels and the South Wharf fender waler within three to five years.

## **5.8 Contingency and Escalation**

Appendix D contains a construction cost estimate with a thirty percent contingency included for conceptual design. We have not included an escalation since the repairs should be considered urgent and completed within the 2011 calendar year.



## Appendices

Appendix A: Drawings of Structures and Above Water Survey Damage Documentation

Appendix B: Photographs of Above Water Condition Survey

Appendix C: MOTEMS Damage Rating Classification System

Appendix D: Order-of-Magnitude Construction Cost Estimate with Contingency

# Appendix A      Citizens Dock Damage Drawings

The Citizens Dock Damage Drawings include documented damage from the May 16 -20, 2011 Above Water Survey coordinated by Wayne Mac Donell PE.

Appendix A Title Sheet

A-1

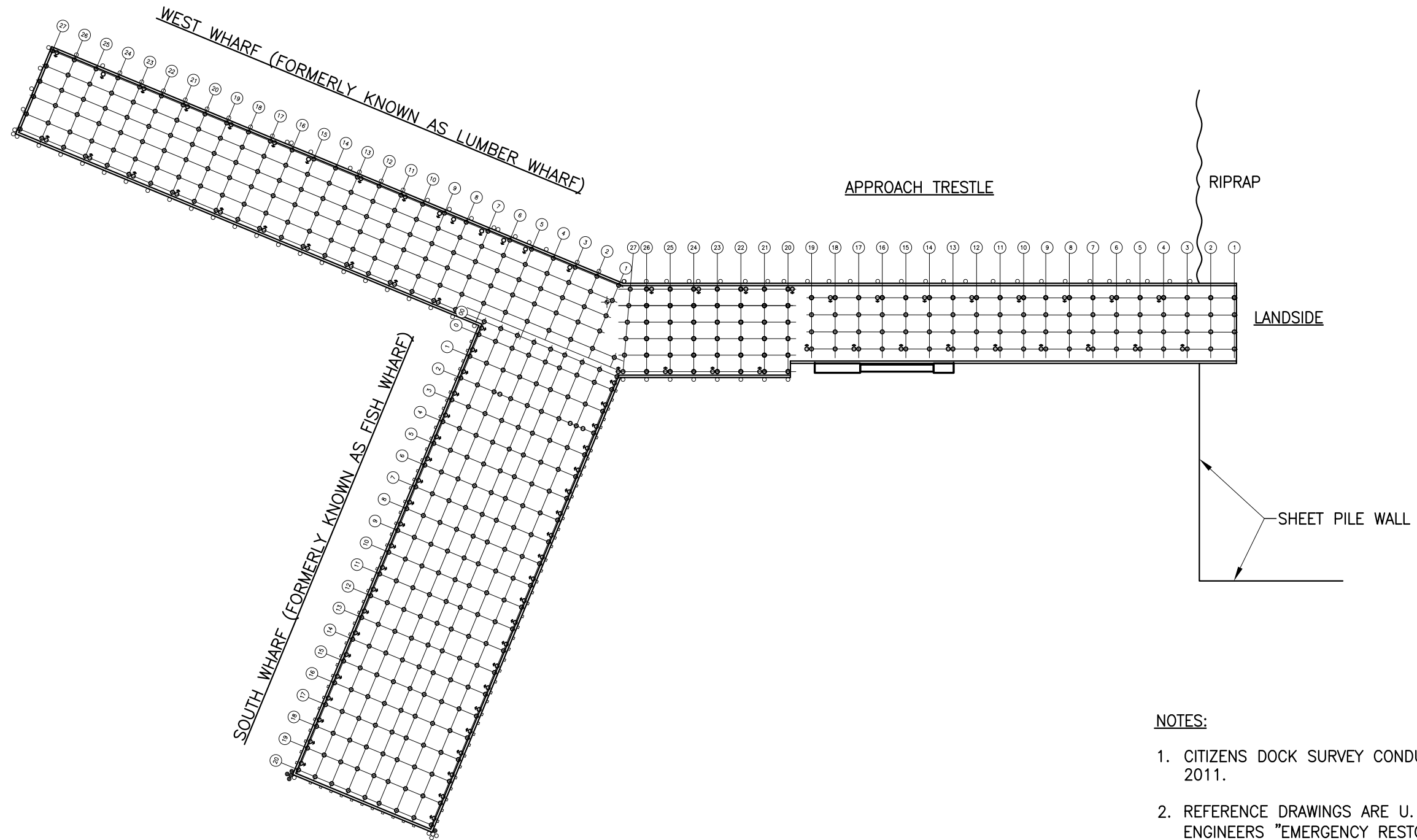
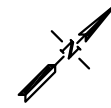
SK1 -- Citizens Dock Overall Damage Plan

SK2 -- Citizens Dock Approach Trestle Damage Plan

SK3 -- Citizens Dock South Wharf Damage Plan

SK4 -- Citizens Dock West Wharf Damage Plan

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**NOTES:**

1. CITIZENS DOCK SURVEY CONDUCTED MAY 17 THROUGH 20, 2011.
2. REFERENCE DRAWINGS ARE U. S. ARMY, CORPS OF ENGINEERS "EMERGENCY RESTORATION WORK, CRESCENT CITY HARBOR, CITIZENS DOCK, SHEETS 1 OF 2 AND 2 OF 2, 8 APRIL 1964, FILE No. 8-10-1"
3. ACTUAL PILE MAY VARY FROM LOCATION SHOWN.

## PILE PLAN OF CITIZENS DOCK

No.	Date	Revision	Aprvd.
1	6/27/11	ADDED BATTER PILES TO SOUTH WHARF	
DRAWING INFO: DESIGNED BY: WOM DRAWN BY: SFW CHECKED BY: WOM			
0 1 BAR IS EQUAL TO ONE INCH ON ORIGINAL DRAWING. ADJUST SCALES IF DISTANCE VARIES ACCORDINGLY.			

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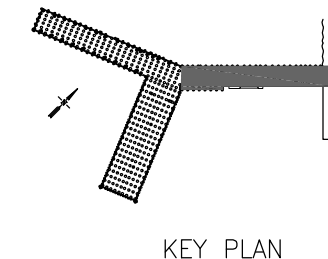
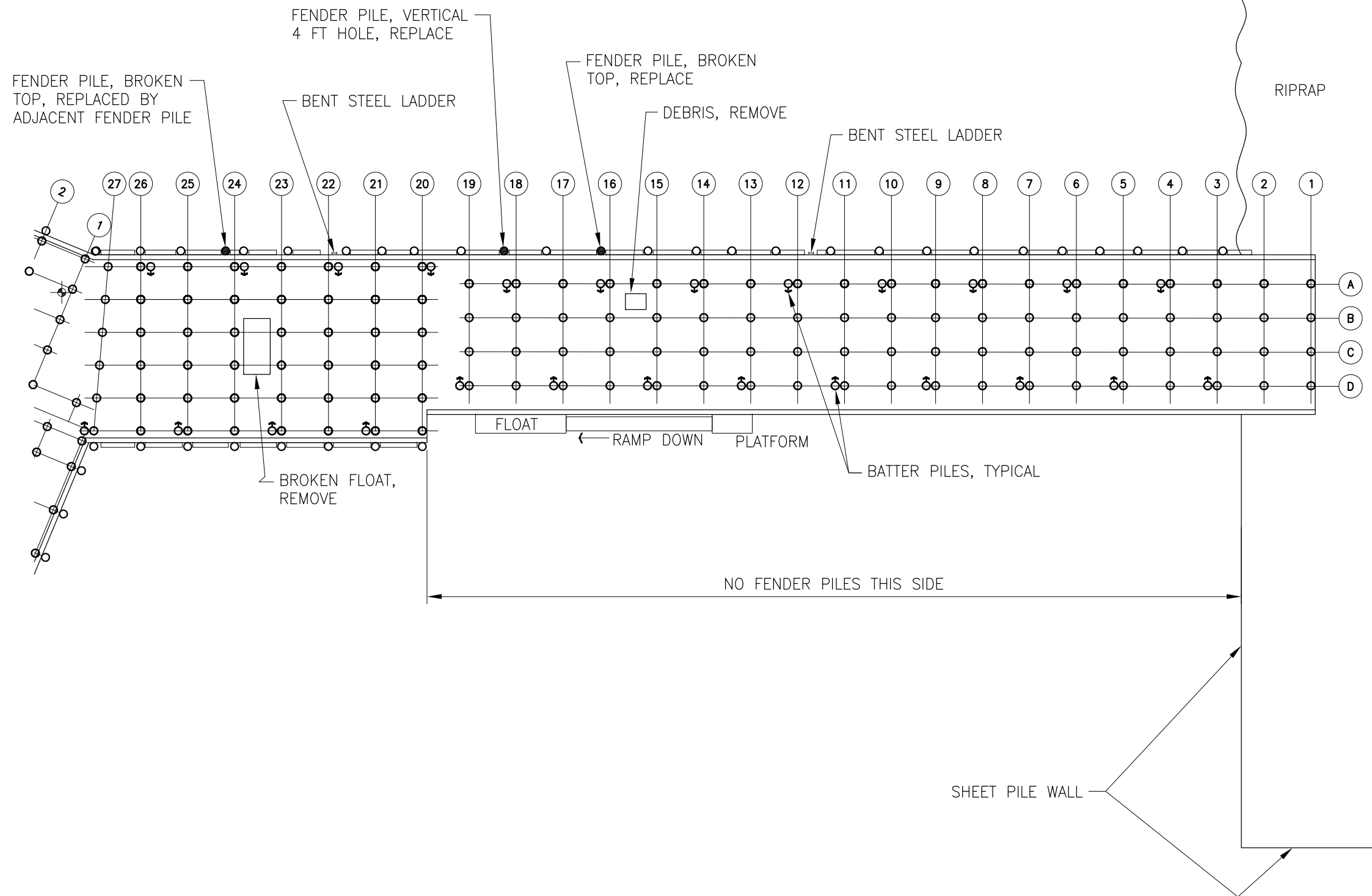
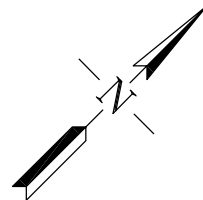
CRESCENT CITY HARBOR DISTRICT  
CONDITION SURVEY OF CITIZENS DOCK  
CRESCENT CITY, CALIFORNIA

PILE PLAN OF CITIZENS DOCK

JOB NO. 2011-022  
SCALE: 1"=50'  
DATE: 06-13-11  
SHEET

# SK-1

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LANDSIDE

**LEGEND**

- VERTICAL TIMBER PILE
- ♀ BATTER PILE
- DAMAGED PILE

# PILE PLAN OF APPROACH TRESTLE

No.	Date	Revision	Aprvd.
DRAWING INFO: DESIGNED BY: WOM DRAWN BY: SFW CHECKED BY: WOM			
1 BAR IS EQUAL TO ONE INCH ON ORIGINAL DRAWING. ADJUST SCALES IF DISTANCE VARIES ACCORDINGLY.			

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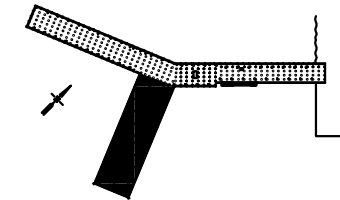
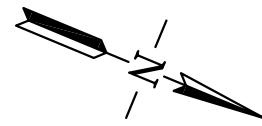
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**CRESCENT CITY HARBOR DISTRICT  
CONDITION SURVEY OF CITIZENS DOCK  
CRESCENT CITY, CALIFORNIA**

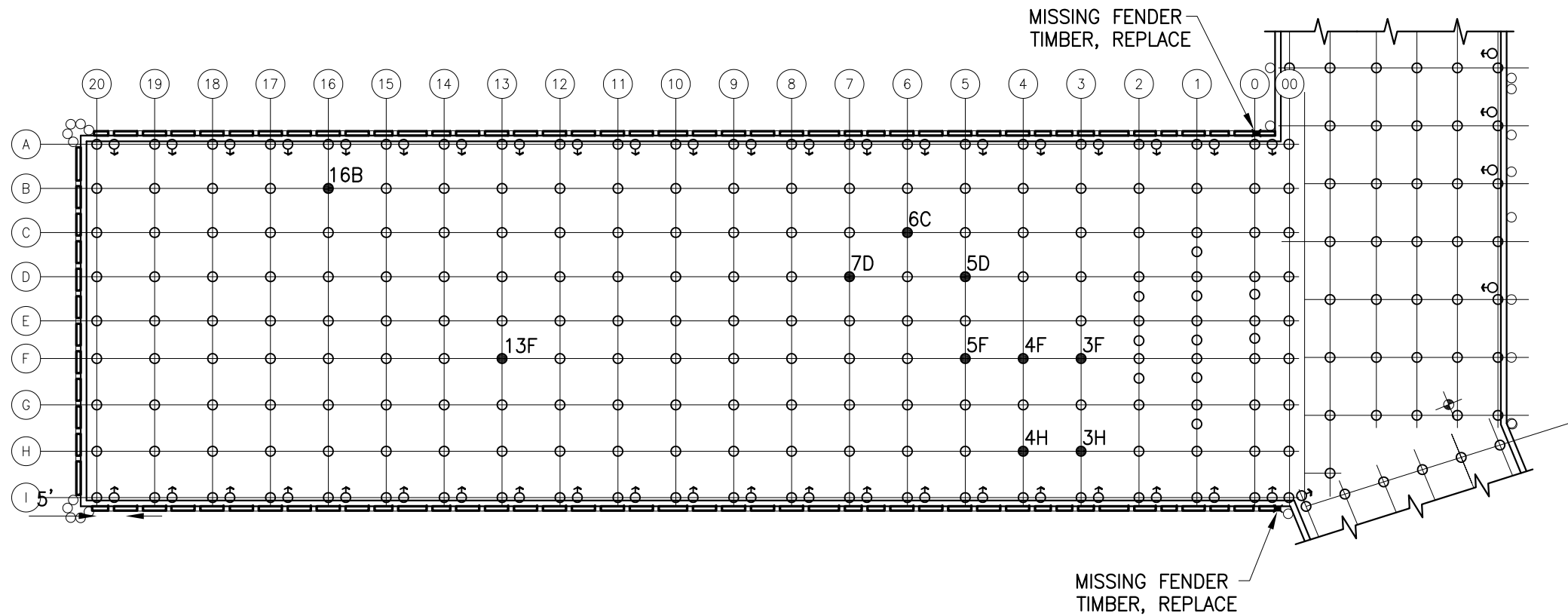
**PILE PLAN OF APPROACH TRESTLE**

JOB NO. 2011-022  
SCALE: 1"=25'  
DATE: 06-13-11  
SHEET  
**SK-2**

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KEY PLAN



## PILE PLAN OF SOUTH WHARF (FORMERLY KNOWN AS FISH WHARF)

**LEGEND**

- VERTICAL TIMBER PILE
- ⊕ BATTER PILE
- DAMAGED PILE
- ✕ MISSING FENDER TIMBER

No.	Date	Revision	Aprvd.
1	6/27/11	ADDED BATTER PILES TO SOUTH WHARF	
DRAWING INFO: DESIGNED BY: WOM DRAWN BY: SFW CHECKED BY: WOM			
0 1" BAR IS EQUAL TO ONE INCH ON ORIGINAL DRAWING. ADJUST SCALES IF DISTANCE VARIES ACCORDINGLY.			

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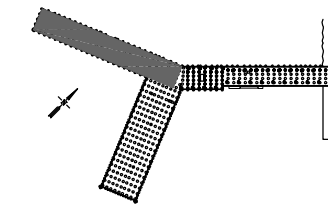
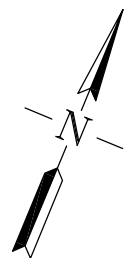
CRESCENT CITY HARBOR DISTRICT  
CONDITION SURVEY OF CITIZENS DOCK  
CRESCENT CITY, CALIFORNIA

PILE PLAN OF SOUTH WHARF

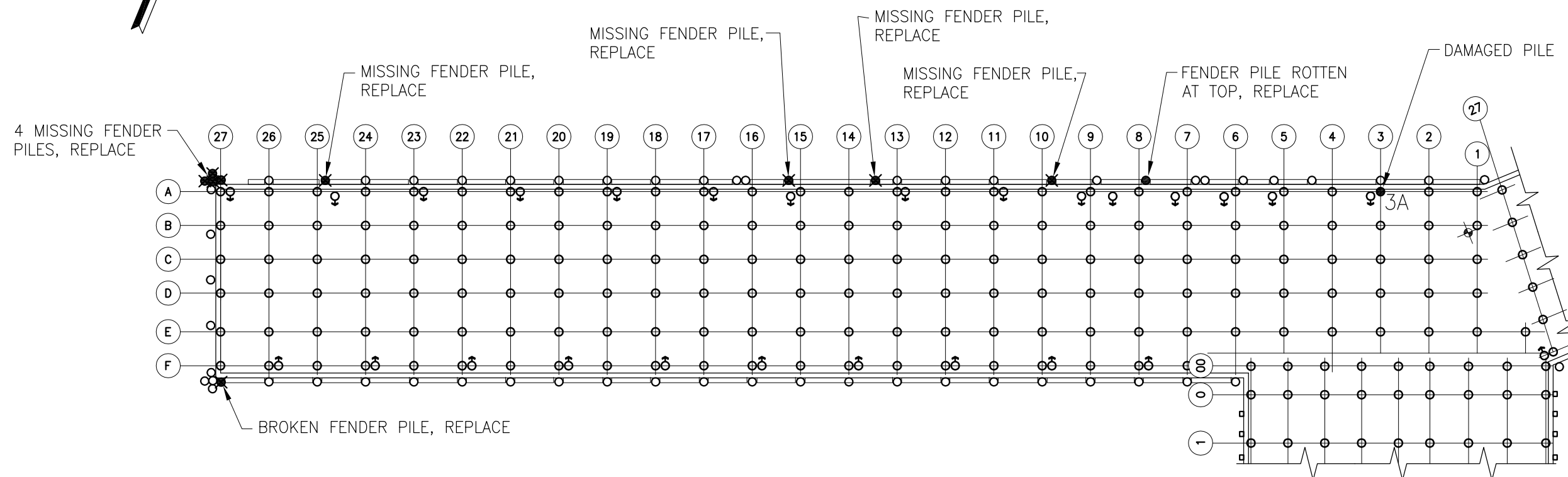
JOB NO. 2011-022  
SCALE: 1"=25'  
DATE: 06-13-11  
SHEET

**SK-3**

STOVER ENGINEERING SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF ELECTRONIC COPIES OF THIS PLAN SHEET.



KEY PLAN



## PILE PLAN OF WEST WHARF (FORMERLY KNOWN AS LUMBER WHARF)

**LEGEND**

- VERTICAL TIMBER PILE
- ⊕ BATTER PILE
- DAMAGED PILE
- ✖ MISSING PILE
- ✱ MISSING FENDER TIMBER

No.	Date	Revision	Aprvd.
DRAWING INFO: DESIGNED BY: WOM DRAWN BY: SFW CHECKED BY: WOM			
1 BAR IS EQUAL TO ONE INCH ON ORIGINAL DRAWING. ADJUST SCALES IF DISTANCE VARIES ACCORDINGLY.			

**STOVER ENGINEERING**  
Civil Engineers and Consultants  
PO BOX 783 - 711 H STREET  
CRESCENT CITY, CA 95531 - 707-465-6742

**BEN C. GERWICK, INC.**  
1300 CLAY STREET, 7TH FLOOR  
OAKLAND, CA, 94612  
TEL: (510) 839-8972  
FAX: (510) 839-9715

**CRESCENT CITY HARBOR DISTRICT  
CONDITION SURVEY OF CITIZENS DOCK  
CRESCENT CITY, CALIFORNIA**

**PILE PLAN OF WEST WHARF**

JOB NO. 2011-022  
SCALE: 1"=25'  
DATE: 06-13-11  
SHEET  
**SK-4**

# Appendix B      Citizens Dock Damage Photographs

The Citizens Dock Photographs include documented damage from the May 16 -20, 2011 Above Water Survey coordinated by Wayne Mac Donell PE.

Appendix B Title Sheet	B-1
Approach Trestle and West Wharf - Showing the North Face (Looking South)	B-2 to B-16
South Wharf - Vertical Support Piles	B-17 to B-24

**Approach Trestle and West Wharf  
Showing the North Face (Looking South)**





Approach Trestle Bents 3 to 4 (Photo #305)  
No damage noted



Approach Trestle Bents 4 to 6 (Photo #306)  
No damage noted



Approach Trestle Bents 6 to 8 (Photo #307)  
No damage noted



Approach Trestle Bent 6 (Photo #308)  
No damage noted



Approach Trestle Bents 7 to 9 (Photo #309)  
No damage noted



Approach Trestle Bents 9 to 12 (Photo #310)  
Bent steel ladder



Approach Trestle Bents 11 to 12 (Photo #311)  
Steel ladder bent



Approach Trestle Bents 10 to 13 (Photo #312)  
Steel ladder bent



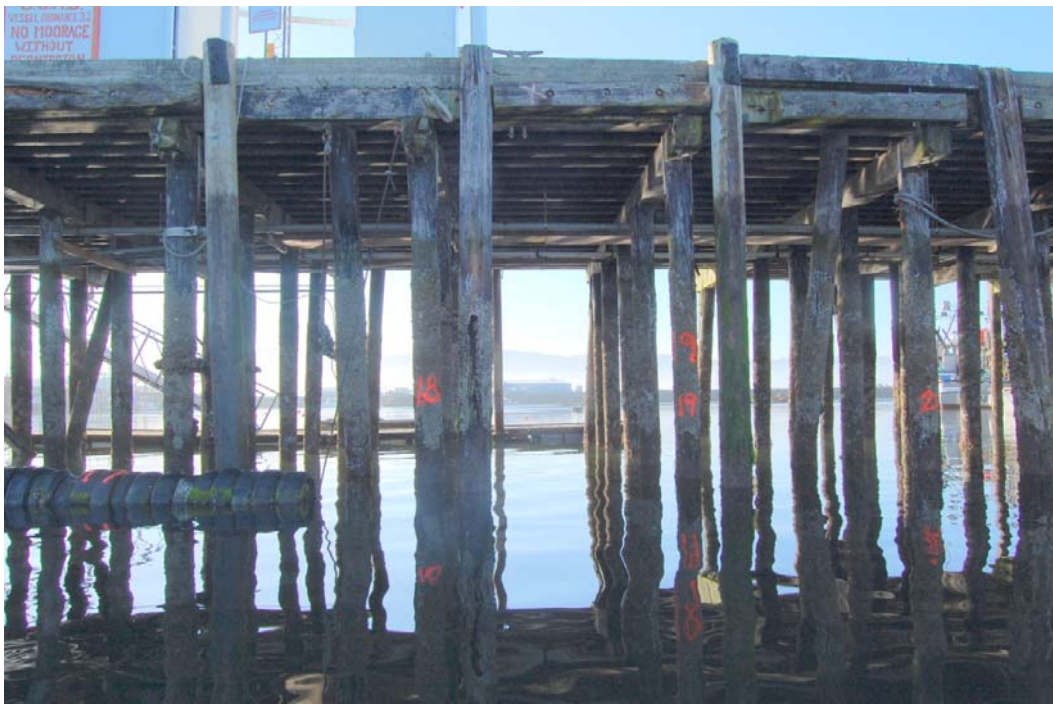
Approach Trestle Bents 11 to 13 (photo #313)  
Steel ladder bent



Approach Trestle Bents 13 to 16 (Photo #314)  
No damage noted, remove debris inside between Bents 14 & 15



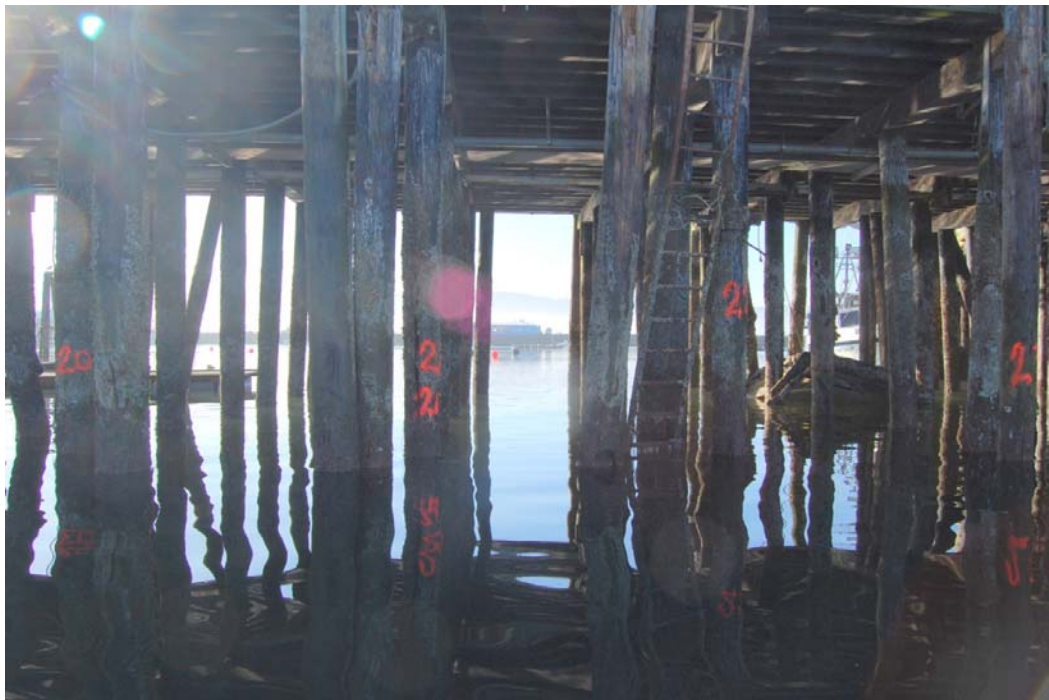
Approach trestle Bents 15 to 18 (Photo #316)  
Replace broken fender pile at Bent 16



Approach Trestle Bents 17 to 20 (Photo #317)  
No damage noted



Approach Trestle Bents 19 to 20 (Photo #318)  
No damage noted



Approach Trestle Bents 20 to 23 (Photo #319)  
No damage noted, except bent ladder



Approach Trestle Bents 22 to 25 (Photo #320)  
No damage noted, except bent ladder. Remove debris between Bents 23 & 24



End of Approach Trestle (at left) and the start of the West Wharf (Photo #321)  
36"± vertical crack on pile at Bent 3 (shown behind fender pile painted "3")





West Wharf Bents 4 to 7 (Photo #322)  
No damage noted



West Wharf Bents 5 to 8 (Photo #323)  
No damage noted



West Wharf Bents 6 to 9 (Photo #326)  
No damage noted



West Wharf Bents 7 to 10 (Photo #324)  
Repair/replace chock between Bents 8 & 9



West Wharf Bents 7 to 10 (Photo #325)  
No damage noted



Between Bents 9 and 15 unable to survey due to the vessel "Moray" (Photo #327)  
Missing fender pile between Bents 15 & 16



West Wharf Bents 15 to 18 (Photo #329)  
No damage noted, except missing fender pile between Bents 15 & 16



West Wharf Bents 17 to 20 (Photo # 330)  
No damage noted. Replace missing chock between bents 18 & 19



West Wharf Bents 19 to 21 (Photo #331)  
No damage noted. Replace missing chocks between Bents 18 & 21



Between Bents 18 and 25 unable to survey due to the vessel "Victory" (Photo #332)  
Lower portion of fender pile between Bents 24 & 25 is broken off



Bents 24 to 27 (Photo #333)  
Replace broken fender pile between Bents 24 & 25  
Add chocks between Bents 26 & 27

# **South Wharf Interior Support Piles**



Pile 3F (Photo #365)

Damaged area shown to be repaired with sleeves, and epoxy and concrete grout. Exterior shall be cleaned prior to installing sleeve.



Pile 4F (Photo #354)

Damaged area shown to be repaired with sleeves and epoxy concrete grout. Exterior shall be cleaned prior to installing sleeve.





Piles 3F, 4F and batter pile (Photo #353)

Batter pile seems to be abandoned



Pile 3H (Photo #348)

Damaged area shown to be repaired with sleeves and epoxy concrete grout. Exterior shall be cleaned prior to installing sleeve.



Pile 4F (Photo #371)

Damaged area shown to be repaired with sleeve and epoxy and concrete grout. Exterior shall be cleaned prior to installing sleeve.



Piles 5D, 5F, and 4F (Photo #357)

Damaged area shown to be repaired with sleeves and epoxy concrete grout. Exterior shall be cleaned prior to installing sleeve.



Piles 5F, 6C, and 7D (Photo #355)

Damaged area shown to be repaired with sleeves and epoxy concrete grout. Exterior shall be cleaned prior to installing sleeve.



Pile 6C (Pile 7D beyond)

Damaged area shown on Pile 6C to be repaired with sleeves and epoxy and concrete grout. Exterior shall be cleaned prior to installing sleeve.



Pile 7D (Photo #360)

Damaged area shown to be repaired with sleeves and epoxy and concrete grout. Exterior shall be cleaned prior to installing sleeve.



Pile 13F (Photo #364)

Damaged area shown to be repaired with sleeves and epoxy and concrete grout. Exterior shall be cleaned prior to installing sleeve.



Pile 16B (Photo #362)

Damaged area shown to be repaired with sleeves and epoxy and concrete grout. Exterior shall be cleaned prior to installing sleeve.

## **Appendix C MOTEMS Condition Assessment Ratings**

The MOTEMS Condition Assessment rating tables and figures from Chapter 2 of the CSLC MOTEMS Audit Manual, 2004, are presented in the following pages for reference. The types of elements include steel, reinforced concrete, prestressed concrete, and timber.

**TABLE 2-1**  
**CONDITION ASSESSMENT RATINGS FOR STEEL ELEMENTS**

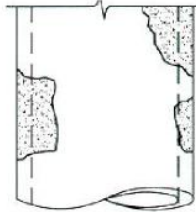
<b>Condition Rating</b>	<b>Existing Damage</b>	<b>Defects Indicating Higher Damage Grade(s)</b>
<b>Not Inspected</b>	Not inspected, inaccessible or passed by <sup>(1)</sup>	
<b>No Damage</b>	Protective coating intact Light surface rust	
<b>Minor</b>	Less than 50 percent of perimeter or circumference affected by corrosion at any elevation or cross section Loss of thickness up to 15 percent of nominal at any location	Minor damage not appropriate if: Changes in straight line configuration or local buckling Corrosion loss exceeding fabrication tolerances (at any location)
<b>Moderate</b>	Over 50 percent of perimeter or circumference affected by corrosion at any elevation or cross section Loss of thickness 15 to 30 percent of nominal at any location	Moderate damage not appropriate if: Changes in straight line configuration or local buckling Loss of thickness exceeding 30 percent of nominal at any location
<b>Major</b>	Partial loss of flange edges or visible reduction of wall thickness on pipe piles Loss of nominal thickness 30 to 50 percent at any location	Major damage not appropriate if: Changes in straight line configuration or local buckling Perforations or loss of wall thickness exceeding 50 percent of nominal
<b>Severe</b>	Structural bends or buckling, breakage and displacement at supports, loose or lost connections Loss of wall thickness exceeding 50 percent of nominal at any location	

(1) If not inspected because of inaccessibility, note as such.



**Figure 2-1  
Condition Ratings For  
Steel Members**

MINOR

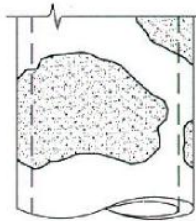


LESS THAN 50 PERCENT OF CIRCUMFERENCE AFFECTED BY CORROSION



LOSS OF THICKNESS UP TO 15 PERCENT AT ANY LOCATION

MODERATE

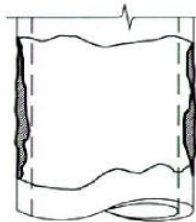


OVER 50 PERCENT OF CIRCUMFERENCE AFFECTED BY CORROSION

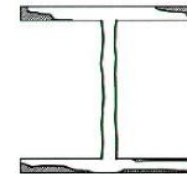


LOSS OF THICKNESS 15 TO 30 PERCENT AT ANY LOCATION

MAJOR

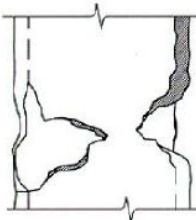


VISIBLE REDUCTION OF WALL THICKNESS

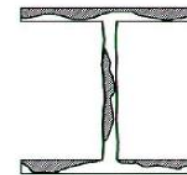


LOSS OF THICKNESS 30 TO 50 PERCENT AT ANY LOCATION, PARTIAL LOSS OF FLANGES

SEVERE



STRUCTURAL BENDS OR BUCKLING; LOOSE OR LOST CONNECTIONS



PERFORATIONS AND LOSS OF THICKNESS EXCEEDING 50 PERCENT AT ANY LOCATION

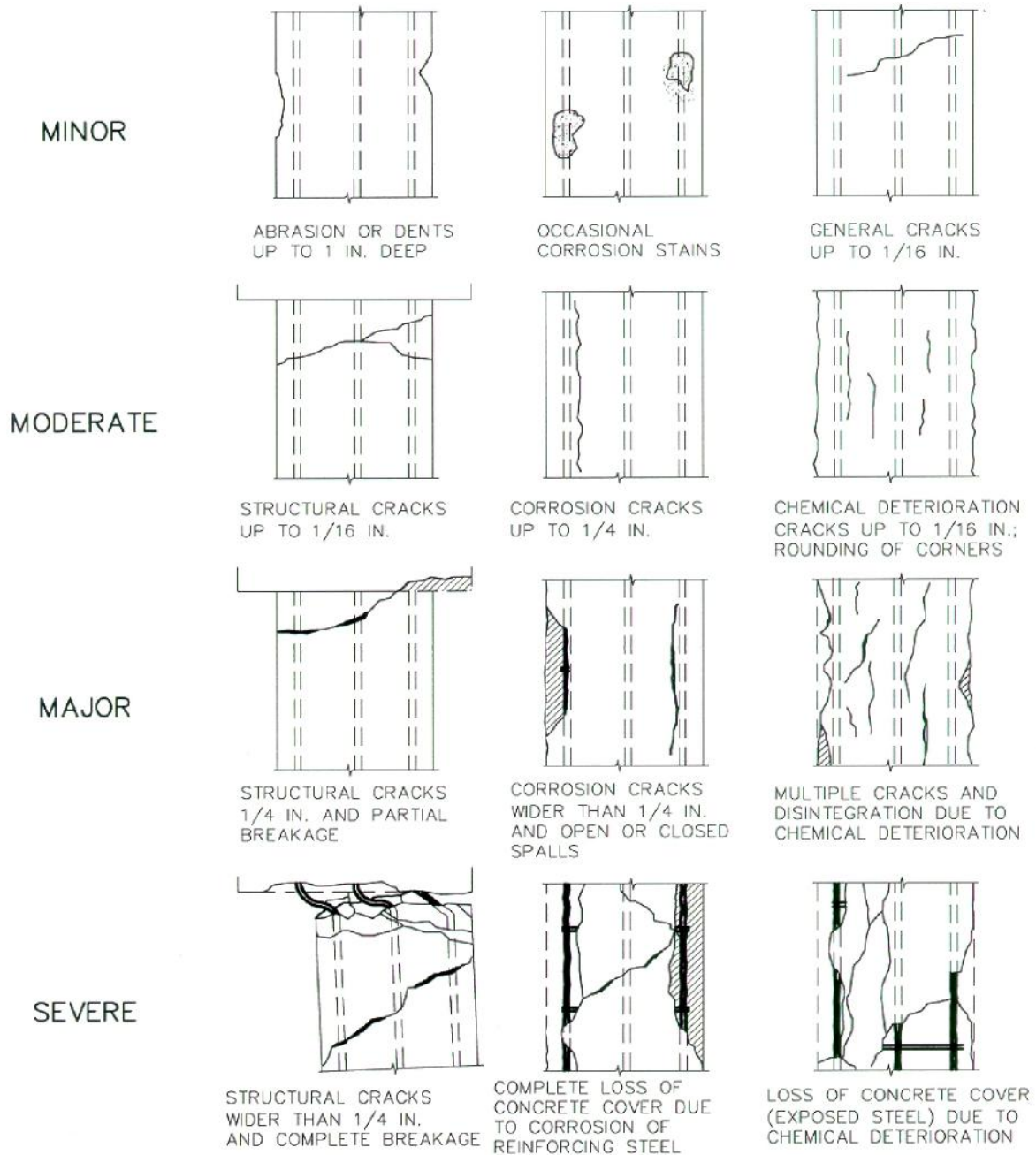
**TABLE 2-2  
CONDITION ASSESSMENT RATINGS FOR REINFORCED CONCRETE ELEMENTS**

<b>Condition Ratings</b>	<b>Existing Damage</b>	<b>Defects Indicating Higher Damage Grade(s)</b>
<b>Not Inspected</b>	Not inspected, inaccessible or passed by(1)	
<b>No Damage</b>	Good original surface, hard material, sound	
<b>Minor</b>	Mechanical abrasion or impact dents up to 1 in. in depth General cracks up to 1/16 in. in width Occasional corrosion stains or small pop-out corrosion spalls	Minor damage not appropriate if Structural damage Corrosion cracks Chemical deterioration(2)
<b>Moderate</b>	Structural cracks up to 1/16 in. in width Corrosion cracks up to 1/4 in. in width Chemical deterioration(2): Random cracks up to 1/16 in. in width; “Soft” concrete and rounding of corners up to 1 in. deep	Moderate damage not appropriate if: Structural breakage and/or spalls Exposed reinforcement Loss of cross section due to chemical deterioration beyond “rounding of corner edges”
<b>Major</b>	Structural cracks 1/16 in. to 1/4 in. in width and partial breakages (structural spalls) Corrosion cracks wider than 1/4 in. and open spalls (excluding pop-outs) Multiple cracking and disintegration of surface layer due to chemical deterioration	Major damage not appropriate if: Loss of cross section exceeding 30 percent due to any cause
<b>Severe</b>	Structural cracks wider than 1/4 in. or complete breakage. Loss of bearing and displacement at connections Complete loss of concrete cover due to corrosion of reinforcing steel with over 30 percent of diameter loss for any main reinforcing bar Loss of concrete cover (exposed steel) due to chemical deterioration Loss of over 30 percent of cross section due to any causes described above	

(1) Same as footnote 1 on previous table.

(2) Chemical Deterioration: Sulfate attack, alkali-silica reaction or ettringite distress.

**Figure 2-2**  
**Condition Ratings For**  
**Reinforced Concrete Members**



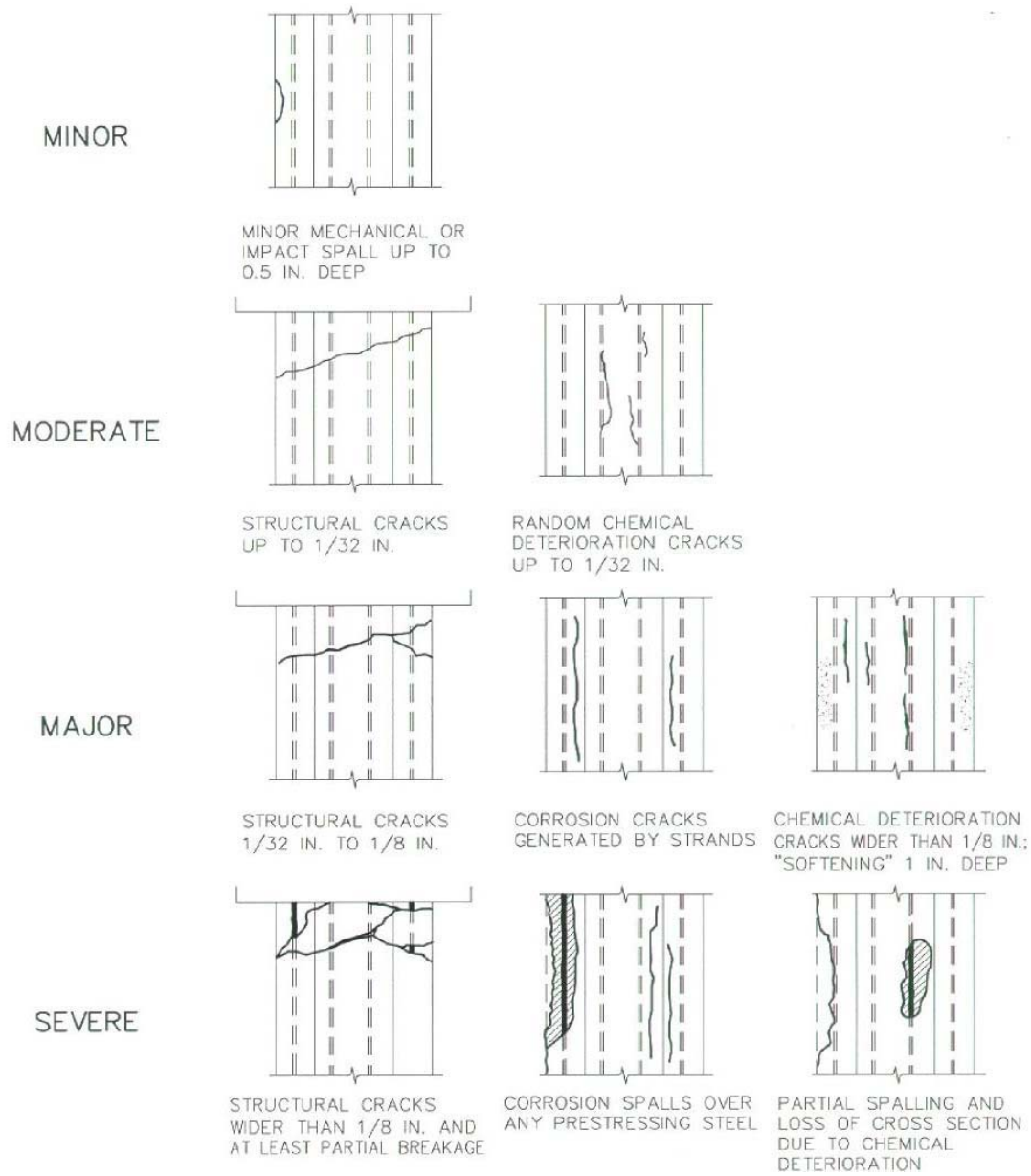
**TABLE 2-3  
CONDITION ASSESSMENT RATINGS FOR PRESTRESSED CONCRETE ELEMENTS**

<b>Condition Rating</b>	<b>Existing Damage</b>	<b>Defects Indicating Higher Damage Grade(s)</b>
<b>Not Inspected</b>	Not inspected, inaccessible or passed by(1)	
<b>No Damage</b>	Good original surface, hard material, sound	
<b>Minor</b>	Minor mechanical or impact spalls up to 0.5 in. deep	Minor damage not appropriate if: Structural damage Corrosion damage Chemical deterioration(2) Cracks of any type or size
<b>Moderate</b>	Structural cracks up to 1/32 in. in width Chemical deterioration: random cracks up to 1/32 in. in width	Moderate damage not appropriate if: Structural breakage and/ or spalls Corrosion cracks Loss of cross section in any form “Softening” of concrete
<b>Major</b>	Structural cracks 1/32 in. to 1/8 in. in width Any corrosion cracks generated by strands or cables Chemical deterioration: cracks wider than 1/16 in. “Softening” or concrete up to 1 in. deep	Major deterioration not appropriate if: Exposed prestressing steel
<b>Severe</b>	Structural cracks wider than 1/8 in. and at least partial breakage or loss of bearing Corrosion spalls over any prestressing steel Partial spalling and loss of cross section due to chemical deterioration	

(1) Same footnote as in previous table

(2) Chemical Deterioration: Sulfate attack, alkali-silica reaction or ettringite distress.

**Figure 2-3  
Condition Ratings For  
Prestressed Concrete Members**

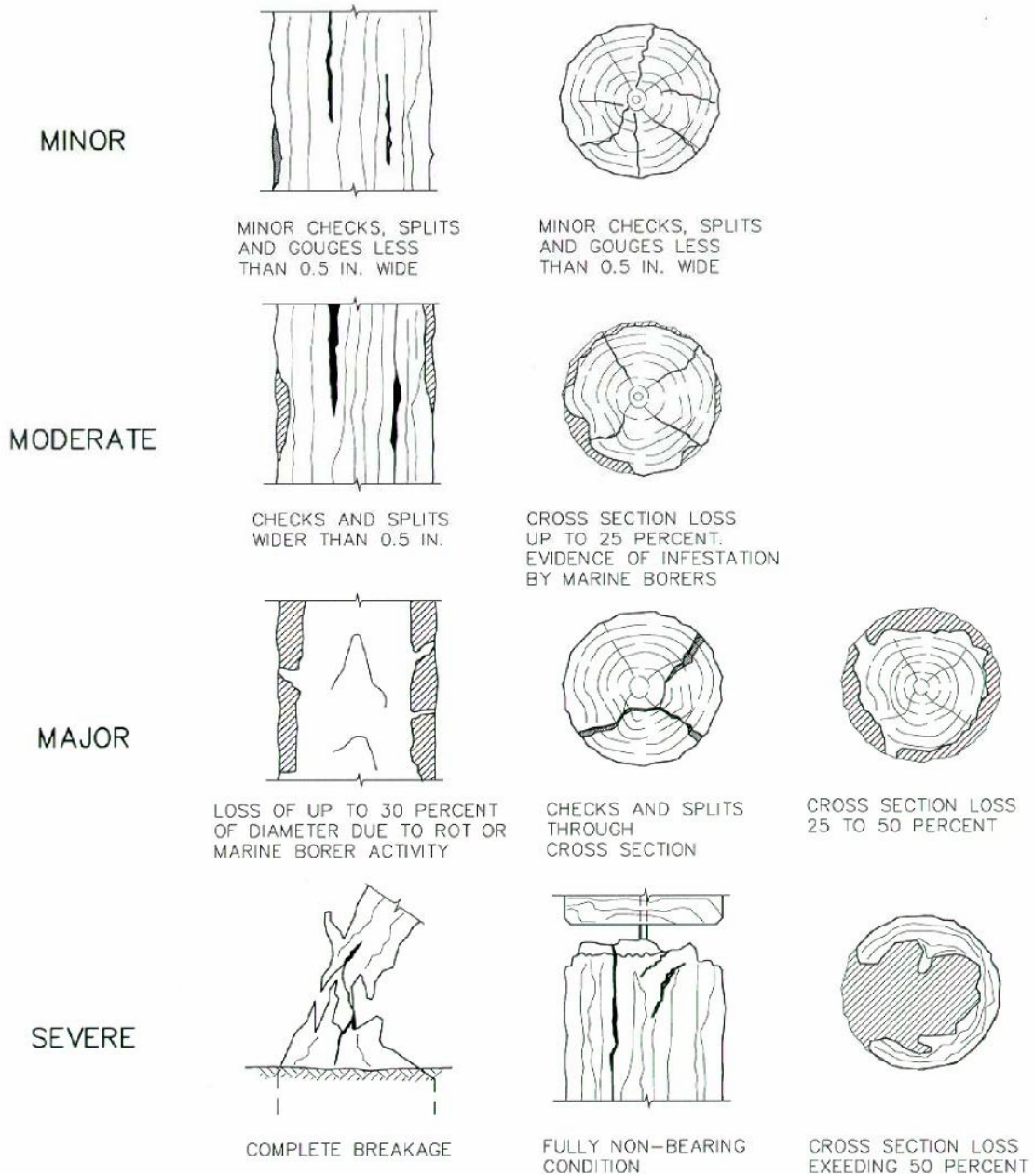


**TABLE 2-4  
CONDITION ASSESSMENT RATING OF TIMBER ELEMENTS**

<b>Condition Rating</b>	<b>Existing Damage</b>	<b>Defects Indicating Higher Damage Grade(s)</b>
<b>Not Inspected</b>	Not inspected, inaccessible or passed by. <sup>(1)</sup>	
<b>No Defects</b>	Sound surface material.	
<b>Minor</b>	Checks, splits and gouges less than 0.5 in. wide.	Minor damage not appropriate if: Loss of cross section Marine borers infestation Displacements, loss of bearing or connections
<b>Moderate</b>	Checks and splits wider than 0.5 in. Remaining diameter loss up to 15 percent. Cross-section area loss up to 25 percent. Corroded hardware. Evidence of infestation by marine borers	Moderate damage not appropriate if: Displacements, loss of bearing or connections
<b>Major</b>	Checks and splits through full depth of cross section Remaining diameter loss 15 to 30 percent Cross-section area loss 25 to 50 percent. Heavily corroded hardware. Displacement and misalignments at connections	Major damage not appropriate if: Partial or complete breakage
<b>Severe</b>	Remaining diameter reduced by more than 30 percent Cross section area loss more than 50 percent Loss of connections and/ or fully non-bearing condition Partial or complete breakage	

(1) Same footnote as in previous table.

**Figure 2-4  
Condition Ratings For  
Timber Members**



# Appendix D      Citizens Dock Repair Cost Estimate

The Citizens Dock Damage Repair Cost Estimate is based on the damage drawings shown in Appendix A from the documented damage from the May 16 -20, 2011 Above Water Survey coordinated by Wayne Mac Donell PE.

Appendix D Title Sheet

D-1

Citizens Dock Order of Magnitude Construction Cost Estimate

Typical Vertical Pile Repair Plan Sketch





**Ben C. Gerwick, Inc.**  
Member of the COWI Group

**Consulting Engineers**

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<http://www.gerwick.com>

**ORDER OF MAGNTIUDE CONSTRUCTION COST ESTIMATE  
FOR  
CRESCENT CITY HARBOR DISTRICT  
CITIZENS DOCK DAMAGE REPAIR  
(6/27/2011)**

Item	Description	Quantity	Unit	Unit Price	Total
<b>1</b>	<b>FENDER PILE AND CHOCK REPLACEMENT</b>				
	Mobilization and Demobilization	1	LS	\$130,000	\$ 130,000
	Fender Piles, Class A, ACZA	13	Each	\$1,000	13,000
	Crane , hammer, leads+7 man crew	5	Days	\$7,100	35,500
	Chocks, 10 x12 ACZA	1080	fbm	\$2.50	2,700
	Labor/ chock	108	Each	\$400	43,200
	Ladders, steel - hd galvanized 200 lbs ea	2	Each	\$750	1,500
	Labor/ ladder (4 mh ea)	2		\$400	800
	Remove Broken Float & Debris	1	LS	\$2,500	2,500
	Subtotal Fender Pile Replacement				\$ 229,200
<b>2</b>	<b>VERTICAL PILE REPAIR</b>				
	Vertical Piles - Clean - Install sleeve -Grout	11	Each	\$15,000	\$165,000
	Subtotal Vertical Pile Repair				\$165,000
<b>3</b>	<b>SUBTOTAL ALL REPAIRS</b>				\$394,200
	CONTINGENCY (30%)				118,300
	<b>TOTAL ALL REPAIRS</b>				<b>\$512,500</b>

Notes:

- 1 All repairs completed within 2011, no escalation
- 2 Repairs and estimates are based on visual above water survey conducted in May 2011 and conceptual repairs.
- 3 One mobilization only for completion of both fender pile and vertical pile repairs.
- 4 Timber fender pile repairs require a derrick barge due to limited access.
- 5 Timber vertical pile repairs could possibly be completed by divers using compressor on existing deck