Port of Anchorage - North Expansion Projects

Project Legend (Chronological Order)

- North Backlands: 2006
- Dry Barge Berth: 2007
- 2008 Marine Terminal Redevelopment (MTR)
  - Barge Berth Phase 2: 2008-2009
  - North Extension: 2008-2009
- North Extension Winter Closure: 2010

North Not To Scale

North Backlands

North Extension

Dry Barge Berth

Barge Berth Phase 2

North Extension Winter Closure

Temporary Cell

Limits of Study Area

Temporary Z-Pile Wall

Temporary Cell

Permanent Outfall Cell

Temporary Z-Pile Wall

Original Design
(As-Built)

Wet Barge Berth	North Extension 1	North Extension 2
400 feet	1,000 feet	800 feet

(Essential Facility)

Current Design

Dry Barge Berth	Wet Barge Berth	North Extension 1	North Extension 2
	700 feet	1,124 feet	1,104 feet

(Essential Facility)

Summary of Findings
From 100-percent Draft
Suitability Summary Report

US Army Corps
of Engineers
Alaska District

PORT OF
ANCHORAGE
Alaska's Port • Alaska's Future

Purpose of the Port of Anchorage Intermodal Expansion Project

The original Marine Terminal Expansion Project was scheduled to be performed between 2005 and 2011 using local, state and federal funding administered by the U.S. Maritime Administration. The Project was to expand, restructure, and improve the Port of Anchorage by:

- Expanding commercial dock space and backlands to meet future demands and larger ship sizes
- Upgrading functionally obsolete cranes to enable full reach across larger ships
- Demolishing and replacing structures that are degraded, decayed, or functionally obsolete
- Providing berths for barges
- Providing additional land and facilities necessary to support military rapid deployment from Alaska bases
- Improving landside traffic circulation and intermodal surface freight operations
- Replacing and relocating code-deficient Port support structures and buildings and develop warehouse storage
- Developing a secure cruise ship terminal to implement Homeland Security mandates
- Providing rail connection to waterfront for commercial and military intermodal transfers
- Installing security and lighting in accordance with Maritime Security mandates
- Function for an industry standard 50 year lifecycle.

Suitability Study

CH2M Hill, a global engineering firm, conducted an independent Suitability Summary Report of the Open Cell Sheet Pile® (OCSP®) foundation system that was designed and partially constructed to support the Intermodal Expansion Project. The suitability study also included an analysis of the associated hydrologic, geotechnical, structural, and seismic conditions to determine the appropriateness of the current design and or potential for improvements to the current design. The study cost $2.2 million.

Study Conclusion

The suitability study determined that the OCSP® system is not adequately designed to meet global stability and seismic displacements based on the design criteria. The study also concludes that the open cell system is adequately designed to meet initial internal stability structural design requirements, assuming it was constructed without defects. However, at the end of 50 years, it will be slightly over-stressed due to corrosion and will not meet safety standards.

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Fig 1: Area Evaluated by Suitability Study

Background Information

Terms:

Factor of Safety: The ratio of how the system design capacity exceeds the load demands with an adquate reserve. There are different Factors of Safety used depending upon the potential loading.

Geotechnical: The science that deals with the application of geology to engineering.

Global Stability: How the structure stays in place (in relationship to the rest of the land) in response to loading – does it move?

Hydrological: Pertaining to the scientific study of the properties, distribution, and effects of water.

Internal Stability: How the structure responds to loading – does it stay together?

Load: Forces on the structure.

What are industry standards for Global Stability Factors of Safety in a structure?

- End of Construction Operational Loading (minimum) = 1.3
- Long-term Operational Loading (minimum) = 1.5
- Seismic Loading (minimum) = 1.0 to 1.2 (depending on severity of the Earthquake)

What is an Open Cell Sheetpile Foundation System?

An Open Cell Sheetpile ® Foundation System is a proprietary system in which flat steel sheet piles are driven to form sheetpile-composed structures that are constructed with a geometry that acts as a membrane to retain soil.

Fig. 2: Open Cell Sheetpile ® Foundation System

The system is patented, holding U.S. Patent No. 6,715,964 B2; U.S. Patent No. 7,018,141 B2; U.S. Patent No. 7,488,140 B2; and U.S. Patent Application No. 12/879,997.

What causes loads for Open Cell Sheetpile ® Foundation System?

- Soil and structure weight
- Tidal elevation
- Groundwater
- Operational loads (trucks, containers, cranes)
- Seismic events

Major Findings of the Suitability Study

Dry Barge Berth (DBB)

The DBB has been successfully constructed and has adequate factors of safety for structural and global stability. The DBB is currently in use by the Port of Anchorage for barge operations.

- DBB During Operations (Static) – Standard = 1.5, Analysis result = 1.49
- Conclusion: Adequate

Wet Barge Berth (WBB)

The WBB was not successfully constructed, as major defects in the installed sheet piling have been documented. Additionally, the factors of safety for global stability are not adequate for the WBB. The 63-foot wall height in the WBB is more than twice the 26-foot height of the DBB, and this contributes directly to the lower factors of safety.

- WBB During Operation (Static) – Standard = 1.5, Analysis result = 1.22
- Conclusion: Deficient

North Extension 1 (NE1)

The NE1 had many damaged sheet piles and defects that have been repaired according to the original designer. However, this section of the OCSP® is about three times as high as the DBB and has even lower factors of safety than the WBB.

- NE1 During Operation (Static) – Standard = 1.5, Analysis result = 1.1
- Conclusion: Deficient

North Extension 2 (NE2)

The NE2 was not successfully constructed, as major defects in the installed sheet pilling have been documented. The factors of safety for this area are the lowest of the four sections due its 89-foot wall height, which is over three times the height of the DBB.

- NE2 During Operation (Static) - Standard = 1.5, Analysis result = 1.13
- Conclusion: Deficient

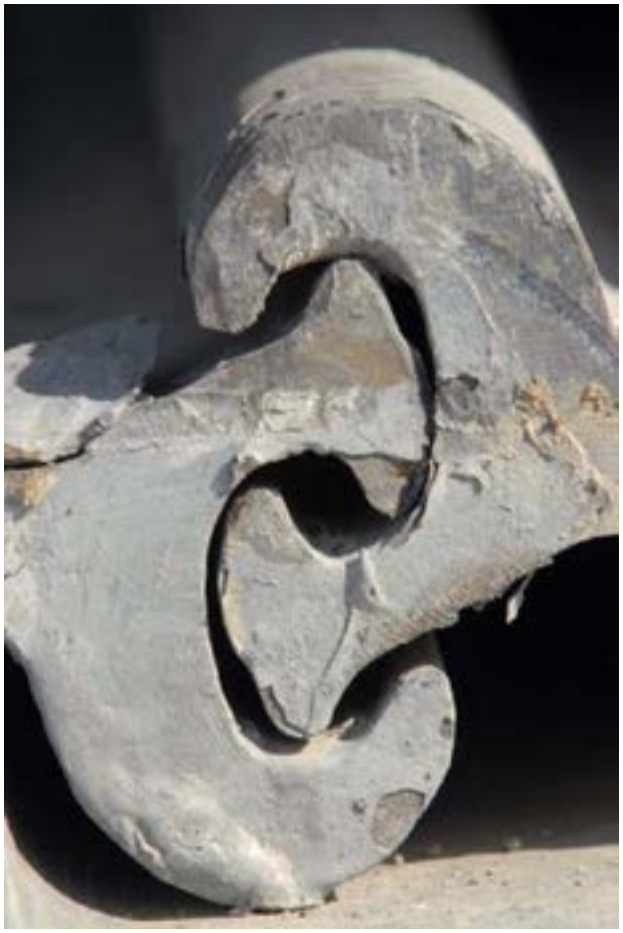

Fig 3: Sheetpile Interlock

Other Findings

The results of the analysis show that Factor of Safety values for cell **internal stability** (interlock strength and tailwall pullout) are satisfactory for both static and seismic load cases **assuming that it was constructed without defects.**

Interlock Issue – We cannot assess conditions in tail walls because they are buried. Internal stability will always be a question as there is no practicable way to perform the inspections.

The taller the structure (from the underwater mudline to the top of the sheetpile wall), the more the structure weighs, and therefore the greater the loads.

With the exception of the Dry Barge Berth, all other structures are deficient in the normal operating condition. Thus, it is not unexpected that these structures fail to meet all seismic standards.

Construction Issues

Constructing the OCSP® structure was a complex endeavor. Challenges included:

Fig 4:
OCSP® as viewed during 2012 limited Inspection Process

1) Selecting the method of construction which involved driving the sheet piles from the landside as compared with a method from where sheet piles are driven from the water side of the structure.
2) Unbalanced soil pressure (driving from the dike on the land side of the wall on the OCSP® wall) which creates a bulge and prevents the sheet piling from going in straight
3) Large rock encountered during driving of the sheet piling impacted pile-driving alignment. This was particularly evident in the Wet Barge Berth.
4) The listing of the Cook Inlet beluga whales and the associated permit conditions severely limited the time available for pile-driving.

Hydrological Issues:

1) The location of the OCSP® system in Knik Arm could result in accelerated sedimentation in some locations as it establishes a solid dock face as contrasted with other systems such as a pile supported design.
2) A potential exists for localized scour. This scour could occur at the base of fender piles and could be on the order of 5 to 7 feet. Propeller wash could also increase scour depths in localized areas.
3) Ice loading is an important design consideration because ice loads result in localized impact loads to the face of the OCSP® system, and they result in increased mooring forces to vessels.

Life cycle Performance Issues:

Life-cycle performance relies on the OCSP® corrosion protection system, which includes galvanizing and an impressed current cathodic protection system. Although protected, corrosion will still occur over time, and this corrosion will result in loss of structural capacity. Estimates of the reduction in wall thickness after 40 to 50 years suggest significant reduction of structure thickness. Factor of Safety values for tension of the sheets are less than required at the end of 50 years by approximately 15 percent.

Summary:

The existing condition of the North End structure as designed and constructed is deficient in critical aspects and must be replaced and/or repaired to achieve a 50 year functional life.

The Suitability Study's final report is scheduled for completion in December.

Under a separate task order and work package CH2M Hill will earn $456,000 to develop several design concepts for completing the North End of the Port of Anchorage Intermodal Expansion Project. The recommendations are due in February 2013.

Work Package 5 Details:

- The purpose of this effort is to make recommendations for the completion of the North End of the Port of Anchorage Intermodal Expansion Project

- The work includes:
    1) *development of several rough-draft concepts based upon a review of the significant body of existing information collected through previous study and design activities;*
    2) *development of a weighted concept selection criteria model to facilitate the concept selection decision process;*
    3) *performing a multiday Design Charrette in Anchorage, where Stakeholder input will be used to collect functional requirements and input from authorities having jurisdiction, perform requirement analysis, develop a scope and schedule based risk register, and refine input data from multiple sources for the development of three (3) Concept Designs;*
    4) *development of up to 3-Concept Designs to an approximate 15-percent design level;*
    5) *development of Cost Schedule Risk Analysis probabilistic modeling for purposes of providing budgetary data;*
    6) *evaluation and scoring of the 15-percent concepts against the weighted concept selection criteria model*
    7) *reporting of the results to the U.S. Maritime Administration and the Municipality of Anchorage*

- The work is being executed under the existing CH2MHill Contract at a cost of $455,756.61

- The final Concept Design products are scheduled for completion in February 2013