RAS AL KHAIMAH PORT EXTENSION

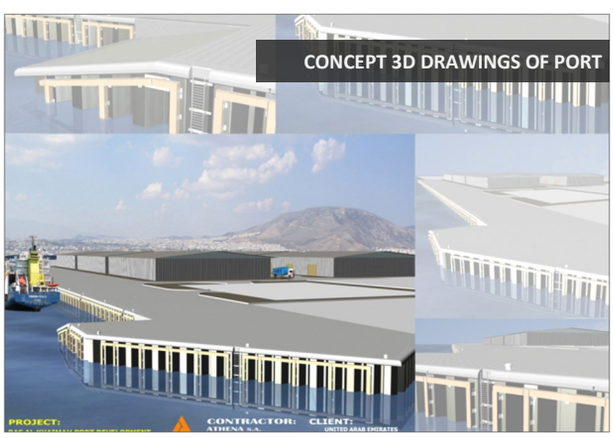
PORT EXTENSION PROJECT

Project Name	Ras Al Khaimah Port, Phase IA, II, IA-Extension
Main Contractor	Athena SA
Location	Ras Al Khaimah,United Arab Emirates
Product	Sheet Piles, H Piles with connector, Tie Rods
Total Tonnage	3,000 MT
Delivery Date	2005—2008

INTRODUCTION

ESC has been one of the integral suppliers of the development of Ras Al Khaimah port, one of the main industrial gateways to the UAE. ESC has supplied over 3,000 tons of sheet piles, H piles with connectors, tie rods over the duration of the development. ESC's success can be attributed to its unique sheet pile design, local and international production capabilities, competitive pricing and great customer service. ESC's engineers completed full design verification calculations to British Standards which was fully accepted by the owner's consultant.

The Ras Al Khaimah Port development is located in Ras Al Khaimah, UAE. An existing port is to be extended by reclaiming land behind a permanent sheet pile wall. ESC proposed to use ESC cold formed sheet piles for the Main Wall and the Anchor Wall. All



parameters were supplied by the client in terms of required capacity.

ESC SCOPE OF SUPPLY

SHEET PILES, H PILES, TIE RODS

ESC scopes included Sheet pile design and supply, Corrosion design and connection details of the sheet pile and tieback system. Designs undertaken in all of these projects were in conformance with the relevant British Standards.

ESC's scope of products

ESC carried out the alternative design calculations on behalf of the Contractor (Athena SA) and submitted them for approval to the Client (RAK Government) and their Consultant (Gibb Ltd). All relevant drawings and engineering detailing were provided by ESC for all projects. Once approval was received the manufacturing was carried out in the ESC factory for delivery to the site.

PROJECT DETAILS

STRUCTURAL REQUIREMENTS (EXAMPLE FOR PHASE IA)

WALL TYPE	PILE LENGTH (m)	MAX. DESIGN BENDING MOMENT (kNm/m)	DESIGN LIFE
Main Wall	16.5	616.0	30 years
Anchor Wall	3.0	N/A	30 years

SUPPLIED PILES BY ESC

WALL TYPE	PILE TYPE	MAX. DESIGN BENDING MOMENT (N/mm^2)	MAX SECTION MODULUS (cm^3/m)
Main Wall	ESC46A (6059)	355	4040
Anchor Wall	ESC18A	275	1800

The sheet pile proposed for the Main Wall was a custom designed pile specifically suited to this project. The sheet pile was built in a modular style which allows the thickness of the plate to be varied to accommodate different stress levels and corrosion zones.

SHEET PILE DATA TABLE (UNCORRODED PARAMETERS)

Table shows the section modulus and moment capacity of each segment of the ESC46A (6059) sheet pile prior to corrosion loss.

PILE SEGMENT	LENGTH (m)	THICKNESS T1 (mm)	THICKNESS T2 (mm)	SECTION MODULUS (cm^3/m)	STEEL GRADE
A	4.5	16.0	10.0	4040.0	S355JOC
B	6.0	15.0	9.0	3660.0	S355JOC
C	6.0	9.0	9.0	2500.0	S355JOC

Full calculations of the derivation of section modulus for the ESC46A (6059) custom pile, and the ESC18A standard pile were supplied to the Client and their Engineers. All calculations were performed in accordance with the guidelines set out in BS 5950 Part 5.

Steel piles were manufactured and delivered in accordance with the requirements stated in the BS EN 10249 Parts 1 and 2. Steel specifications follow those stated in BS EN 10025:1993.

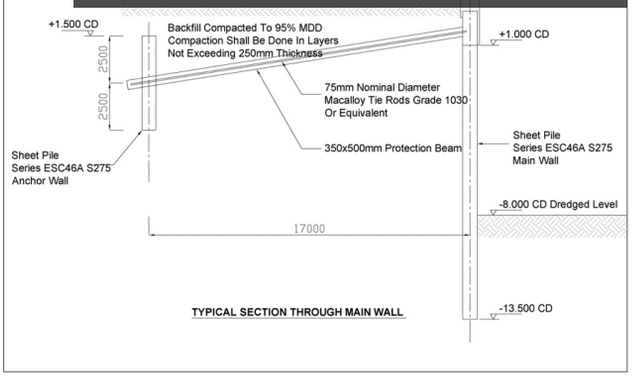
All piles contained welded elements. The welding procedure was designed and approved by accredited certification bodies (Lloyds) to ensure complete strength transfer across the welded joint.

COATING REQUIREMENTS (PHASE 1A & OTHERS)

The specified coating for the sheet piles was for sand blasting followed by 50µm of primer and then 400µm of coal tar epoxy paint. The coating was applied to the entire front surface and two metres of the back surface of the Main Wall piles only.

ESC will be used a product called JotaCoat 550 for all painting works. ESC work closely with the paint manufacturer Jotun and have developed a painting specification that is designed to suit high corrosion environments.

SECTION DRAWING FOR CONSTRUCTION OF PHASE IA



CORROSION DESIGN (PHASE 1A & OTHERS)

The specification for the corrosion design is that the sheet pile must have a design moment capacity of 616 kNm/m after a thirty year period. Coating was not to be considered in this calculation.

Corrosion rates varied along the length of the pile depending on the corrosion zones. Likewise, moments along the length of the pile will vary with the maximum required moment occurring approximately halfway between the anchor point and the dredged level. The objective of the corrosion design was therefore to ensure that the moment capacity in this zone is at least 616kNm/m after thirty years.

PILE SEGMENT	CORROSION ZONE	CORROSION RATE (mm/yr)	PERIOD (yrs)	TOTAL Loss (mm)	REDUCED THICKNESS T1 (mm)	REDUCED THICKNESS T2 (mm)
A	Splash	0.15	30.0	4.5	11.5	5.5
B	Immersion	0.05	30.0	1.5	13.5	7.5
C	Embedded	0.03	30.0	0.09	8.1	8.1

The loss of thickness in each segment will affect the section modulus of the pile and hence the bending moment capacity.

SEGMENT PROPERTIES POST CORROSION LOSS

SHEET PILE DATA TABLE (Corroded Parameters)						
PILE SEGMENT	LENGTH (m)	THICKNESS T1 (mm)	THICKNESS T2 (mm)	REDUCED MODULUS (cm^3/m)	DESIGN STRESS (N/mm^2)	BENDING CAPACITY (kNm/m)
A	4.5	11.5	5.5	2570.0	230	591
B	6.0	13.5	7.5	3090.0	230	711
C	6.0	8.1	8.1	2170.0	230	499

The stress of 230 N/mm2 is adopted from BS449 as the design stress for sheet pile walls using high tensile steel. It should also be noted that all the calculations made full allowance for panel buckling considerations in the thin plate sections.

Email: info@escsteel.com
Website: www.escsteel.com

PROJECT DETAILS

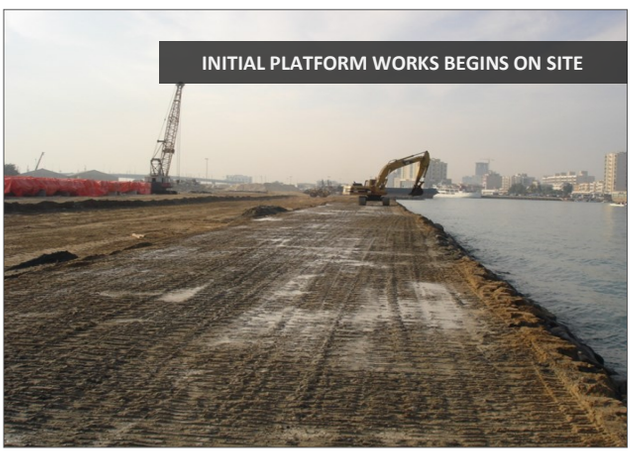
As always, ESC personnel were on site to assist Athena SA during the beginning of the installation process. Several recommendations were made regarding piling guides and handling processes. ESC provided efficient Dawson Lifting Shackles that helped increase the productivity of the installation, while ensuring maximum safety during the process.

SOIL PROFILE

The existing seabed was between approximately -2.0 EL to +1.0 EL in the vicinity of the proposed wall. Subsequent filling activity has reclaimed the area to approximately +3.0 EL. Fill material is dense to very dense sandy gravel with cobbles and boulders.

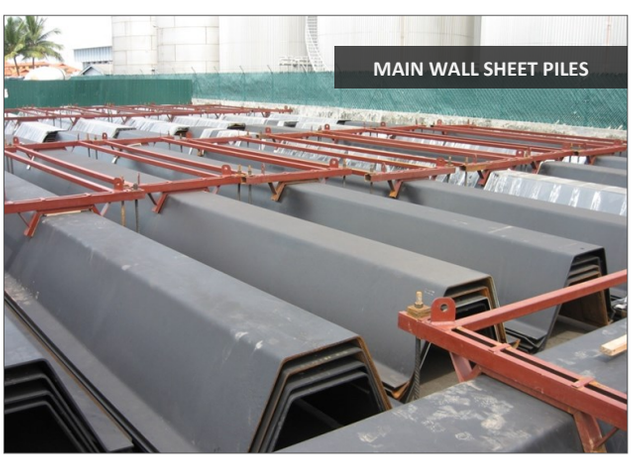
The original seabed is a layer of medium dense to very dense silty sand, overlying a medium dense to very dense silty gravel layer with sandstone bands up to 8.0m thick.

Below the gravel layer are pockets of medium dense to dense sands, overlying a very dense sand layer with sandstone bands at approximately -13.0EL.



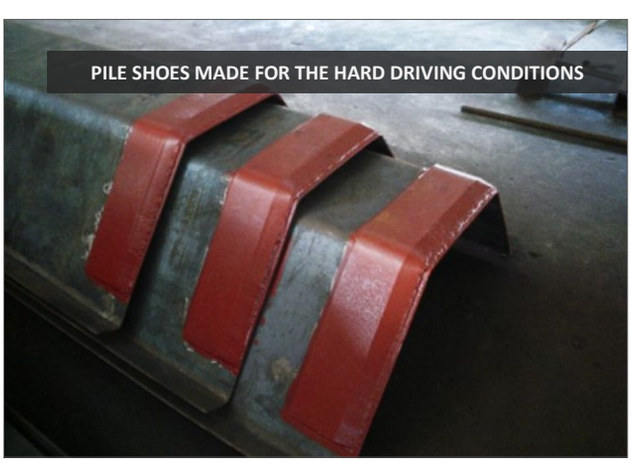
INITIAL PLATFORM WORKS BEGINS ON SITE

CATHODIC PROTECTION ANODES



MAIN WALL SHEET PILES

ESC18B ANCHOR WALL PILES

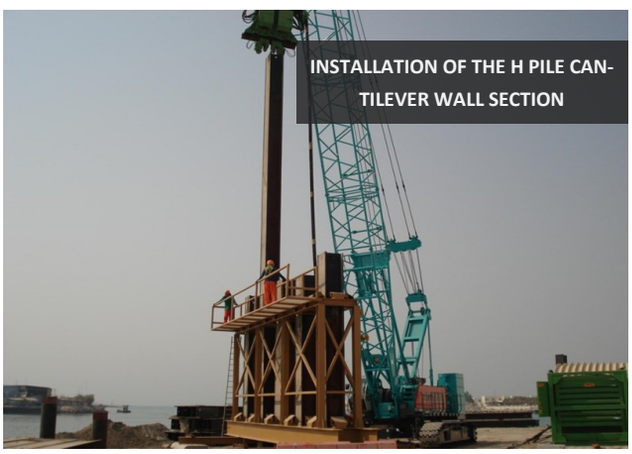


PILE SHOES MADE FOR THE HARD DRIVING CONDITIONS

ON-SITE INSTALLATION

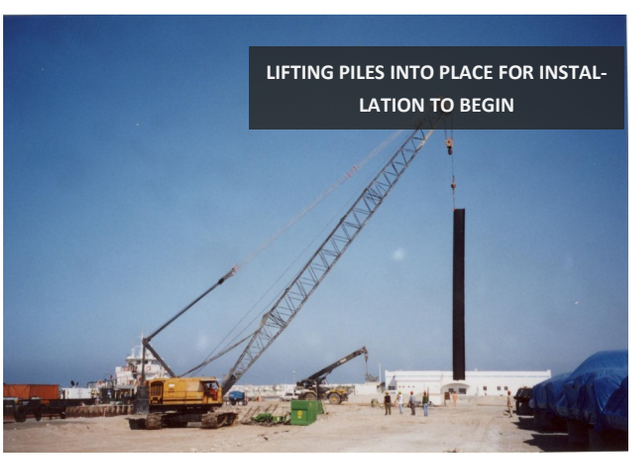
EXCAVATION UNDERWAY FOR THE TIE ROD INSTALLATION

ANCHOR WALL SHEET PILES INSTALLED



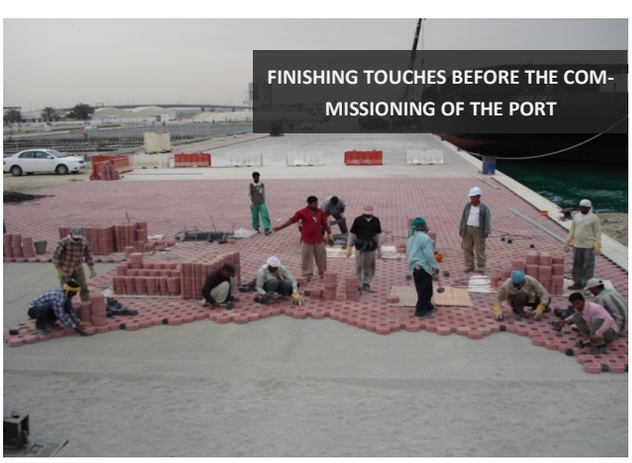
INSTALLATION OF THE H PILE CANTILEVER WALL SECTION

FINAL INSTALLATION OF THE SHEET PILES TO DEPTH IS CARRIED OUT BY THE IHC S90 HYDRAULIC DROP HAMMER



LIFTING PILES INTO PLACE FOR INSTALLATION TO BEGIN

TIE ROD INSTALLATION IS UNDERWAY



FINISHING TOUCHES BEFORE THE COMMISSIONING OF THE PORT

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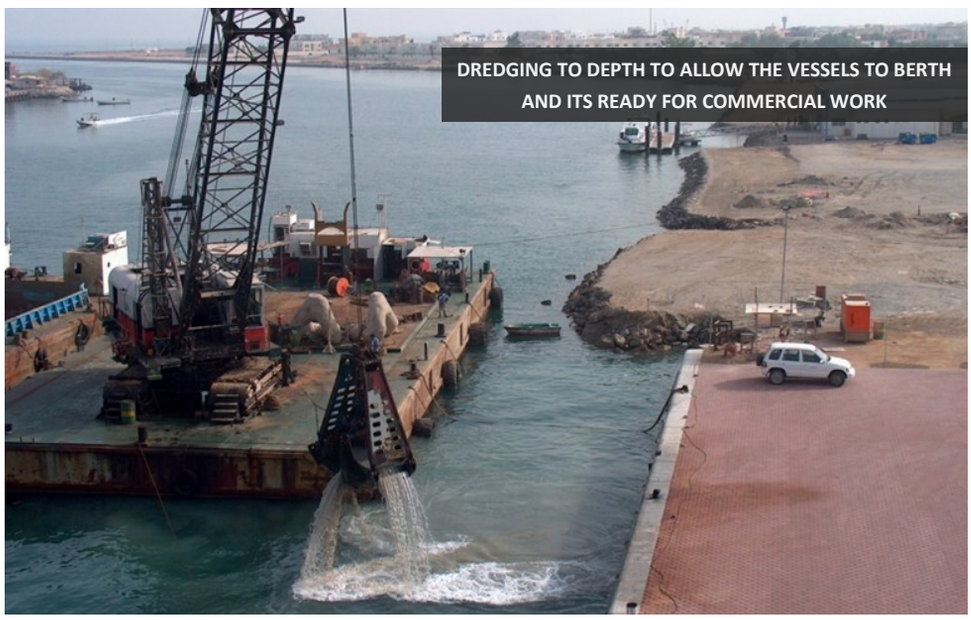
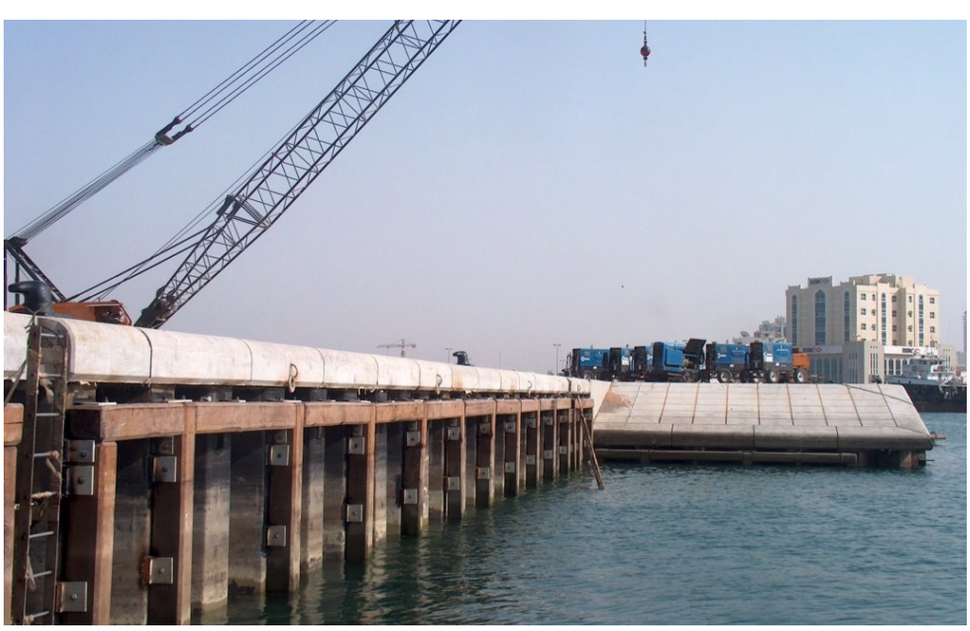
NEARING COMPLETION





PROJECT COMPLETED

FINISHED AND READY TO ACCEPT SHIPS

THE FIRST SHIP COMES ALONGSIDE AT PHASE 1A AUGUST 2006

Email: info@escsteel.com
Website: www.escsteel.com