

USACE SAN FRANCISCO DISTRICT COASTAL STRUCTURES UPDATE

James Zoulas
Chief of Survey
Construction Branch, San Francisco District
12 November 2020



US Army Corps
of Engineers®



COASTAL STRUCTURES PROGRAM OVERVIEW



The USACE San Francisco District spans along the California coastline from the Oregon Border to near Monterey.

13 projects with coastal structures

- CRESCENT CITY
- HUMBOLDT BAY HARBOR
- NOYO HARBOR
- BODEGA BAY HARBOR
- RICHMOND HARBOR
- BERKELEY MARINA
- OAKLAND HARBOR
- FISHERMAN'S WHARF
- OYSTER POINT MARINA
- PILLAR POINT HARBOR
- SAN LEANDRO MARINA*
- SANTA CRUZ HARBOR
- MOSS LANDING HARBOR
- MONTEREY HARBOR



COASTAL STRUCTURES



Most structures constructed in early and mid-20th century

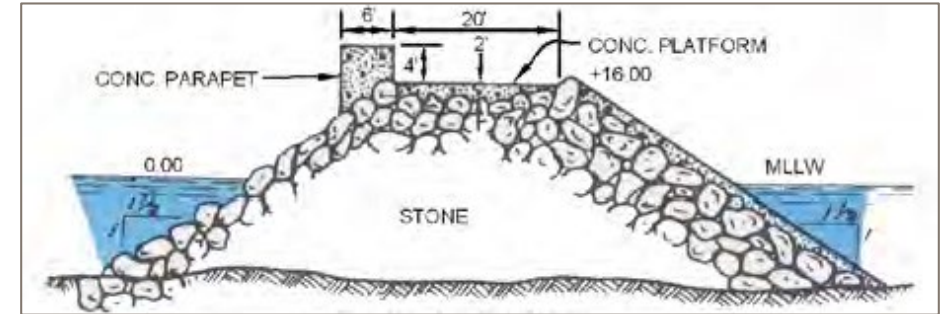
Oldest structures include Humboldt jetties (1899) and Oakland South Jetty (1876)

Newest structures at Oyster Point (2013)

Most structures are rubble mound jetties or breakwaters

Several projects include concrete breakwaters

Several of the structures require relatively frequent repair





COASTAL STRUCTURES MAINTENANCE



Prioritization of structures for repair and rehabilitation based on ratings from inspections

Request for assistance from other USACE components if needed

Development of plans and specifications for construction contract

Award and oversight of construction contract

Most recent completed repair work at Noyo Harbor (2018) and Bodega Bay (2019)

Ongoing work at Humboldt Harbor jetties and planned work at Moss Landing Harbor jetties (2022)





COASTAL STRUCTURE INSPECTIONS



Conducted on an annual basis

Teams of 2 or 3 walk the entire structure

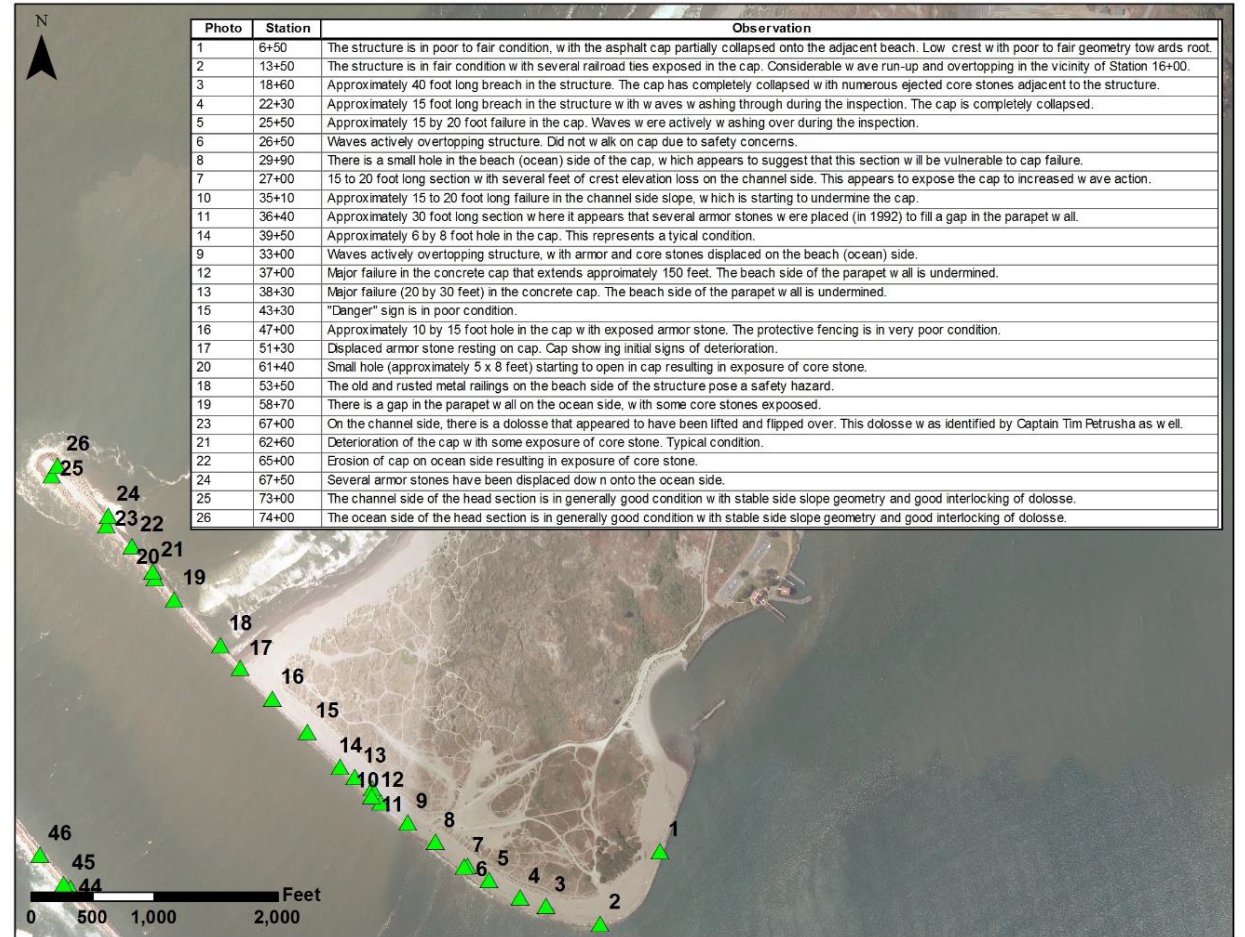
Photo documentation and mapping in GIS

Purpose is to determine Structural Condition and Functional Condition Ratings*

Ratings range from A – F

Ratings utilized to identify and budget for repair and rehabilitation

* Engineering Circular 11-2-218 (31 Mar 2019)





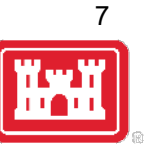
STRUCTURAL CONDITION RATINGS



Damage Condition levels	CNS Structural Condition Rating (SCR) Table
Insignificant damage or defects - A	<p>1. There is no evidence that the structure has a critical design flaw or has been significantly damaged.</p> <p>Only small areas of the structure show signs of deterioration, which is considered to be insignificant. 2. Loss or deterioration of any material composing the structure is limited to very few units. 3. There is no change in the geometry of the structure. There are no apparent areas of settlement or displacements of the structure's alignment and slopes. The head, the root, and any corner or spurs of the structure show no change. 4. There is no exposure of any other critical material or elements of the structure. 5. The foundation of the structure is sound and there is no evidence of scour or loss of supporting substrate around the base of the structure.</p>
Minor damage or defects - B	<p>1. Deterioration is visible but the structure appears to be sound and repairs are not indicated.</p> <p>Minor deterioration is noted over small areas of the structure. 2. In deteriorated areas, less than approximately 10% of the of any material composing the structure shows signs of deterioration, and less than approximately 10% of any type of the material composing the structure has been lost. 3. The geometry of the structure shows limited change. The crest elevation may have been reduced by less than 10% of the structure's above MLLW profile, and the crest width may have slightly decreased. Minor displacement of the structure's alignment and side slopes is evident. The head root, and corners or spurs of the structure show no more change than other sections of the structure. 4. The noted deterioration does not expose any other critical materials composing the structure. 5. Foundations components are sound but slight scour may exist near the toe of the structure.</p>
Moderated damage or defects-- C	<p>1. The structure is showing deterioration that may require repair in the near future.</p> <p>2. Moderate deterioration of materials is noted over many areas of the structure. A moderate amount (10-20%) of materials composing the structure shows signs of deterioration, and a moderate amount (10 - 20%) of any material composing the structure has been lost. 3. The geometry of the structure is showing significant change in some areas. The structure's cross section is losing crest elevation and/ or crest width. Some areas of the structure may have settled, collapsed, or eroded to an extent that other portions of the structure are exposed or left unsupported. In the damaged area, the above MLLW cross sectional profile may be reduced by 20 to 50%. The crest width may reduce up to 1/3 of its original width at the elevation of the original crest, but repairs would be possible by replacing a few armor units. A moderate amount of displacement in the structure's alignment and slopes is present (often as a result of lost or slumping material on one side of the structure causing the centerline of the structure to shift or due to units sliding down the side slopes). Bridging of armor stones may also be occurring. The extent of these displacements renders the structures stability to be vulnerable. The head(s) may have receded by 10-20 % of its original length. The root is still firmly attached to the shore, but scour or flanking may exist at the trailing end of the structure. Corners or spurs of the structure may have slightly greater damage than the rest of the structure. 4. In the deteriorated regions, minor amounts of other critical materials composing the structure are now exposed but there is no evidence of the exposed material being lost or damaged. 5. Foundation components of the structure may be starting to show deterioration by changing in shape or movement of the base material or by corrosion. Evidence of scour at the toe of the structure or under the structure is present.</p>
Seriously Degraded - D	<p>1. An extensive portion of the structure has deteriorated to a condition that repairs are indicated.</p> <p>2. Deterioration of materials is noted over a significant area of the structure. A significant amount (20-40%) of materials composing the structure shows signs of deterioration, and a significant amount (20-40%) of any material composing the structure has been lost. 3. The geometry of the structure is significantly changed. The above MLLW cross-section profile may have been reduced to >50% of its original above MLLW profile. Some area of the structure have settled, collapsed or eroded to an extent that, in the damaged area, no portion of the crest is still located at the original elevation and the resulting crest has lost 70% of the above MLLW crest elevation (crest elevation is at MLLW or a few feet above MLLW). A significant amount of displacement in the structure's alignment and slopes is present. Bridging of stones is likely. Sliding of the armor units may be present as well as displacement of the armor units. The head(s) has receded by 20-40% of its original length. The root is still attached but flanking of the tail occurs for about 1/3 the length of the trailing end. The extent of these displacements renders the structure unstable. 4. Deterioration exposes significant amount of other critical materials composing the structure and there is evidence that under layer material and substructure components are being damaged or lost. 5. The foundation could exhibit failure modes over short distances (100 ft) to include scour and erosion around the toe and under the structure, lost substrate material, major subsidence, reduced thicknesses or diameters by approximately 15% for support members, and buckling or failure of piles.</p>
Completely Degraded -- F	<p>1. General failure with extensive deterioration indicates repair is needed for a major section of the structure.</p> <p>2. More than 50% of materials composing the structure show signs of extreme deterioration, and more than 40% of any material composing the structure has been lost. 3. The geometry of the structure clearly shows that much of the structure is lost or severely damaged. Significant lengths (>300 ft) of the structure have settled, collapsed, or eroded to an extent that the expected crest elevation has been reduced to at or below the MLLW level. The structure appears to be a pile rather than an engineered structure. The structure may flex or structural material may be mobile under hydrodynamic forces. An extreme amount of displacement in the structure's alignment and slopes is present. The extent of the displacement renders the structure critically unstable. 4. The deterioration exposes significant amounts of other critical materials composing the structure, and there is evidence that under layer material and substructure components are being damaged or lost over long (>300ft) sections of the structure. 5. There is evidence that the underwater portions of the structure are severely degraded over long sections (>300 ft) of the structure. The foundation could exhibit failure modes over long distances (>300 ft) to include scour and erosion around the toe and under the structure, lost substrate material, major subsidence, reduced thicknesses or diameters by approximately 25% for support members, and buckling or failure of piles.</p>



STRUCTURAL CONDITION RATINGS



Project Name	Structure Name	Structure Type	Structural Condition	Functional Condition	District Condition
Berkeley Marina	Berkeley Marina Offshore Rubble-Mound Breakwater, California	Breakwater	B	B	B
Berkeley Marina	Berkeley Marina Sheetpile Breakwater, California	Breakwater	B	B	B
Bodega Bay Harbor	Bodega Harbor North Jetty, California	Jetty	D	B	C
Bodega Bay Harbor	Bodega Harbor South Jetty, California	Jetty	D	B	C
Bodega Bay Harbor	Spud Point Marina Breakwater, California	Breakwater	D	A	B
Crescent City Harbor	Crescent City Inner Breakwater, California	Breakwater	B	A	A
Crescent City Harbor	Crescent City Outer Breakwater, California	Breakwater	B	A	A
Crescent City Harbor	Crescent City Sand Barrier, California	Revetted Mole	B	A	A
Fisherman's Wharf Harbor	Fisherman's Wharf East Side Segmented Breakwater, California	Breakwater	B	A	A
Fisherman's Wharf Harbor	Fisherman's Wharf Sheet Pile Breakwater, California	Breakwater	B	A	A
Fisherman's Wharf Harbor	Fisherman's Wharf West Side Segmented Breakwater, California	Breakwater	B	A	A
Gas House Cove	Gas House Cove Breakwater, California	Breakwater	B	A	A
Humboldt Harbor and Bay	Humboldt Bay North Jetty, California	Jetty	F	B	D
Humboldt Harbor and Bay	Humboldt Bay South Jetty, California	Jetty	C	B	B
Monterey Harbor	Monterey Breakwater, California	Breakwater	D	A	B
Moss Landing Harbor	Moss Landing Harbor North Jetty, California	Jetty	D	C	D
Moss Landing Harbor	Moss Landing Harbor South Jetty, California	Jetty	B	B	B
Noyo River and Harbor	Noyo North Jetty, California	Jetty	C	C	C
Noyo River and Harbor	Noyo South Jetty, California	Jetty	B	A	A
Oakland Harbor	Oakland Harbor South Jetty, California	Jetty	D	A	B
Pillar Point Harbor	Pillar Point Harbor East Breakwater, California	Breakwater	B	A	A
Pillar Point Harbor	Pillar Point Harbor West Breakwater, California	Breakwater	B	A	A
Richmond Harbor	Richmond Harbor Breakwater, California	Training Wall	D	A	B
San Leandro Marina	San Leandro Marina Breakwater, California	Breakwater	B	A	A
Santa Cruz Harbor	Santa Cruz Harbor East Jetty, California	Jetty	B	A	A
Santa Cruz Harbor	Santa Cruz Harbor West Jetty, California	Jetty	B	A	A



HUMBOLDT HARBOR

Parallel rubble mound jetties – 7,400 to 8,000 feet in length

Stabilize entrance to Humboldt Harbor between sandy spits

Originally constructed in late 19th Century

Major repairs throughout 20th Century

Dolosse added in early 1970s

Large sections capped with concrete for maintenance access



Photo by Gary Todoroff





HUMBOLDT JETTIES DAMAGE



Significant damage to trunk section of North Jetty observed in 2010s

Numerous failures of concrete cap

Core stone “blown out”





HUMBOLDT JETTIES REPAIR

Construction contract awarded in April 2020

Construction started in Summer 2020 (ongoing)

Base contract of \$10.34 M (North Jetty)

Options of \$ 6.86 M and \$ 4.9 M (South Jetty)

Approximately 21,000 tons of armor stone for North Jetty

Approximately 31,000 tons of armor stones for South Jetty

Largest armor stones are approximately 20 tons





MOSS LANDING HARBOR



Parallel jetties of 1,520 and 1,550 feet in length

Last repaired in 2008

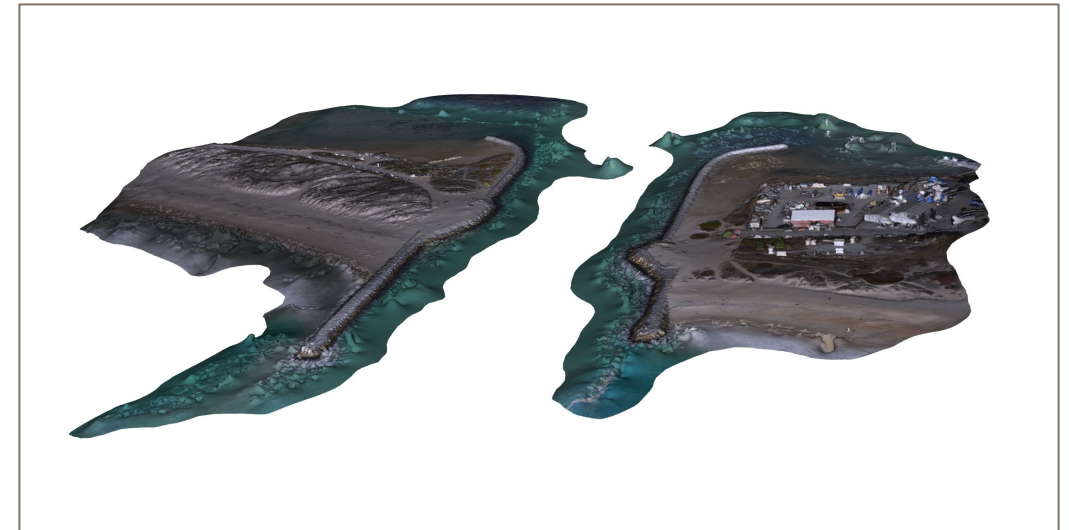
Significant degradation of head section of North Jetty

Topographic survey with small unmanned aerial system (sUAS) complete

Bathymetric survey(s) in progress

Plans and specifications for repair under development

Potential construction in Summer 2022





FY21 LOOK AHEAD

11 inspections planned

Will identify deficiencies requiring repairs

Pilot program to utilize sUAS to augment inspections





QUESTIONS?

James Zoulas, James.G.Zoulas@usace.army.mil

Al Paniccia, Alfred.Paniccia@usace.army.mil