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ESC PROJECT CASE STUDIES

BOOK III (2017-2018)

Global Foundations, Steel Structures, Flood Mitigation, Port,
Retaining Walls and Retention Projects

About ESC

Further to simply supplying products we at ESC take a different approach to piling which is tailored to the customers' requirements. ESC believes that just supplying a product is insufficient and we strive to provide a level of support that is beyond customer expectations. This support ranges from general advice on the Client's options to full engineering support and design. ESC has amongst its divisions expertise in marine equipment, corrosion, trench safety and structural steel fabrication.

ESC products are produced & designed in accordance with the latest international standards as well as ISO 9001 Quality Management Systems. Other specific standards depending on the client's needs can be applied on request.

ESC has designed and supplied its products to projects in every continent of the world, including Antarctica. In the last decade, ESC has successfully diversified into structural steel fabrication, synthetic sheet piling, cathodic protection, mooring bollards and marine fender systems to provide complete engineered solutions.



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COMPANY CERTIFICATION

ESC products are produced & designed in accordance with the latest international standards 9001:2015, ISO 14001:2015, OHSAS 18001:2007 certifications for both supply, design and installation scopes related to sheet piling and piling related products.



ESC serves the global market from a range of strategic locations. ESC Group operates with over 15 agent and ESC offices around the world. Highlighted on the left are the representative offices for the steel structures division.

About ESC

Across the globe, the ESC Group of Companies now consists of the following registered enterprises:

- ▶ ESC Al Sharafi Steel LLC, UAE
- ▶ ESC Al Sharafi General Contracting LLC, UAE
- ▶ ESC Steel Engineering Sdn Bhd, Malaysia
- ▶ Acerlum ESC SAPI de CV, Mexico
- ▶ ESC Nigeria Ltd., Nigeria
- ▶ ESC Steel Philippines Inc., Philippines
- ▶ ESC-Beregstal Jsc, Russia
- ▶ ESC Steel LLC, USA
- ▶ PT ESC Steel, Indonesia

And partners,

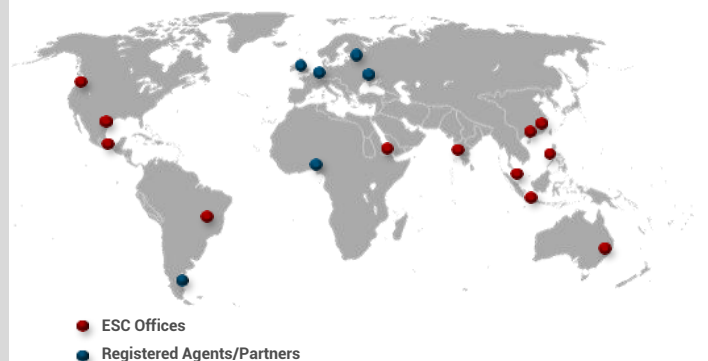
- ▶ Cimtronic Design & Engineering, Argentina
- ▶ Europile B.V., Netherlands
- ▶ Mageba Ukraine LLC, Ukraine
- ▶ Bulkplus Integrated Limited, Nigeria

The ESC Group has manufacturing plants located in China and the United Arab Emirates.

The ESC Group is also represented by agents of our own officers across Asia, Europe, North & South America, India, Africa and the Pacific.

The ESC Case Study Booklet aims to highlight and explain the more technical components of some older and more recent jobs that ESC has completed.

Global Locations



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AL ITTIHAD FOOTBRIDGE

STEEL ARCH PIPE FOR FOOTBRIDGE PROJECT

Project Name	Footbridge at Al Itihad Road, King Faisal and King Abdul Aziz Street Project
Project Owner	Government of Sharjah Roads & Trans. Authority
Consultant	CH2M
General Contractor	Waagner Biro Gulf LLC
Project Location	Sharjah, United Arab Emirates
Total Tonnage	254 MT
Delivery Date	April 2017

INTRODUCTION

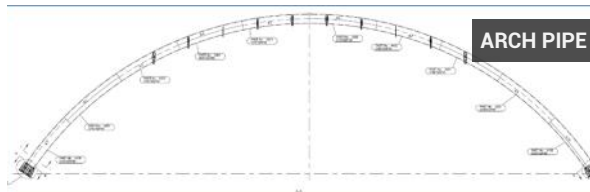
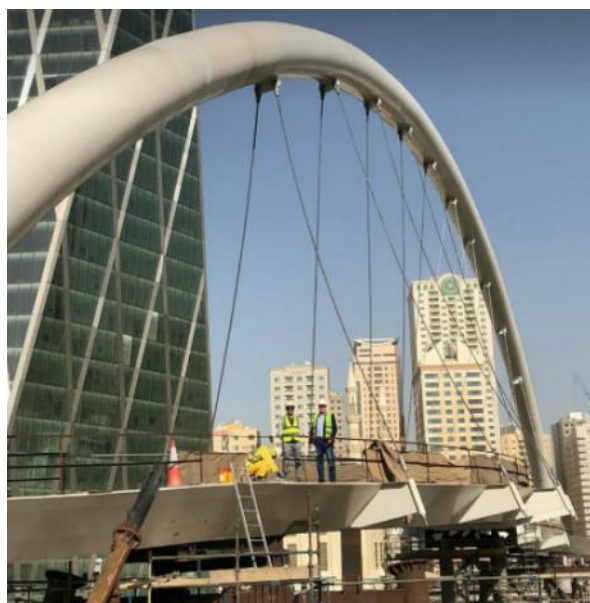
ESC Group was contracted by Waagner Biro Gulf Middle East Bridge Division for the specialty heavy steel fabrication of the heavy pipe arch for a new foot bridge over Al Ittihad Road, one of the busiest highways in Sharjah, United Arab Emirates.

Prior to this project, pedestrian crossing of the Al Ittihad Road, which connects Dubai to Sharjah, was a serious hazard to the public. The Sharjah Urban Planning Council approved the unique footbridge design, which consists of a single arch that spanned over 92 metres length and 25 metres height. The arch was broken down into single 10 metre length pieces to accommodate less complex transport and easier handling. The arch would be constructed in situ and splice welded on site, where they would eventually meet in the centre section.

ESC Group during the tender phase submitted detailed documentation, showing full workflow, timescales, previous similar case studies and the necessary certification for CE marking of both raw materials and end product to BS EN 1090-1 and BS EN 1090-2 Execution Class 3.

ESC's engineers effectively communicated with all the technical queries submitted both by the main contractor and the consultant in Europe. ESC had the advantage by having both offices and skilled personnel in the United Arab Emirates – the project country and China - where the steel raw material was procured and the product was fabricated .

Prior to production, ESC completed a comprehensive Inspection & Test Plan (ITP) with a breakdown of all the processes which included: welder qualification review, raw material inspection, component dimensional inspection, weld inspection and coating inspection. Strategic review, witness and certify hold points were incorporated for each of the stages. A 3rd party inspector was selected for the project as well by ESC and accepted by the client. After several iterations working with both the project client and consultant, the ITP was agreed and approved well before production started.



The steel bridge arch design required a 1524mm circular hollow section at a 60mm thickness at S355J2+N steel grade. Certain sections of the arch called for special steel grade S355+N Z25, where the Z25 required extra testing for thorough thickness ductility, important for special bridge components for both when high loads are transmitted through the thickness and also where large welds are specified on elements that are restrained against shrinkage. Few pipe mills in the world could produce this at such a low diameter to thickness ratio. The pipe section was also formed in a single piece using the JCOE process with a single longitudinal submerged arc weld.

AL ITTIHAD FOOTBRIDGE PROJECT

FOOTBRIDGE PROJECT

To bend the arch into a gradual curve required state of the art heat induction bending. Heat induction bending is used by locally heating the section along the length whilst pivoting it around a preset bend radius. The heat has to be very localized to prevent the previously bent section from plastically deforming producing an uncontrolled distortion. Each pipe was carefully checked using both manual methods and laser positioning equipment to calculate whether the bent product was within the project specific tolerances. The pipe weld was also inspected before and after heat induction bending.

After the heat induction bending, the pipes were slotted to include the hanger plates for the suspension cables. The footbridge deck followed a snake bend trajectory to improve aesthetics. Due to this, the geometry of the hangar plates all followed various planes relative to the plane of the arch which made fitting a complex matter. Using cutting edge laser sensors and highly skilled fitters, precise slotting

and fitting was able to be carried out. All plates required full penetration double sided butt welding on a very thick section. This required a well-planned WPS (Weld Procedure Specification) and AWS trained welders working in confined spaces both inside and outside the pipe. Worker health and safety was always the number 1 priority and all appropriate measures were taken to prevent any accidents or health hazards.

ESC completed and packed the pipe arch segments to minimize any chance for damage during shipment. The pipe segments were successfully delivered on time in May 2017 and construction is scheduled to commence in Q3 2017.



ESC SCOPE OF SUPPLY

ARCH PIPE

ESC has been awarded with the contract to supply steel arch pipe for footbridge at Al Ittihad Road located in Dubai, UAE. The arch pipe consists of 10 sections, ESC scope of supply includes the entire 10 sections of arch pipe which consist of OD1524x60mm arch pipe, welding of arch diaphragm plate to arch pipe, fabricated and welded flange plates, stiffener plates, circular plates, and base plates for the first and tenth arch pipe. All the material fabricated in accordance with EN 1090-2 with quality class EXC3.



OD1524mm LSAW STEEL PIPE FORMING

PROCESSES

BEVELLING



LSAW PIPE FORMED



THERMAL INSULATION AND WELDING

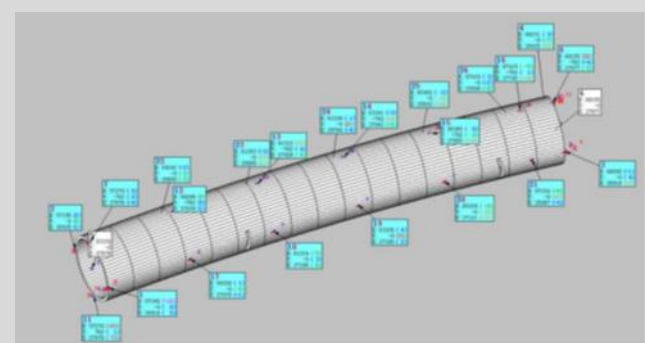
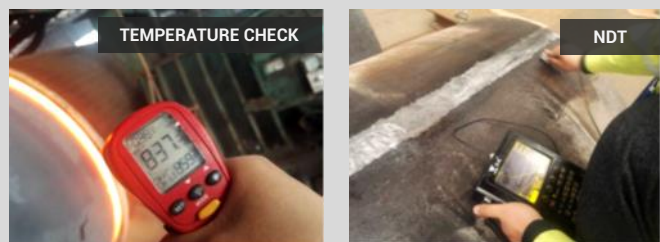


All welds tested in accordance with the Manual of Contract Documents for Highway Works Volume 1 Specification for Highways Works – Series 1800 Structural Steelwork category F56.

HEAT INDUCTION BENDING

PROCESSES

Heat induction bending is carried out to form the desired bending angle for each pipe section. The heat induction bending temperature is controlled to ensure it is within 900°C to prevent changes in mechanical properties of the arch pipe. A sample from the bent arch pipe is taken to perform a mechanical test to ensure the mechanical properties after heat induction bending remain within the requirements in the specification.



The above figure shows the results from total station inspection. Total station is used to ensure high precision and accuracy dimensions can be obtained and prevent a mismatch of each section during the field installation process.



FABRICATION OF ACCESSORIES

ACTIVITIES



FLANGE PLATE



BASE PLATE



STIFFENER PLATE



DIAPHRAGM PLATE

All steel surfaces that are to be welded are grinded to minimize the risk of defective welds.

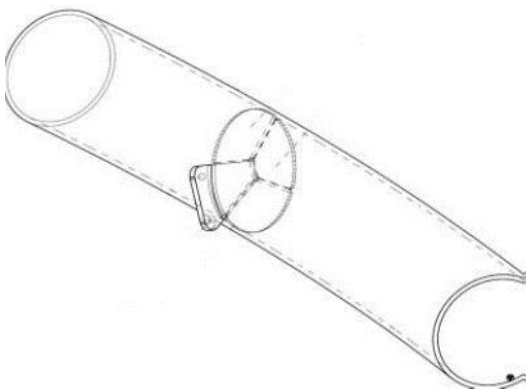
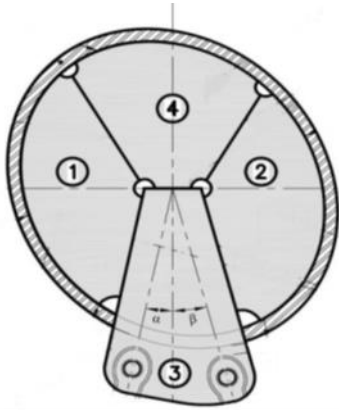
All external longitudinal welds are ground flush for aesthetic purpose.



ACCESSORIES

WELDING & ASSEMBLY

Since the diaphragm plate is designed to be at an angle to the arch pipe, in order to maintain the accuracy of the angle, special precaution is required when welding and installing the diaphragm plate.



- Step 1 – Fin plate hole on pipe is measured and cut for the installation of fin plate ③.
- Step 2 – Assembly of the diaphragm plate using the sequence ③→①→②→④.
- Step 3 – Spot weld each assembled diaphragm plate.
- Step 4 – Remove fin plate ③ to prevent the welding stress affect the position and angle of the fin plate.
- Step 5 – Fully weld plate ①, ②, and ④.
- Step 6 – Finally install and fully weld fin plate ③.



INTERNAL SURFACE

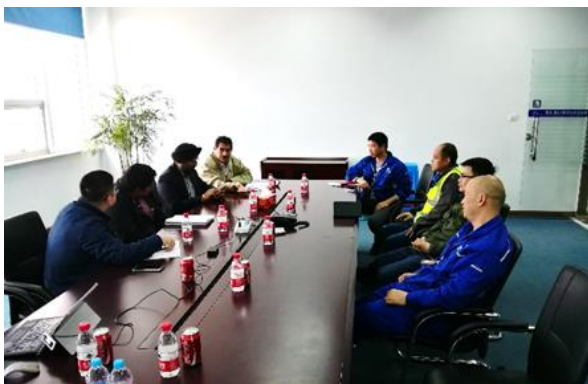
PAINTING

Internal surface that is inaccessible at the field (after the installation of diaphragm plate in the factory) will be painted with one layer of SigmaPrime 200 (manufactured by PPG) with a total DFT of 100 microns.

The steel surface quality is prepared to achieve Grade P3 as per ISO 8501-3 prior to blasting process. The surface is blasted to a cleanliness level of class Sa2.5 as per ISO 8501-1.



CLIENT VISIT



FINISHED PRODUCT



PACKING & EX-MILL

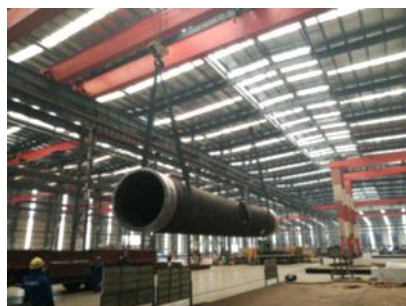
EDGE BEVEL PROTECTION



Since field weld connecting each arch pipe section is required, a bevelled edge is prepared on each section of arch pipe. Special protection is made on each pipe end to prevent damage to the bevelled edge during handling and shipping process.

PACKING & TRUCK LOADING

Due to the shape and components of the first and last arch pipe (two arch pipes with flanges), a foundation is designed for the packing and delivery purpose. The foundation serves to secure the arch pipe to prevent damages during the stacking and shipping process. Each section of arch pipe will be secured with 3 foundations.



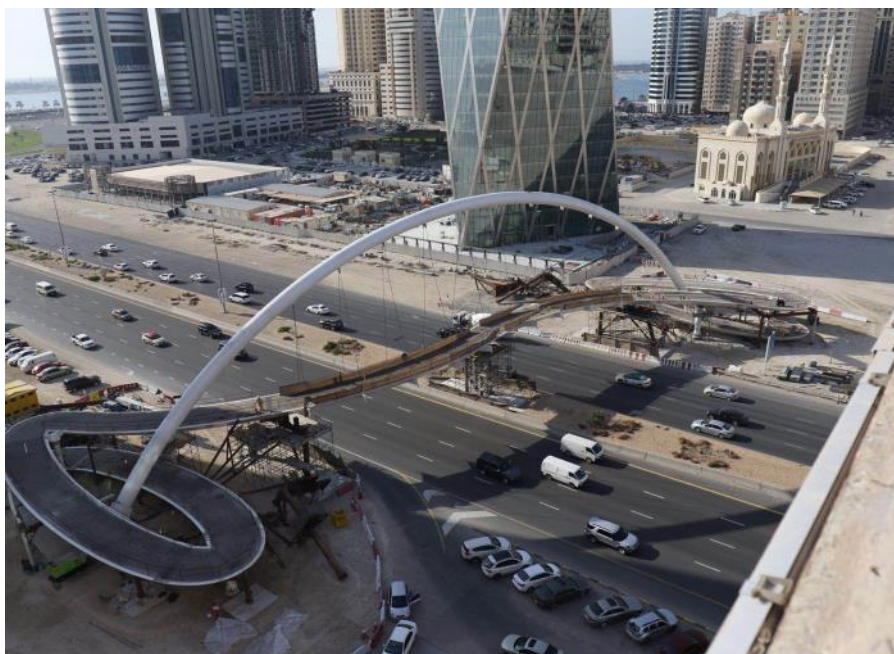
SHIP LOADING



The ship loading process carried out in Luojing Wharf of Shanghai on 16th April 2017. ESC sent two representatives to witness the entire ship loading process (One logistic controller and one QC personnel).



ARCH PIPE AT CLIENT SITE



AL KHAWANEEJ SECOND SEWERAGE & DRAINAGE SYSTEM

CIRCULAR SHORING SYSTEM PROJECT

Project Name	Al Khawaneej Second Sewerage & Drainage System
Project Owner	Dubai Municipality, Government of Dubai
ESC Client	Arabtec Engineering Services (AES)
Consultant	Ch2m
Project Location	Al Khawaneej, Dubai, UAE
Product	Design, Supply, Installation and Extraction Of Circular Shoring System
Project Execution Period	December 2017–June 2018

INTRODUCTION

Dubai Municipality in the year 2017 allocated Dhs 7 billion in its annual budget for executing necessary infrastructure in the field of health and environment in the newly developed or developing regions of Dubai. Under this scheme, Dhs 300million were allocated to develop deep underground sewerage network in Al Khawaneej area of Dubai. The project was anticipated to be completed in the year 2018.

Horizontal directional drilling (HDD) was proposed for the construction of deep underground sewerage network. As part of the sewerage network, several Manholes were planned along the network. The manhole construction required excavations from 13m to 22m. To facilitate the deep excavations, ESC proposed Circular Shoring System.

SITE STRATIGRAPHY

The overburden soils at this project consisted of medium dense to dense silty sands to about 6m depth from the existing ground level. This is followed by extremely weak to weak, poorly cemented light brown Sandstone was encountered to the final explored depth. Ground water table was not found during the geotechnical exploration. The natural water level in the region is expected to be well below 30m depth. The stratigraphy at site i.e., presence of hard ground and no water table, is considered to be ideal for

kingpost shoring system.

DESIGN CONCEPT - CIRCULAR SHORING SYSTEM

The Circular shoring system consisted of series of kingposts installed in a circular pattern. The pit diameter is designed to be 9m to provide enough space for manhole construction. 356x358x129kg/m Beams of Grade 275 are used as kingposts. Since the excavation depths ranged between 13m and 24m, these beams are fabricated to required additional lengths. Length of the kingposts ranged between 18m and 26m depending on the excavation depth.

The nature of excavations required multiple level walings. These walings are pre-fabricated at ESC yard to suit the pit diameters i.e., 9m. Each waling unit is divided into 3 arc segments connected with 3 connectors. To optimize the design requirements, 305x305x97kg/m beams are used for first level and 356x358x129kg/m beams are used for second level walings.

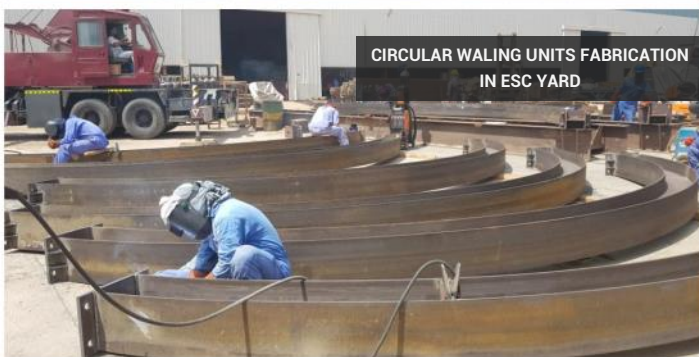
ESC SCOPE OF SUPPLY

CIRCULAR SHORING SYSTEM

ESC carried out the design, supply, installation, and extraction of circular shoring system for this project.



FABRICATION OF CIRCULAR WALINGS



PAINTING OF CIRCULAR WALING



STACKING OF FABRICATED CIRCULAR WALING



LOADING & DELIVERY TO SITE



ON-SITE INSTALLATION

Due to the nature of ground conditions, pre drilling is carried out to facilitate the installation of kingposts. Prior to commencing the drilling process, each kingpost locations are surveyed and marked on the ground. Kingposts of desired length are then installed at the pre-drilled locations. Prior to carrying out the excavation works, ESC's QA/QC team ensured the alignment of kingposts, spacing between the kingposts and also the clear spacing required for manhole construction inside a 9m diameter pit.

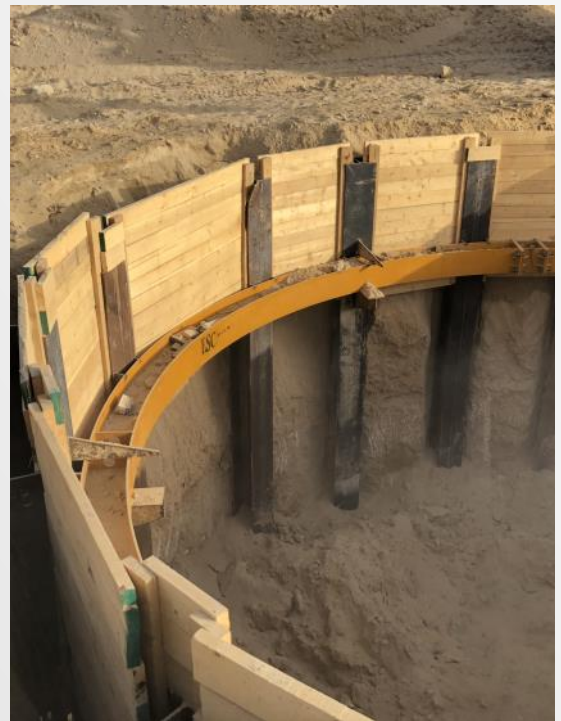
Timber infill panels are installed between the kingposts

simultaneously during the excavation in stages. These timber infill panels are installed up to the end of loose to medium dense overburden sand or to the top of the underlying Sandstone (bedrock).

Pre-fabricated circular waling beams are then assembled on site next to the pit location and lowered using a mobile crane to the desired level as per the approved shoring design drawings.



ON-SITE INSTALLATION



ON-SITE INSTALLATION



TYPICAL CIRCULAR WALING WITH THREE SEGMENTS AND THREE CONNECTORS



TYPICAL CIRCULAR SHORING SHAFT WITH MULTI LEVEL CIRCULAR WALINGS



CIRCULAR WALING BEING INSTALLED IN MANHOLE NO. 73



CIRCULAR WALING INSTALLED

ADVANTAGES - CIRCULAR SHORING SYSTEM

There are several advantages of a circular shoring system over conventional square or a rectangular shoring designs. Some of the main advantages are listed below:

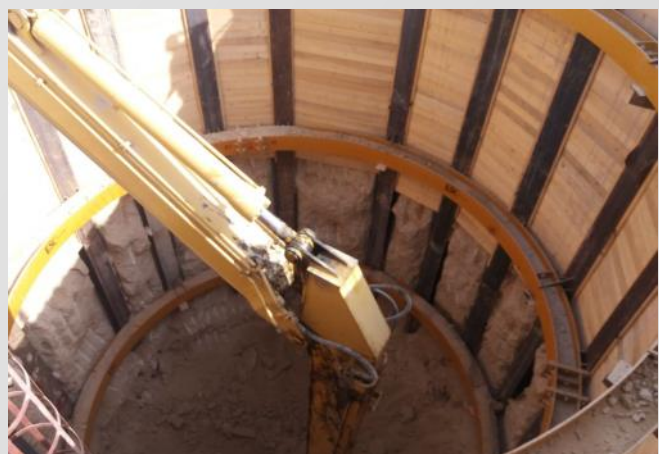
Due to the nature of stress development in circular shoring system (hoop stresses), the structural elements like kingposts and waling beams can be optimized to lighter sections which otherwise might require very heavy steel sections – particularly for deeper walings at 18m depth or below.

Circular walings can be easily fabricated at ESC's yard to suit the different pit diameters. These circular walings can be modified to suit different shaft diameters which can be used at many other project sites.

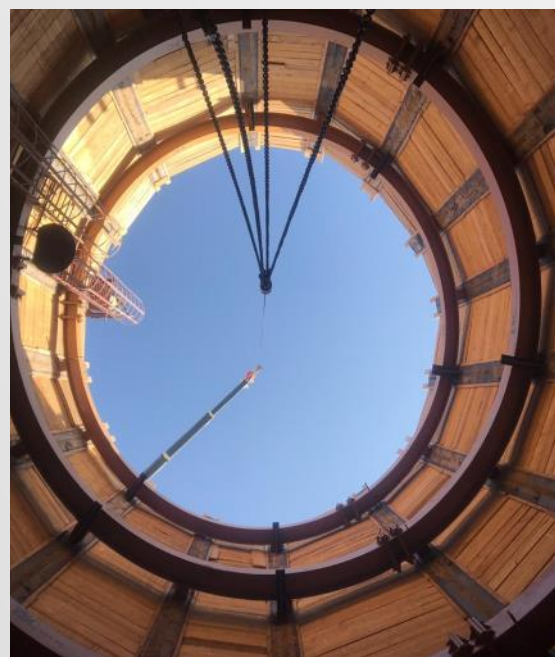
Since the shoring system comprises of steel elements (Beams), excavation can be commenced immediately without any waiting periods for curing

Several re-uses can be extracted within the same project or any potential future projects

Depending on the number of re-uses, there can be considerable financial savings for the project and for potential future projects too



ON-SITE INSTALLATION

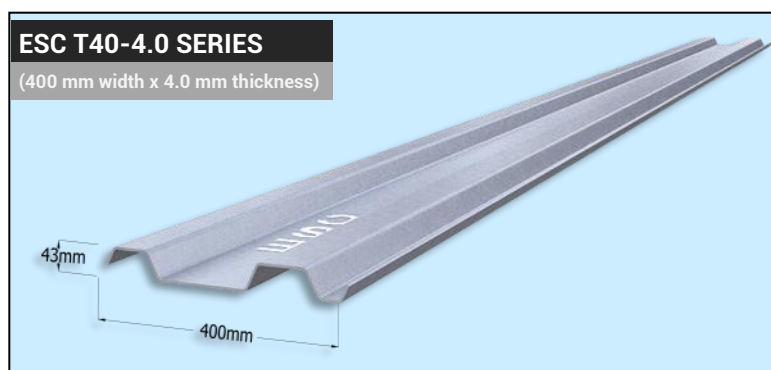


DISTRICT COOLING PLANET EXTENSION, UAE

TRENCH SHEETING PROJECT

Project Name	District Cooling Planet Extension
Client	EMPOWER District Cooling
ESC Client	Steel Construction Engineering Company LLC
Location	Business Bay, Dubai, UAE
Product	Trench Sheets
Total Length	1,048 LM
Delivery Date	August 2018 – January 2019

INTRODUCTION



The scope of work involved a trench excavation of approximately 4.0m~6.0m depth. A total of 1,048LM of trench excavation is planned using ESC Trench Sheets.

T40-4.0 Trench Sheets, 6m length with one level bracing was installed to facilitate the necessary excavation for the new chilled water pipe laying works.

ESC SCOPE OF SUPPLY

TRENCH SHEETS

ESC has supplied T40-4.0 Trench Sheets.

These Trench Sheets are 400mm width x 4mm thickness, 6.0m in length. Total Number of Trench Sheets ordered are 1,400

pcs in phases. Pic 4 illustrates the successful excavation and pipe laying works after the installation of ESC Trench sheets.

ESC-T40-3.5	400.0	42.50	3.5	13.74	34.34	21.98	54.94
ESC-T40-3.7	400.0	42.67	3.7	14.52	36.31	23.14	57.86
ESC-T40-4.0	400.0	42.97	4.0	15.70	39.25	24.85	62.14
ESC-T40-5.0	400.0	43.97	5.0	19.63	49.06	30.41	76.03
ESC-T40-6.0	400.0	44.97	6.0	23.55	58.88	35.77	89.42

ESC T40 Trench Sheet Profile & Mechanical Properties.

PROJECT PHOTOS



TRENCH SHEETS BEING MANUFACTURED



TRENCH SHEETS LOADING FOR DELIVERY TO CONSTRUCTION SITE



T40-4.0 TRENCH SHEETS



ESC TRENCH SHEETS INSTALLED AMIDST BUSY STREET IN DUBAI DOWN TOWN AREA FOR NEW PIPE LAYING WORKS

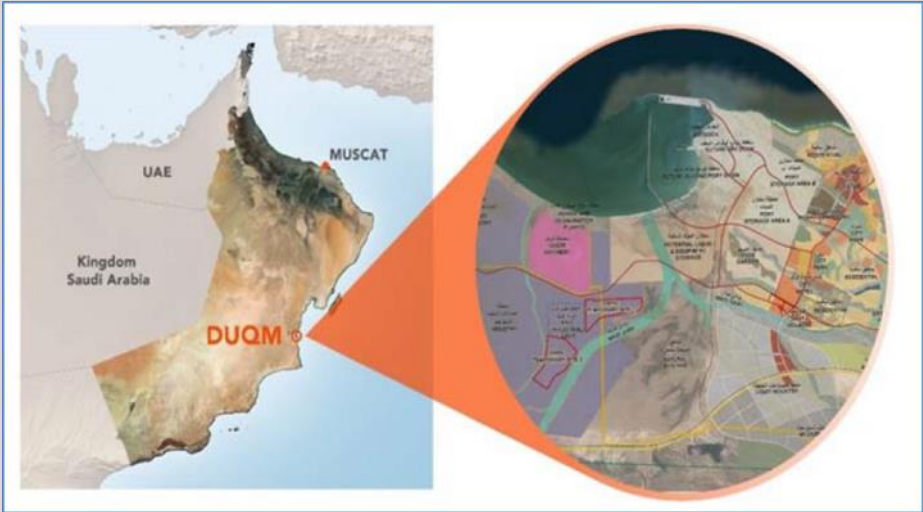


DUQM LIQUID BULK BERTHS PROJECT

LIQUID BULK BERTHS PROJECT

Project Name	DUQM Liquid Bulk Berths Project
Client	Port of Duqm
Contractor	Six Construct
Location	Sultanate of Oman
Product	LSAW Pipe
Total Tonnage	5,046MT
Corrosion Protection System	Interzone 505 (Total DFT: 800µm)
Delivery Date	November 2017

INTRODUCTION



Location map & master plan details.

The Government of The Sultanate of Oman is in the process of developing Duqm town and the Port of Duqm, as a strategic dry dock, free trade zone, industrial and tourism destination. The Port of Duqm is seen as a catalyst for the development of the Al Wusta region. The Port and Dry Dock are being developed to increase the trade; i.e. cargo trans-shipments, ship repair, manufacturing and tourism. The site enjoys proximity to the busy regional sea-lanes of Oman's coastal waters and is characterized by a friendly climate.

ESC SCOPE OF SUPPLY

LSAW PIPE

ESC was awarded the job to supply 5,046MT of painted LSAW pipe (specification: OD1219, thickness 22mm, length from 13m ~ 24.5m) with material API Spec. 5L grade X60. The LSAW pipe is required to be fabricated in accordance with client supplied project specific specifications.



PRODUCTION & INSPECTION

PROCESSES



SURFACE PREPARATION

ACTIVITIES

Past president of SSPC: year 2016~2017, with NACE level III, and SSPC level III qualification) along with his assistant (NACE level III qualification) are assigned by client to audit ESC about the painting process to minimize the risk of failure.

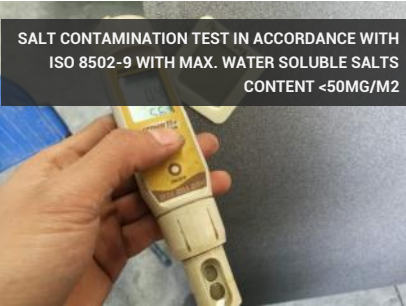
PRE-BLASTING INSPECTION



SHOT BLASTING TO SA2.5

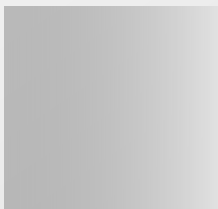
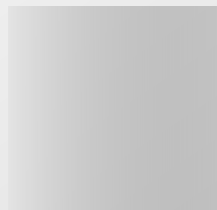
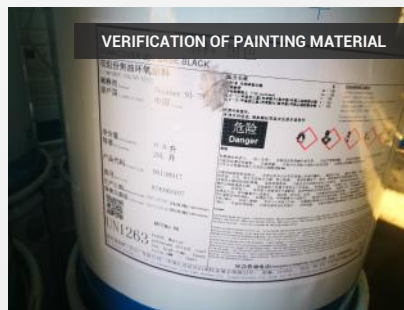


POST BLASTING INSPECTION



PAINTING PREPARATION

ACTIVITIES



- Check substrate temperature
- Check paint temperature
- Check amount of thinner added
- Monitor paint mixing ratio

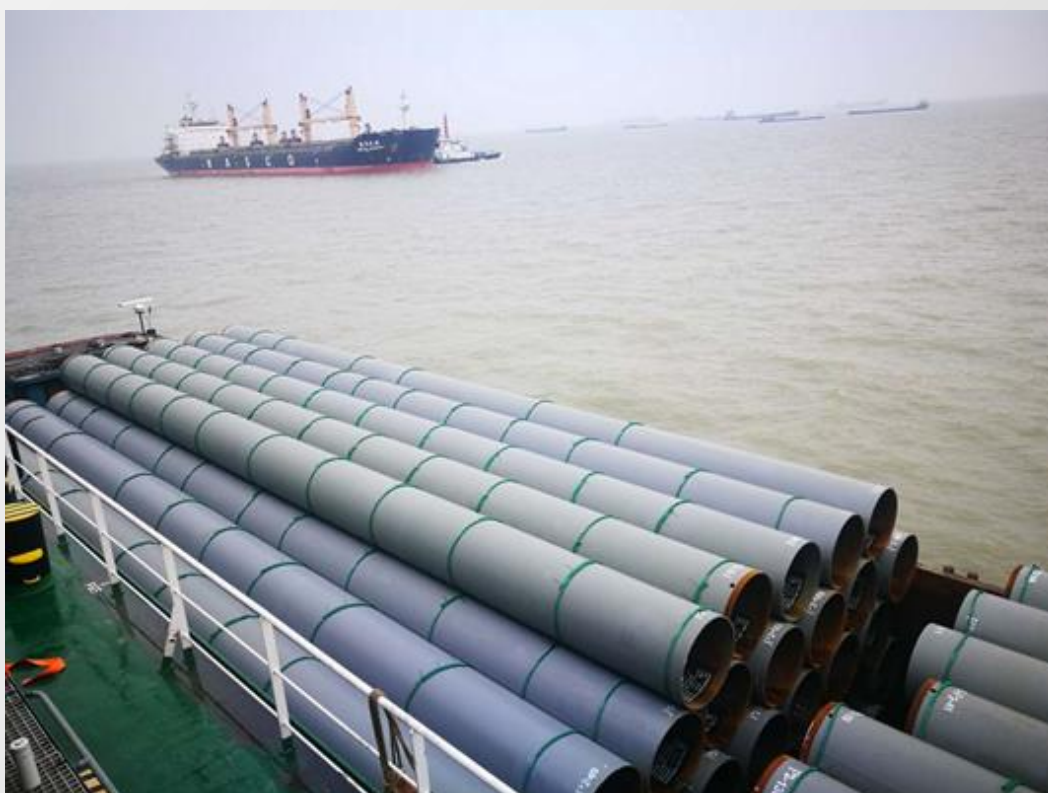
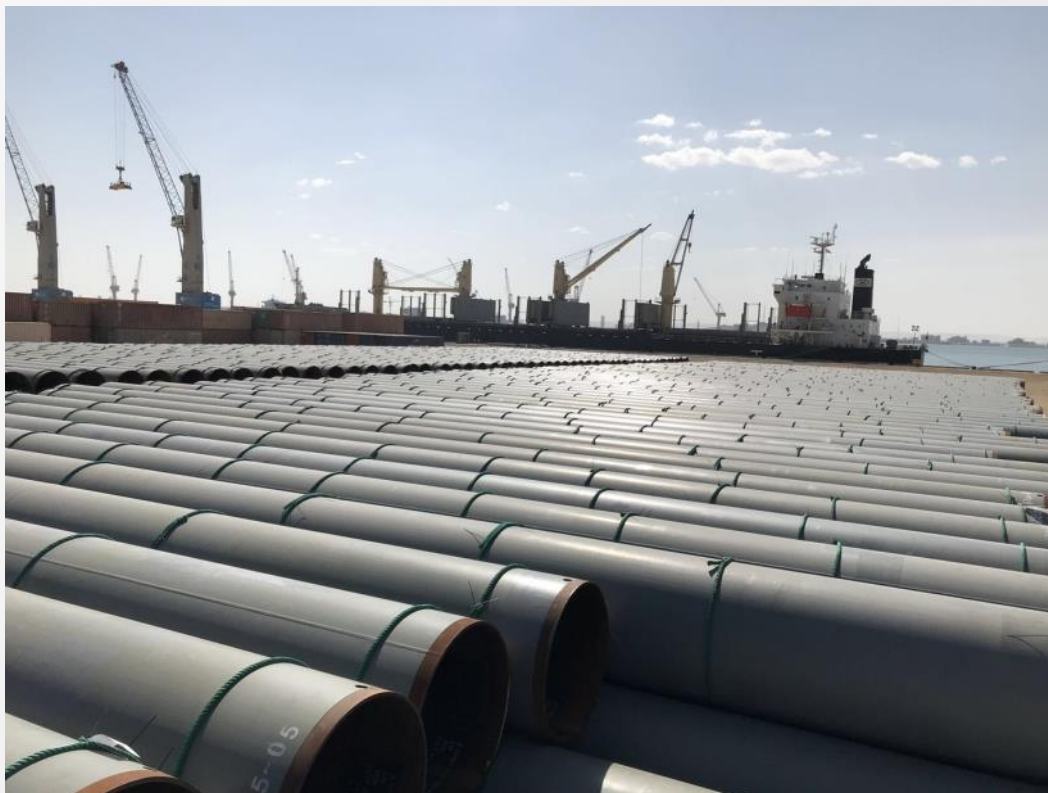


PAINTING

ACTIVITIES



FINISHED PRODUCT



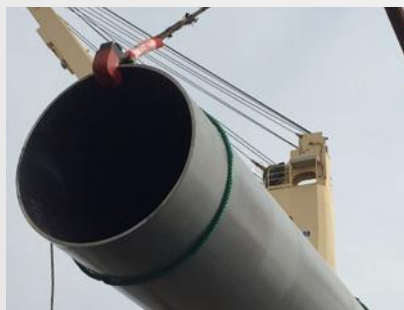
SHIP LOADING



Customized lifting hooks used for lifting to prevent damage.



Stopper with pad at side edge to prevent pipe sliding.



Wooden pad at the bottom for the pipe to prevent direct contact of painted pipe with hard seating surface.



ON-SITE INSTALLATION





FALKLANDS MARE HARBOUR PROJECT

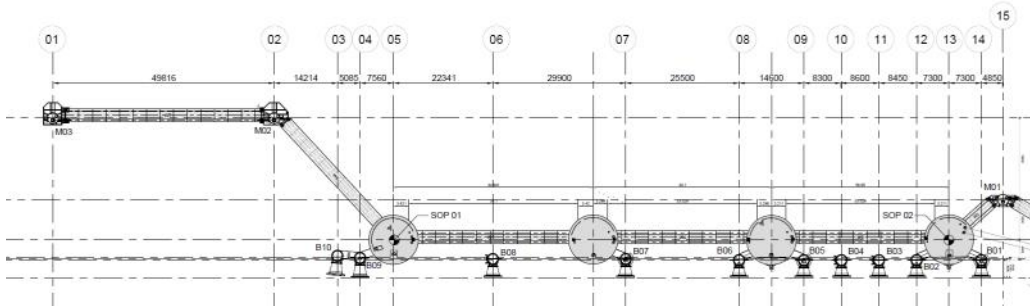
HARBOUR PROJECT

Project Name	Falklands Mare Harbour Project
Contractor	Volker Stevin International
Client	Defense Infrastructure Organisation , UK
Location	Mare Harbour, Falklands Island
Product	LSAW Pipe
Total Tonnage	800 MT
Delivery Date	Mar 2017

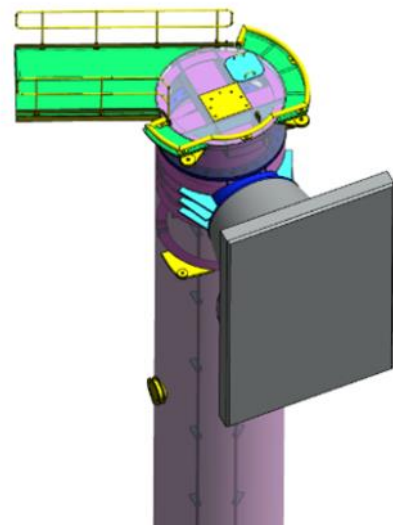
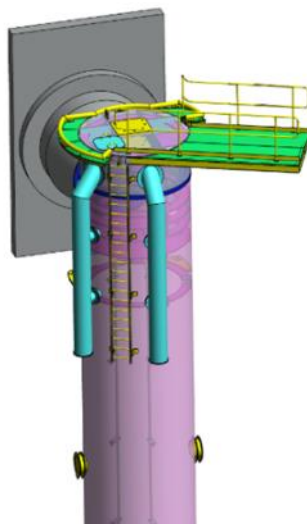
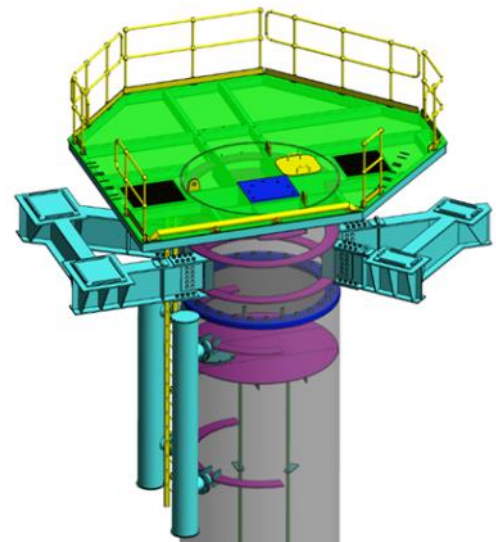
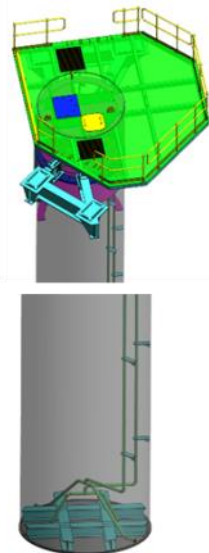
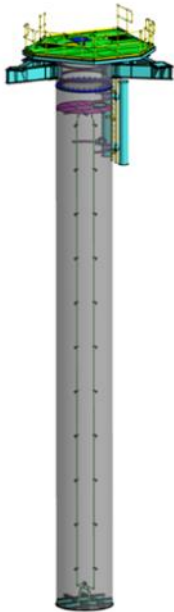
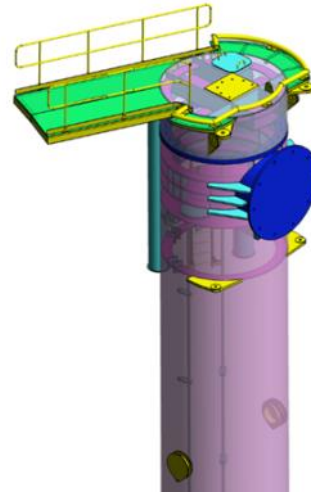
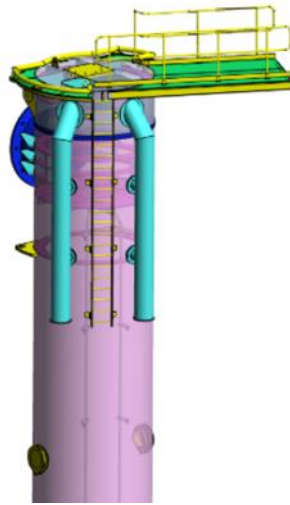
ESC SCOPE OF SUPPLY

LSAW PIPE

ESC has been awarded the contract to supply 800MT of mooring pile for Mare Harbour RoRo facility upgrade project in the Falkland Islands. ESC's scope of supply include the pipe pile and the pile head steel structure (bollards, anchor bolts, fenders, chains, and other related connection parts). The pipe with external diameter of 1067 ~ 2489mm and the steel grade of the project are S355J2, API 5L X70 and X80.



PILE DESIGN 3-D DRAWINGS



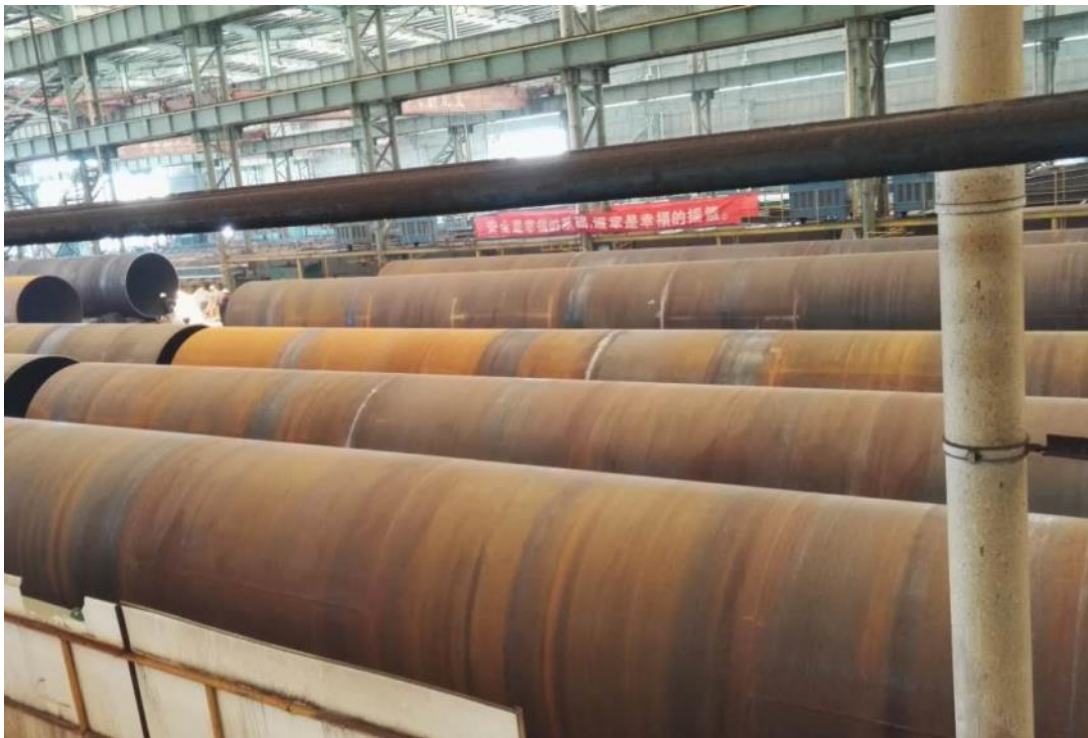
LSAW STEEL PIPE FORMING

Each heat number is retested to confirm all material mechanical properties and chemical composition is as per requested by the client.

Material traceability (part number and heat number) is maintained (physical marking and paper records) throughout the production processes starting from incoming raw material to the finished

product.

Welding is carried out in accordance with ISO 15614 standard. All welds are tested with 100% visual inspection, 100% ultrasonic test, and 10% magnetic particle inspection with quality level complying BS EN 5817 category C.



MOORING PILE HEAD FORMING

All components that are delivered as loose items are trial assembled as per design drawings to ensure all items fit and to minimize the risk of delivering defective components to the field.



MOORING PILE HEAD COMPONENTS



PILE HEAD STIFFENERS



LADDER



TRUNNION



HANDRAIL

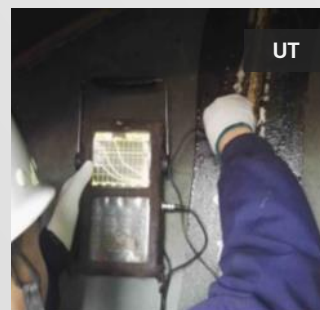
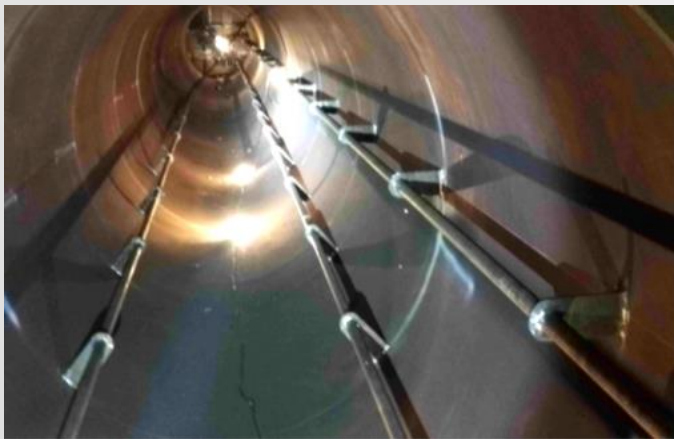
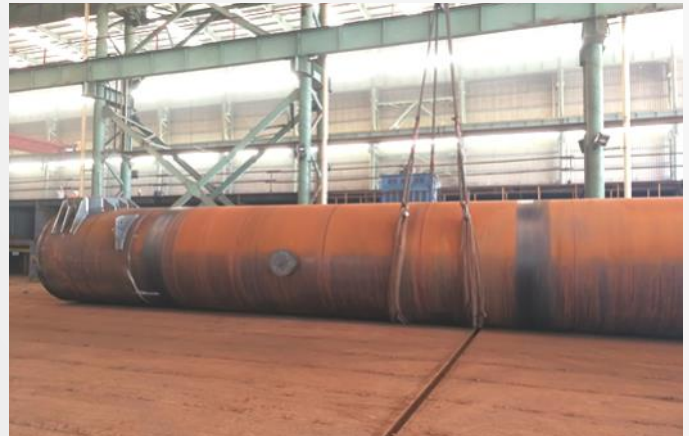


PILE HEAD STRUCTURE

WELDED COMPONENTS

STEEL PIPE WITH WELDED COMPONENTS

After the welding of grout pipes, all grout pipes are tested with a water pressure test at the pressure of 2MPa with a holding time of 15 minutes to ensure no leakage during the application.



PAINTING

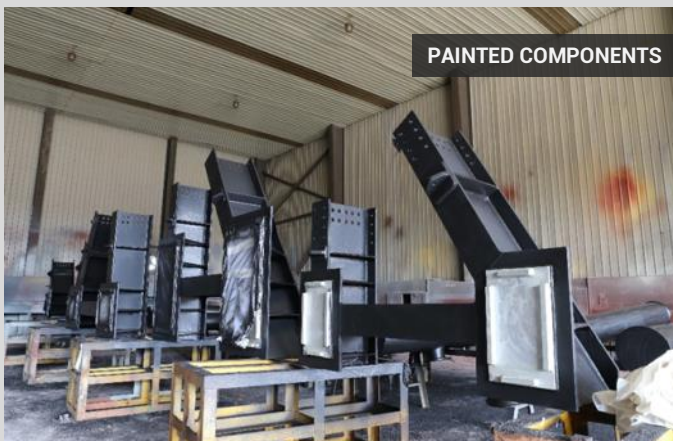
SURFACE CONDITION

Surface Cleanliness: Sa 2.5

Surface Roughness: >75 microns



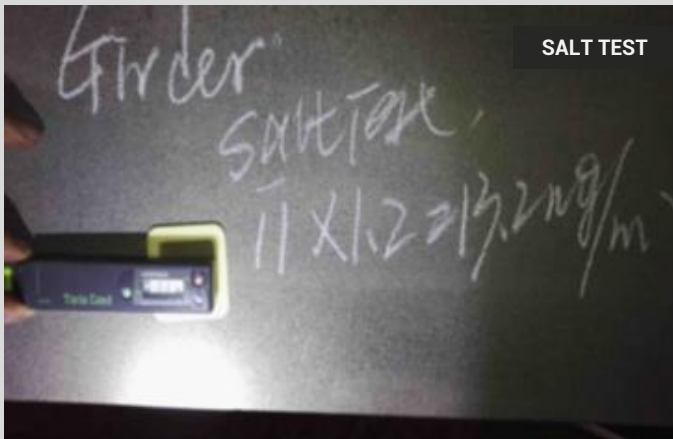
ANTI-SKID COATING



PAINTED COMPONENTS



PAINTED PILE BODY



SALT TEST



SURFACE ROUGHNESS



VISUAL & DFT

PAINTING SYSTEM

1st Coat: Interzone 505 (440 microns)

2nd Coat: Interzone 505 (440 microns)

Total DFT: 880 microns

Application method: Airless Spray

PACKING & STACKING

All materials are properly packed, protected, and stacked to ensure no damage during the handling process.



Packing and stacking is designed to ensure no painted surface comes in contact with any hard surface.

Spider is used to prevent the pipe from deformation.

Rack is used on loose small components.



SHIP LOADING



LASHING CONDITION



ON-SITE INSTALLATION





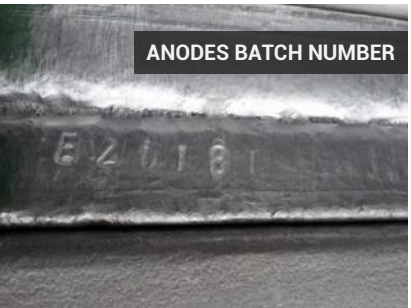
PALAWAN SUPPLY OF ANODES & TIE RODS

SUPPLY OF ANODES & TIE RODS

Client	Luzviminda Construction and Development Corporation
Location	Palawan, Philippines
Product	Anodes & Tie Rods
Quantity	338 pcs. Anodes
Delivery Date	2018

INTRODUCTION

All anodes and tie rods were manufactured by ESC. Prior to shipping a thorough inspection was performed for the anodes and tie rods with ESC's in-house QA/QC present in the factory.



ANODES INSPECTION



ESC
PILE

PROJECT NO: ESCPH17-1010

PORT OF LOADING:	SHANGHAI, CHINA
PORT OF DISCHARGE:	MANILA, PHILIPPINES
DESCRIPTION:	Anodes.
PACKAGE NO:	2
NET WEIGHT:	5273 KGS
GROSS WEIGHT:	5310 KGS
SUBTOTAL:	84 Pcs

MADE IN CHINA

TIE RODS COMPONENTS





PORT OF VERACRUZ

PORT EXPANSION PROJECT

Project Name	Port of Veracruz Expansion
Location	Veracruz, Mexico
Product	King H Pile (with clutches)
Total Tonnage	1,000 MT
Delivery Date	2017

INTRODUCTION

The Port of Veracruz is located in the Gulf of Mexico off the Atlantic Ocean, its location is strategic for trade between Mexico and the world. It is a leader in cargo movement along with agricultural bulk products and vehicles amongst others.

Additionally, at this moment the first stage of construction is carried out for the expansion of the port of Veracruz, a work of port infrastructure and logistics which will make the zone one of the most important on the American continent. With 54 Maritime Routes, inter-connected with 150 Ports throughout the world Veracruz is a port zone with an ample foreland promoting domestic trades with countries of the 5 continents.

In recent years the Port of Veracruz has undergone modernization of its infrastructure. Having all the necessary infrastructure with perfectly well-designed roadways, lighting, security and access points. They have constructed and put into operation the centre for attention to transport

logistics where transport trucks enter and leave the port zone in a controlled manner. Efficient, secure and offering food and rest stations for transport drivers. The logistics activity zone is a 300-hectare area providing an area for business which give added value to foreign trade goods as well as the distribution centre.

The port of Veracruz is secure have implemented the International Ship and Port Facility Security Code the ISPS Code and have ISO 28000 which provides for the supply chain security.

The Expansion of the Port of Veracruz has begun. The objective is to position it as a modern port zone. According to the new dynamics world trade with first rate infrastructure and equipment, 25 new docking positions will be constructed in two phases, during the first stage the same which is currently under way and which will conclude in 2018 the 4.3 KM long western breakwater will be constructed.

ESC SCOPE OF SUPPLY

KING H PILE (with clutches)

ESC supplied 1000 metric tons of clutched King H Pile ESC-H1180B-1-2 for the combined wall system Grade S430 in 32metre lengths.

The Veracruz Port had purchased several thousand tons of Z profile sheet piles but due to design changes they needed to

convert the sheet piles into a high section profile (due to increased dredge depth of the berth) so the system was converted to a H Pile combi wall. ESC was contacted to manufacture and supply to site the H Pile with clutches that could interlock with the existing hot rolled Z sheet piles.

PROJECT MATERIALS



SHIP LOADING



ON SITE INSTALLATION



NEARING COMPLETION





RAAF AIRCRAFT HANGAR, AUSTRALIA

AIRCRAFT HANGAR PROJECT

Project Name	RAAF Aircraft Hangar
Client	CASA Engineering
Location	Victoria, Australia
Product	Structural Steel Prefabricated Building
Total Tonnage	500 MT
Delivery Date	May 2017

INTRODUCTION

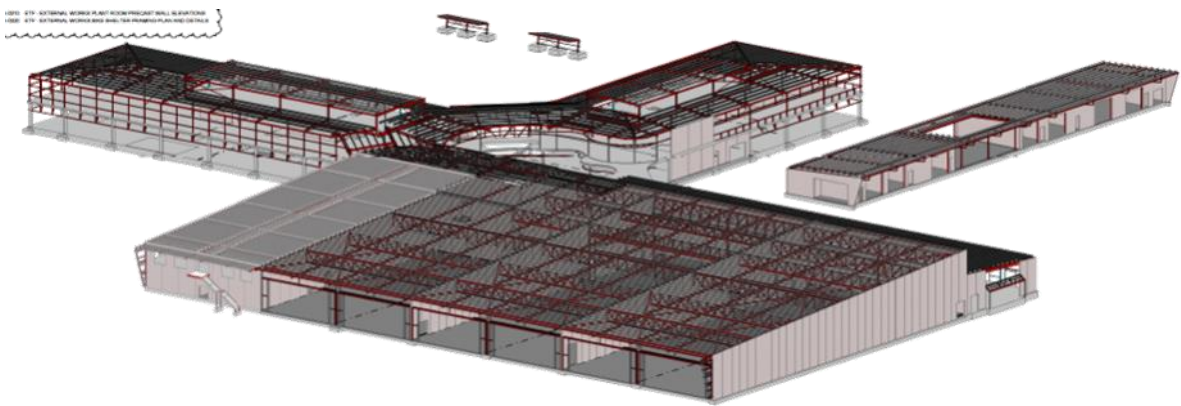
This project is part of the overall investment to deliver facilities, infrastructure and airfield works for the implementation of the PC-21 aircraft which is aimed to be used as part of the Pilot Training System of the Australian Department of Defence. Up to 27 training aircraft could be parked inside the hangar. The structure was designed to have sufficient structural capacity for both wind and earthquake loadings.

The main project standard for the steel pre-engineering building structure was Australian Standard AS 4100 for materials, construction, fabrication and erection. The welds

also required different extent of visual, radiographic and magnetic particle inspection as per AS 1554.1. The steel grades used for the sections and plates varied between Grade 250 and Grade 300. All components delivered were galvanized for corrosion protection. The project required all components to be annealed to over 650°C before the hot-dip galvanizing with a final coating mass of over 600g/m².

The aircraft hangar was fabricated in CASA workshops in Australia which is part of the ESC Group.

ESC successfully completed the full steel fabrication in May 2017.



ESC SCOPE OF SUPPLY

STRUCTURAL SECTIONS

ESC was contracted by one of its regional partners CASA Engineering in Australia to produce over 500 metric tons of structural steel prefabricated building system for an aircraft hangar to be used for the AIR5428 Pilot Training Systems Centre in East Sales, Victoria, Australia.

FABRICATION PHOTOS



INSPECTION OF FABRICATED STEEL



ON-SITE INSTALLATION





RONDOUT TUNNEL PROJECT

TUNNEL CONSTRUCTION PROJECT

Project Name	Rondout Tunnel Project
Client	New York City Environmental Protection (NYC DEP)
Main Subcontractor	Kiewit/Shea JV
Location	New York, USA
Product	Access Chambers
Total Tonnage	335 MT
Delivery Date	2018

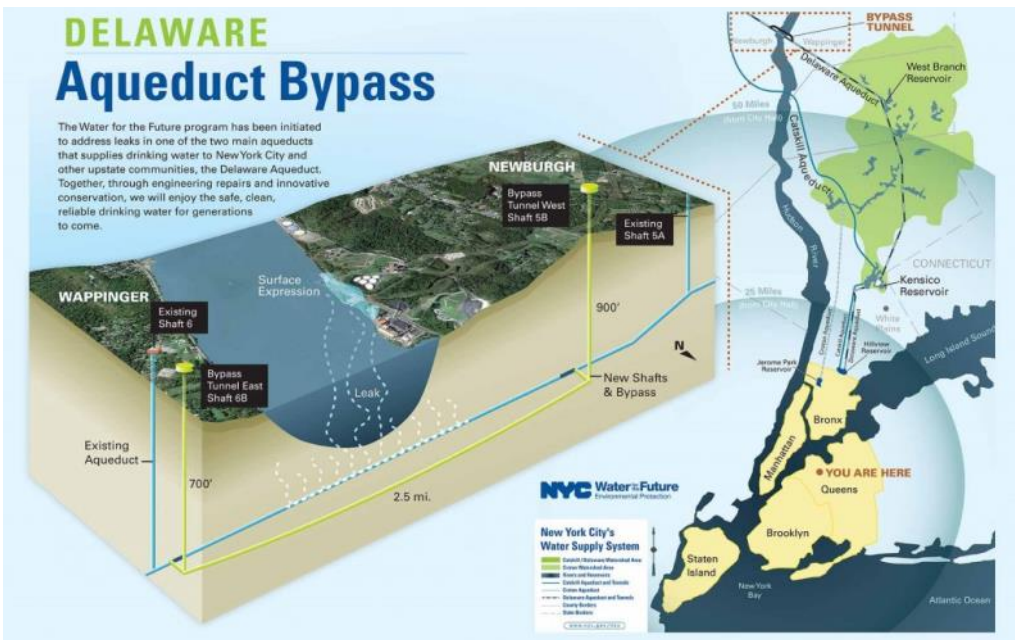
INTRODUCTION

Originally placed into service in 1944, the Rondout-West-Branch Tunnel (RWB) is a section of the Delaware Aqueduct, which supplies nearly 60% of the water for New York City. The aqueduct also is the primary source of water for several upstate communities. The 13.5-foot-diameter (4.1 m) rock RWB Tunnel is approximately 45 miles (72 km) long, ranges in depth from 300 to 2,300 feet (91–701 m), and operates with an internal head of up to 1,200 feet (366 m). It was constructed during the late 1930s and 1940s using drill-and-blast methods. Most of the tunnel has an un-reinforced concrete liner. In areas of poor ground conditions and significant groundwater inflow during construction, steel “interliners” were incorporated in the lining system.

Since about 1970, leakage has been observed at the ground surface, especially in an area immediately west of the Hudson River near Roseton, New York. The geology in this area of the alignment is complex. The depth, from ground surface to the existing tunnel at the Hudson River, ranges from 600 to 900 feet (183–274 m). Rondout-West Branch Tunnel

(RWBT) is currently leaking between 15 and 35 million gallons per day. DEP plans to address the leaks in RWBT by undertaking the RWBT repair program, which consists of:

- Constructing a bypass tunnel around the leaking areas in Roseton.
- Repair of Aqueduct in Wawarsing.
- Developing water supply augmentation projects.



ESC SCOPE OF SUPPLY

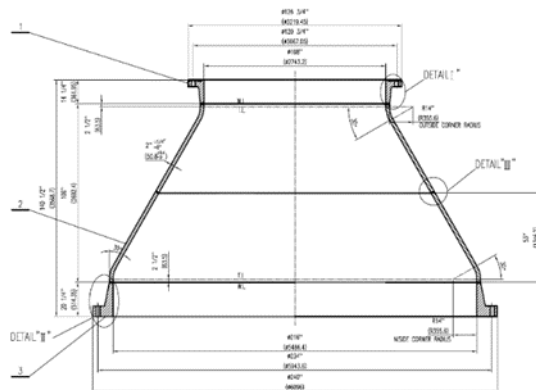
STEEL STRUCTURES

ESC was awarded the supply 2 sets of access chambers for the construction of Rondout west branch bypass tunnel in USA.

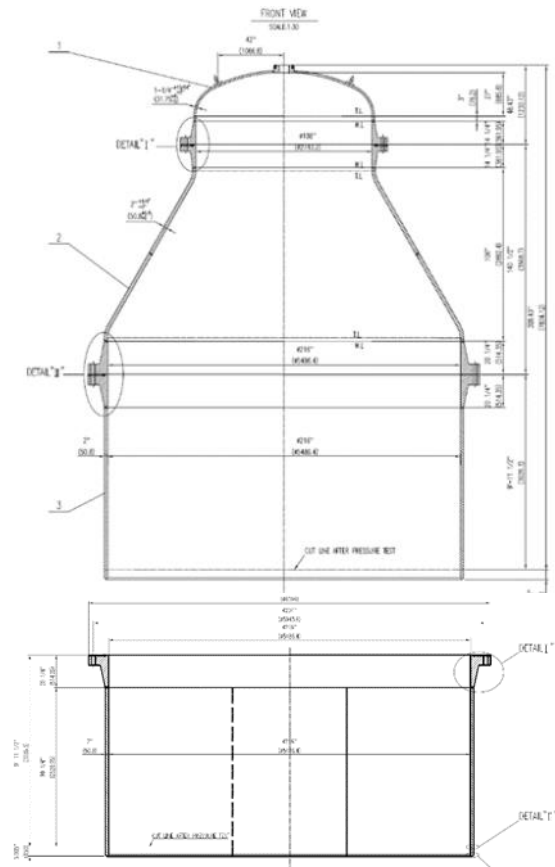
The access chambers are manufactured in accordance with ASME Section VIII – Rules for Construction of Pressure Vessel.

Each set of access chambers consist of the following components:

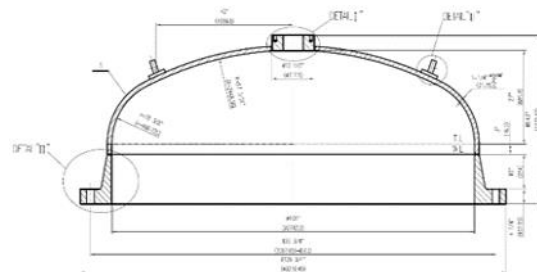
- ▶ Shaft cap with flange
- ▶ Transition fitting with flange
- ▶ Access pipe with flange
- ▶ Other accessories (stud & nut, O-ring, and plug for telltale hole)



Transition Fitting: ASTM A537 Class 1
ID216" & ID108" Flange: ASTM A105(N)

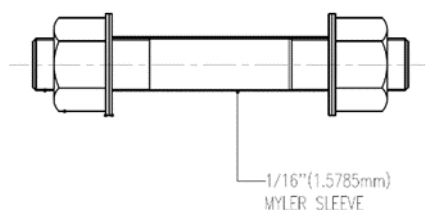


Access Pipe: ASTM A572 Gr.50
ID216" Flange: ASTM A105(N)



Shaft Cap: ASTM A516 Gr.70
ID108" Flange: ASTM A105(N)

STUD, NUT AND WASHER



Size 1 (296 sets, each set with 2 phenolic washers & 2 plain washers): Stud 2 1/4"-4.5UNC-2A, L20", ASTM A564/A564M Gr.630 H1150; Heavy Hex Nut 2 1/4"-4.5UNC-2B, ASTM A564/A564M Gr.630 H1150

Size 2: (144 sets, each set with 2 phenolic washers & 2 plain washers): Stud 2"-4.5UNC-2A, L=14 1/2", ASTM A564/A564M Gr.630 H1150; Heavy Hex Nut 2"-4.5UNC-2B, ASTM A564/A564M Gr.630 H1150

Size 3: (24 sets, without washer): Stud 3/4"-10UNC-2A, L4.5", ASTM A193/A193M Class 2:B8M, Nut 3/4"-10UNC-2B, ASTM A194/A194M 8M

All studs are required to be tested via a tensile test, impact test, and hardness test.

All nuts are required to be tested via a hardness test and a proof load test.

3/4" nut proof load shall be at least 133.5kN

2" nut proof load shall be at least 701kN

2 1/4" nut proof load shall be at least 911kN

There are very limited stud & nut manufacturer or testing lab in China that possess the capability to test the proof load for nut of 2" (701kN) and 2 1/4" (911kN). ESC sent these nuts to a government CNAS test lab in order to perform the proof load test for the 2" and 2 1/4" nut.

CLIENT AUDIT



Client representatives from NYC DEP and Kiewit performed supplier audit prior to the commencement of the project. The scope of this audit included the main fabricator's facility and other components supplier's facilities (shaft cap, flange, transition fitting, access pipe, stud and nut, and O-ring).



INCOMING MATERIAL INSPECTION



An inspector from NYC DEP and ESC own QA/QC staff were based in the workshop to witness the entire fabrication process from incoming raw material inspection to the painting process.

Samples are cut from each material to perform in-house mechanical properties and chemical composition retest for each heat number.

Another set of samples from each heat number is couriered to the USA for client retest in their lab.

A 100% lamination ultrasonic test is performed on each material (flanges and steel plates).

FABRICATION OF FLANGES & OTHER ACCESSORIES



FABRICATION OF SHAFT CAPS



Picture 1 – Forming of Shaft Cap

Picture 2 – Shaft cap welded with accessories (lifting lug & shaft cap insert) and tack welded with flange.



Picture 3 – Welding of shaft cap with flange

Picture 4 – Shaft cap welded with flange

FABRICATION OF TRANSITION FITTINGS



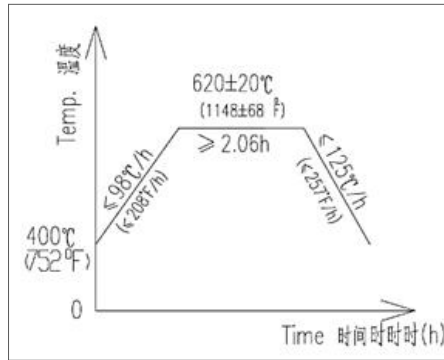
FABRICATION OF ACCESS PIPES



POST WELD HEAT TREATMENT

Each part of the access chamber (shaft cap, transition fitting, and access pipe) are heat treated separately after the welding process.

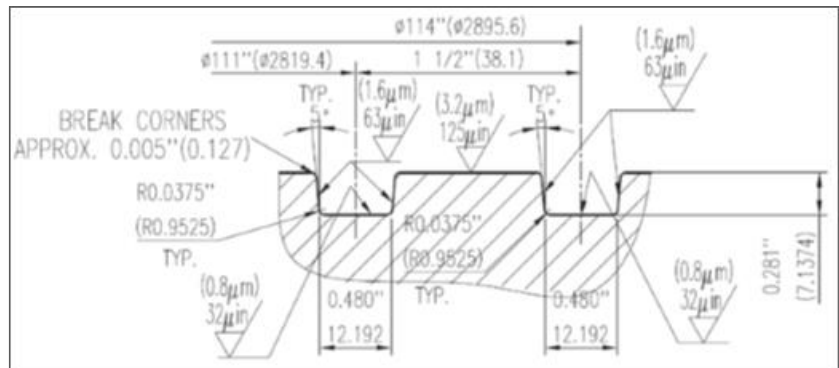
Each part is braced before the heat treatment process to prevent deformation.



Surface roughness requirements:

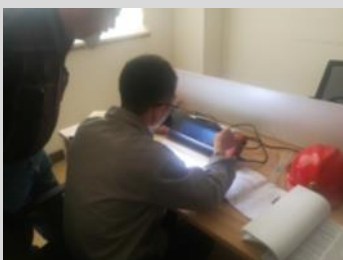
The flange face is machined to achieve the surface roughness requirements of $R_a = 0.8\mu\text{m}$ (for O-ring groove seating surface), $1.6\mu\text{m}$ (for O-ring groove wall), and $3.2\mu\text{m}$ (flange sealing face) in accordance with ASME B46.1.

FINAL MACHINING



INSPECTION

1. 100% RT performed on all full penetration welds.
2. 100% PT performed on root pass after back gouging for butt welding.
3. Perform PT and thickness inspection on surface where temporary attachment are cut removed.
4. Perform mechanical test using the welding test plate prepared during actual production.



HYDROSTATIC TEST (BOLT TORQUEING)

All nut with "P" and "T" marking. Only nut with "T" marking are used during hydrostatic test, and will be discarded after hydrostatic test.

All studs & nuts are tightened using a hydraulic torque wrench.

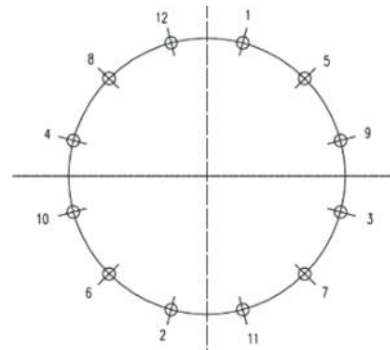
The required stud & nut tension force for ID108" flange is



72,000lbf and for ID216" flange is 110,000lbf.

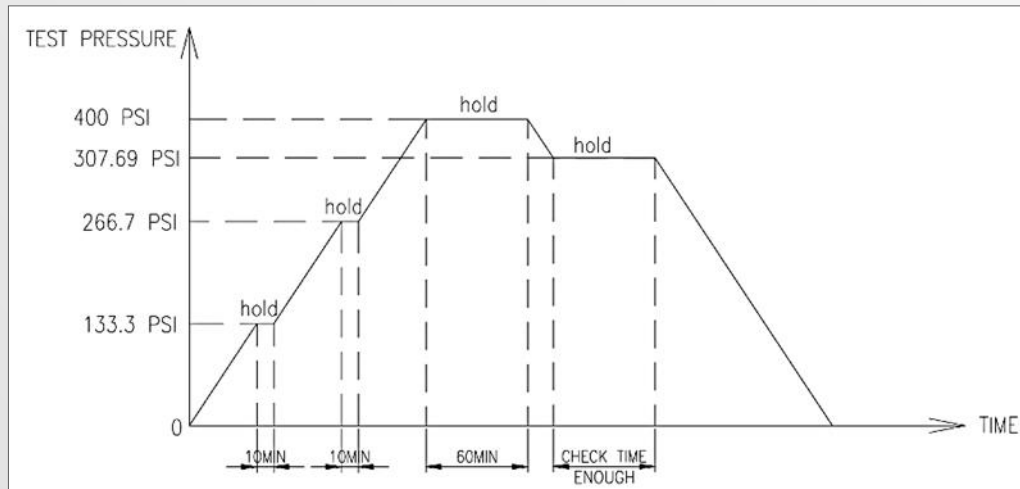
The required torque in order to achieve the tension force is calibrated using a Skidmore Wilhelm Model K-100 before the stud and nut are assembled.

All studs and nuts are tightened using multi-pass tightening torque at 50%, 80%, and 100% final target torque. The studs and nuts are tightened according to the star pattern. Thread of the studs are lubricated with molybdenum disulphide grease prior to tightening process.



HYDROSTATIC TEST

Hydrostatic test pressure equal to 400psi applied gradually for a period not less than 10 minutes at stage 1/3 (133.3psi), 2/3 (266.7psi), and full max pressure (400psi) not less than 60 minutes. The water temperature for the hydrostatic test is controlled to ensure that it is more than 4.5°C. Overall inspection on all welds and sealed surface is carried out at the pressure of 307.69psi to ensure no leakage (check the pressure gage, no pressure drop is allowed).



BLASTING & PAINTING

Surface preparation: blasting to Sa2.5, surface roughness inspection, ambient condition inspection, and dust test.

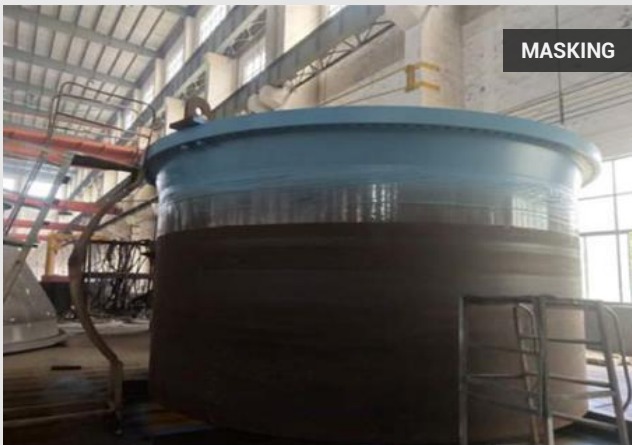
Surface cleanliness: Sa2.5

Paint: PPG Amerlock 400 epoxy

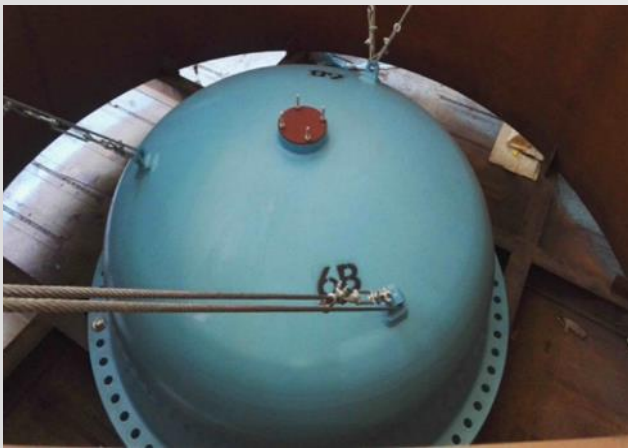
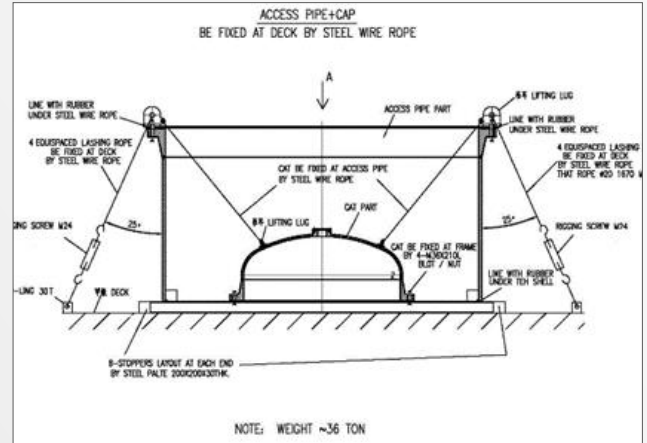
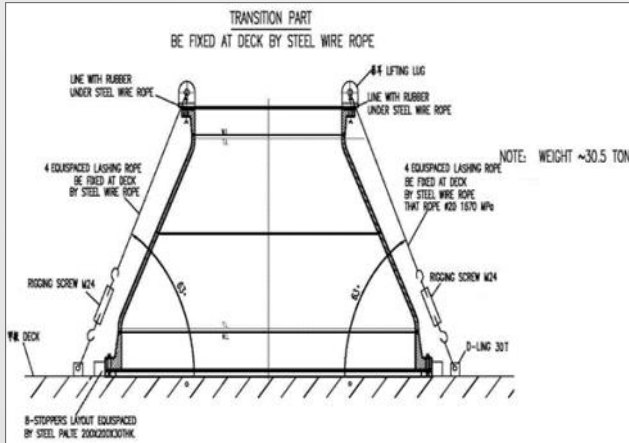
Total DFT: 229 ~ 381μ



100% LOW VOLTAGE CONTINUITY TEST CARRIED OUT IN ACCORDANCE WITH NACE SP0188 ON EACH LAYER OF PAINT



PACKING



The packing method for each component (base seating for shaft cap and access pipe, lashing method, and lifting lug size) are calculated by the engineer to ensure its is cost effective and safe during the shipping process.

Flanges are protected by bolted plywood covers on each flange after application of slush oil and wrapping with oil impregnated Kraft paper for corrosion protection.

SHIPPING





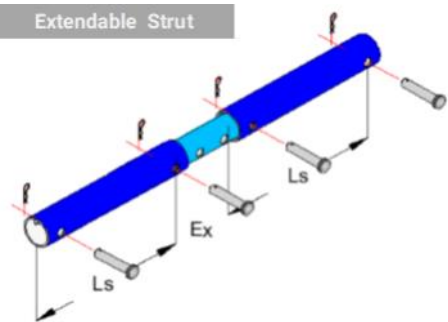
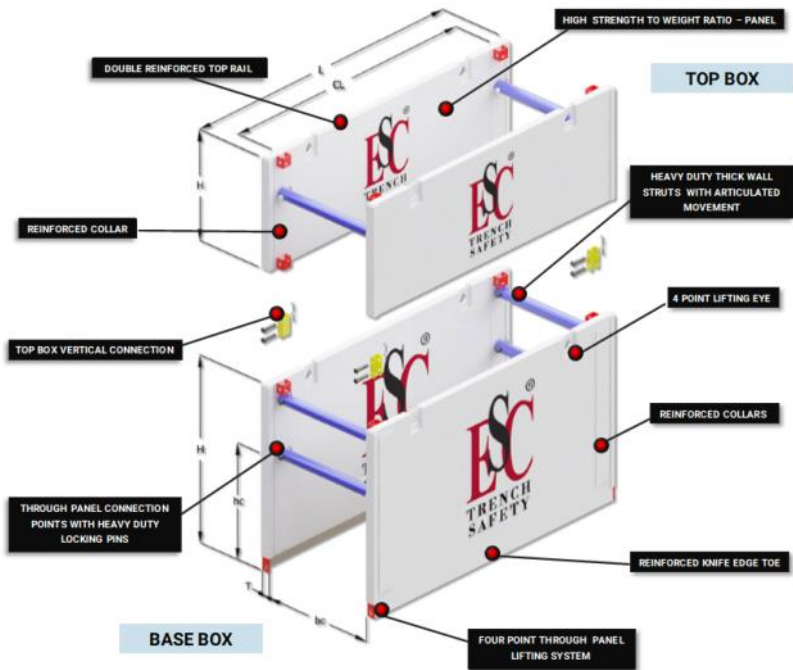
SEWER NETWORK, UAE

REPAIR & REHABILITATION PROJECT

Project Name	Sewer Network
Client	Abu Dhabi Sewerage Services Company (ADSSC)
ESC Client	Mechanical and Civil Engineering Contractors (MACE)
Location	Abu Dhabi, UAE
Product	Trench Box
Quantity	10 pcs.

INTRODUCTION

The scope of work involved trench excavation about 2.4m~2.5m depth. A total of 480LM of trench excavation is planned by using ESC Trench Boxes. Due to the nature of the trench width, the project required Trench Boxes with the Variable Struts.



EXTENDABLE LENGTH STRUT COMBINATIONS						
SN Strut	SI Strut	Extension Length Ex				Weight (per strut) (kg)
		MIN (mm)	MAX (mm)	Increments (nos)	Increment Length (mm)	
SN 50	SI 70	1000	1300	2	150	46.6
SN 60	SI 70	1200	1500	2	150	52.8
SN 80	SI 120	1600	2200	4	150	76.4
SN 100	SI 160	2000	2800	4	200	97.7
SN 120	SI 200	2400	3600	6	200	119.0

Schematic view of the ESC Trench Boxes with Variable Struts .

ESC SCOPE OF SUPPLY

TRENCH BOX

ESC has supplied TB40/10/24 Trench Boxes (Pic 1) with customized extendable struts. These Trench Boxes are 4m in length and 2.4m in height and come with fixed as well as variable struts option. The struts SN60 (fixed unit) together with the variable unit SI (c) 90 has the ability to vary the width of the

Trench Box from a minimum of 1.2m to a maximum of 1.7m.

A total of 10 TB40/10/24 Boxes are supplied with the intention of re-using over 12 sewerage lines each spanning 40LM in a phased manner to carry out the intended sewerage network rehabilitation works.



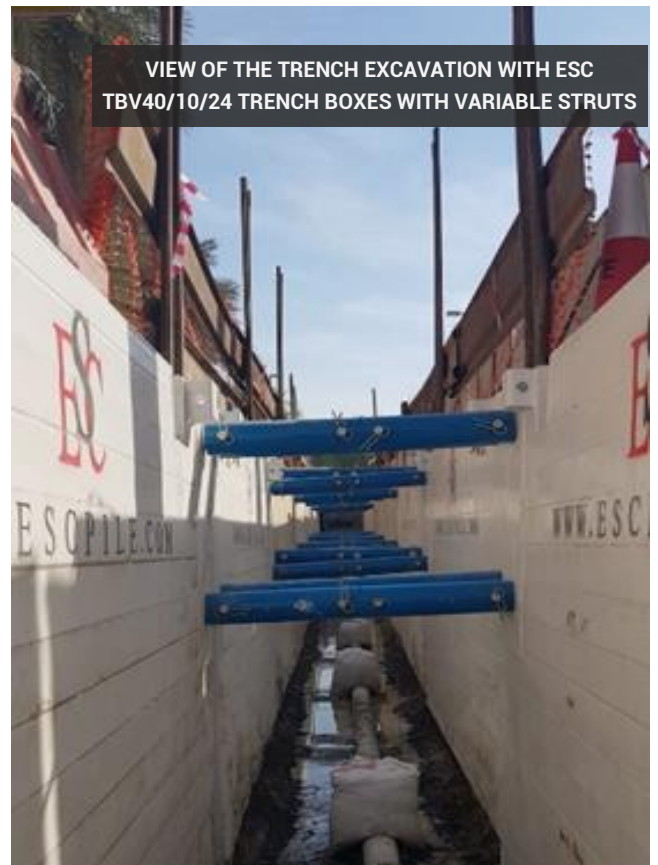
TRENCH BOXES BEING MANUFACTURED
ESC ABU DHABI YARD



ESC TBV40/10/24 TRENCH BOXES WITH VARIABLE
STRUTS BEING DELIVERED TO CONSTRUCTION



VIEW OF THE TRENCH EXCAVATION WITH ESC
TBV40/10/24 TRENCH BOXES WITH VARIABLE STRUTS



VIEW OF THE TRENCH EXCAVATION WITH ESC
TBV40/10/24 TRENCH BOXES WITH VARIABLE STRUTS



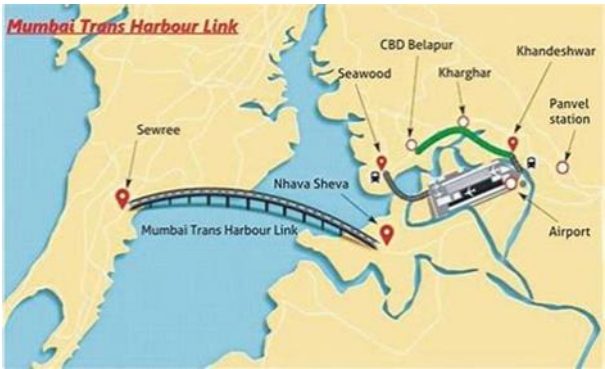
MUMBAI TRANS HARBOUR LINK PROJECT PACKAGE I

TEMPORARY ACCESS BRIDGE PROJECT

Project Name	Mumbai Trans Harbour Link Project Package I
Owner	Mumbai Metropolitan Regional Development Authority
Contractor	L&T – IHI Consortium
Location	Mumbai, India
Product	Bridge Girders
Quantity	2,780MT
Delivery Date	April 2019

INTRODUCTION

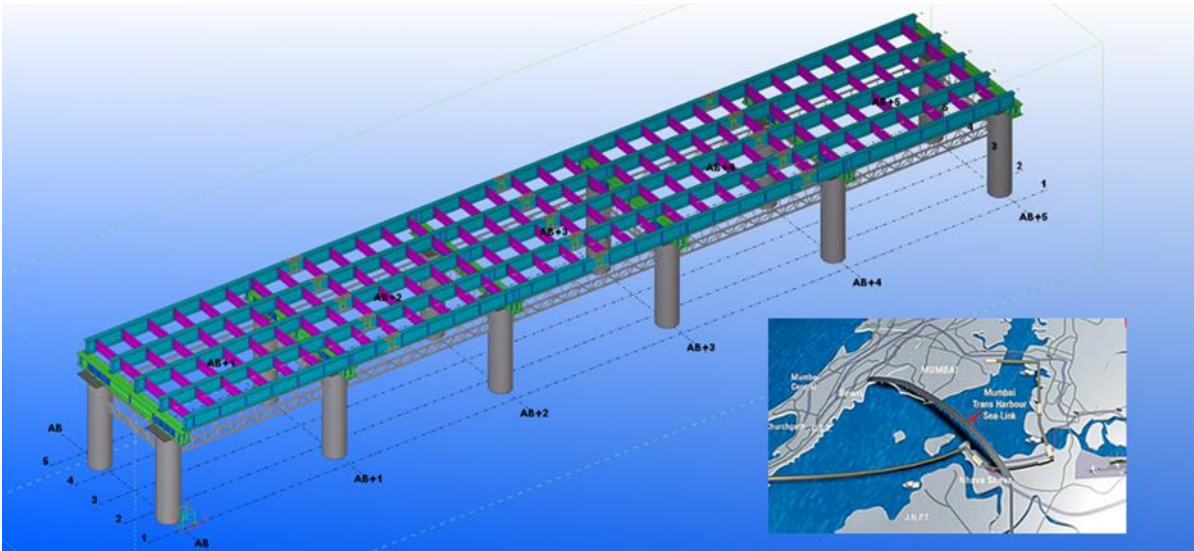
The Mumbai Trans Harbour Link (MTHL), is an under-construction 21.8 km, freeway grade road bridge connecting the Indian city of Mumbai with Navi Mumbai, its satellite city. When completed, it would be the longest sea bridge in India. The sea link will contain a 6 lanes highway, which will be 27 meters in width, in addition to two emergency exit lanes, edge strip and crash barrier.



ESC SCOPE OF SUPPLY

BRIDGE COMPONENTS

ESC was awarded the scope of work for full steel fabrication works for bridge girders, cross beams, floor beams, and decking panels for a total length of over 960 meters in Mumbai, India.



INCOMING MATERIAL INSPECTION

Material Grade: ASTM A36/A36M or GB/T700 Q235B with yield strength min. 250 MPa

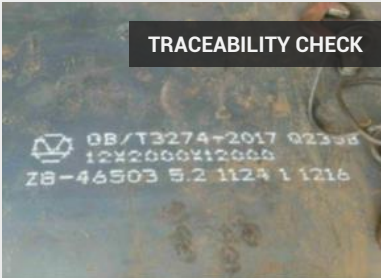
All raw materials are visually inspected, dimension checked, traceability checked, and review mill test certificate during the incoming process. Major components will be retested in 3rd party lab to ensure the mechanical properties and chemical compositions are acceptable.



RECTANGULAR BARS



DIMENSION INSPECTION



TRACEABILITY CHECK



C CHANNEL



PLATE CUT & MARKED FOR RETEST



MATERIAL RETEST

PRODUCTION PROCESSES

DECK PANEL



FLOOR BEAM



Welding Procedure : ASME Section IX
 NDT: AWS D1.1 (100% VT, 10% MT/PT – PJP Welds, 20% UT – CJP Welds)



ULTRASONIC TEST



DRY PENETRANT TEST



MAIN BEAM

TRIAL ASSEMBLY



Trial Assembled Main Girders, Cross Beams and Splice Plate.



MEASURE PIER LOCATION LEVEL



DIMENSION INSPECTION



Trial Assembled Deck Panel.



PAINTING

Painting System: Fast-drying Epoxy Iron Red Primer

Color: Red

Total DFT: 70 microns

Application Method: Airless Spray



DECK PANEL



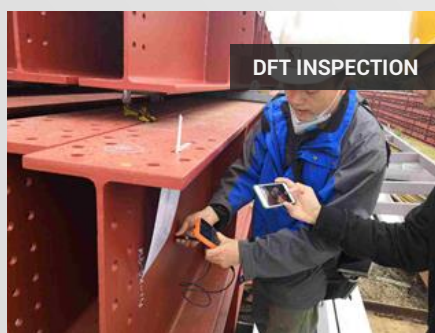
MAIN BEAM



CROSS BEAM



SPLICE PLATE



DFT INSPECTION



PACKING, STACKING AND EX-MILL



ARRIVAL IN PORT STORAGE YARD

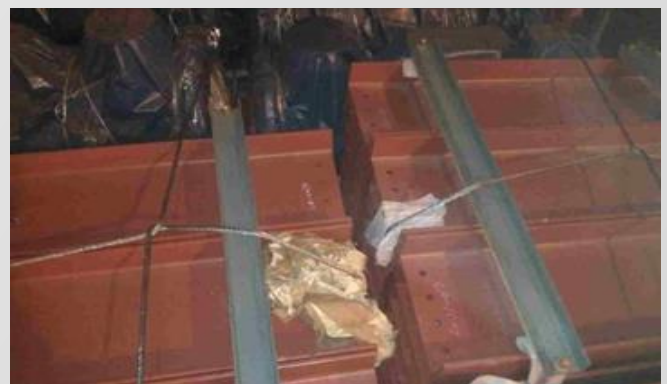
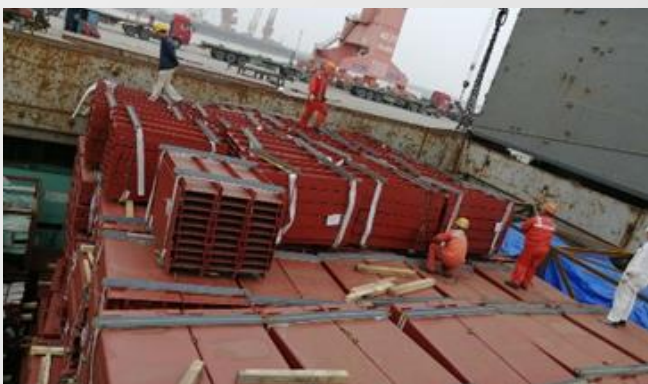


SHIP LOADING

ESC has assigned inspectors to monitor the entire ship loading process to ensure safe, secure, and sufficient protection to prevent damages during the shipping process. Soft sling is used to prevent damages



STACKING, LASHING AND PROTECT IN SHIP



INSTALLATION ON SITE



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