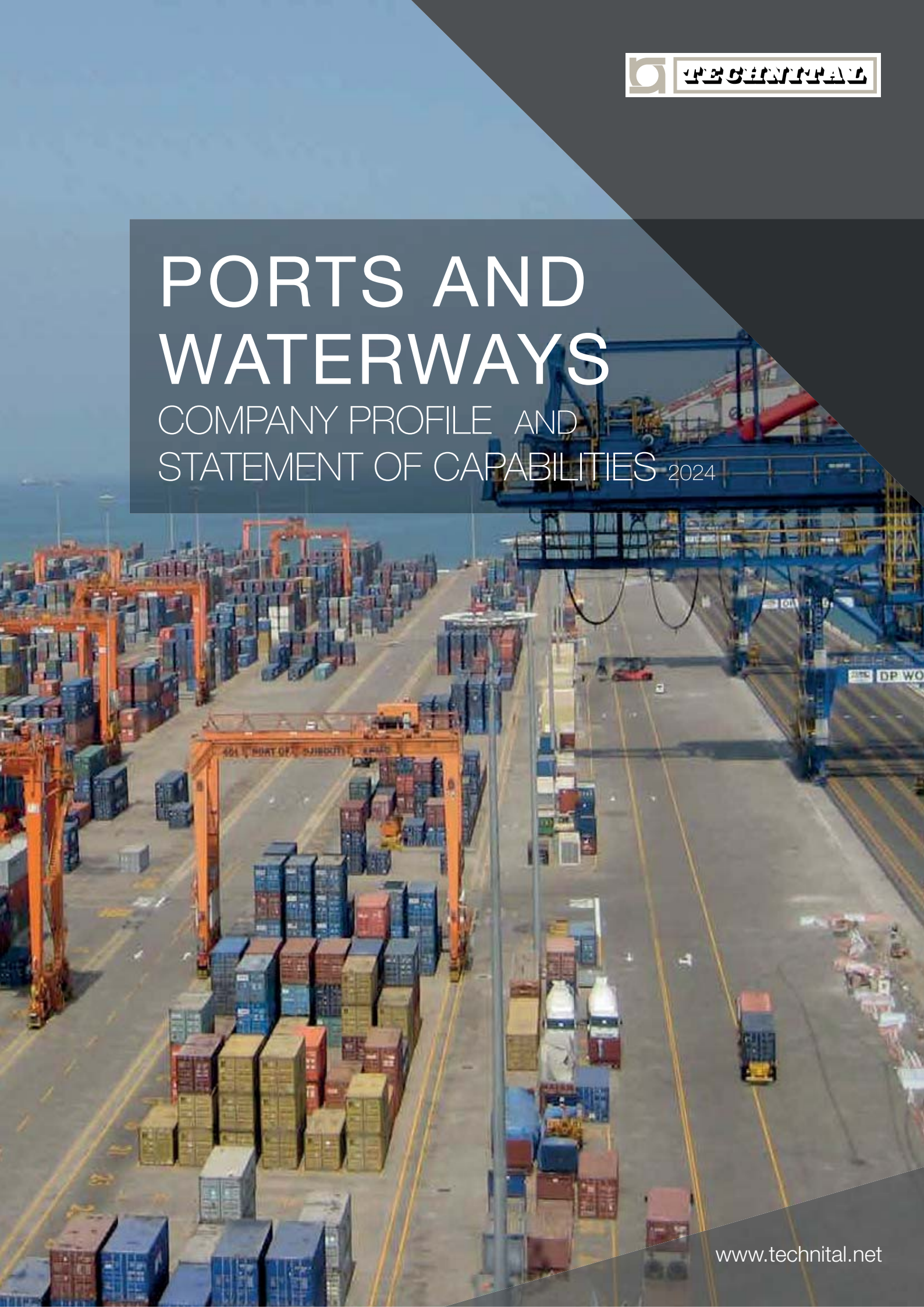
TECHNITAL

PORTS AND WATERWAYS

COMPANY PROFILE AND STATEMENT OF CAPABILITIES 2024



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1 Company Profile

About TECHNITAL

Description

TECHNITAL is a private joint stock company established more than 50 years ago (in 1964) and is one of the oldest engineering consultancy companies in Italy. Thanks to its high level of expertise, its dynamic nature and versatility, management autonomy and efficiency and its sophisticated hardware equipment and software libraries, the Company has been awarded large scale international and national projects by major public and private entities and by international funding organizations.

TECHNITAL's headquarters are situated in Verona, Italy. The organization abroad includes 15 between branches and subsidiaries in Algeria, Armenia, Benin, Bosnia & Herzegovina, Croatia, Georgia, Iraq, Kenya, Kosovo, Qatar, Tanzania, Trinidad & Tobago, Tunisia, Uruguay and Zambia and a number of local offices which is continuously changing according to the on-going international projects (at the moment there are 4 local site offices).

Services

TECHNITAL is a dynamic company working in the fields of transport infrastructure (roads and motorways, railways, inland waterways, urban transport, ports and airports), hydraulics (water treatment and desalination plants, dams, aqueducts, sewerage systems, waste water treatment), marine and coastal engineering, environment, energy (incineration and waste-to-energy plants, hydroelectric plants, solar plants, biogas plants), waste treatment (recycling plants, dump sites), buildings, architecture and urban planning.

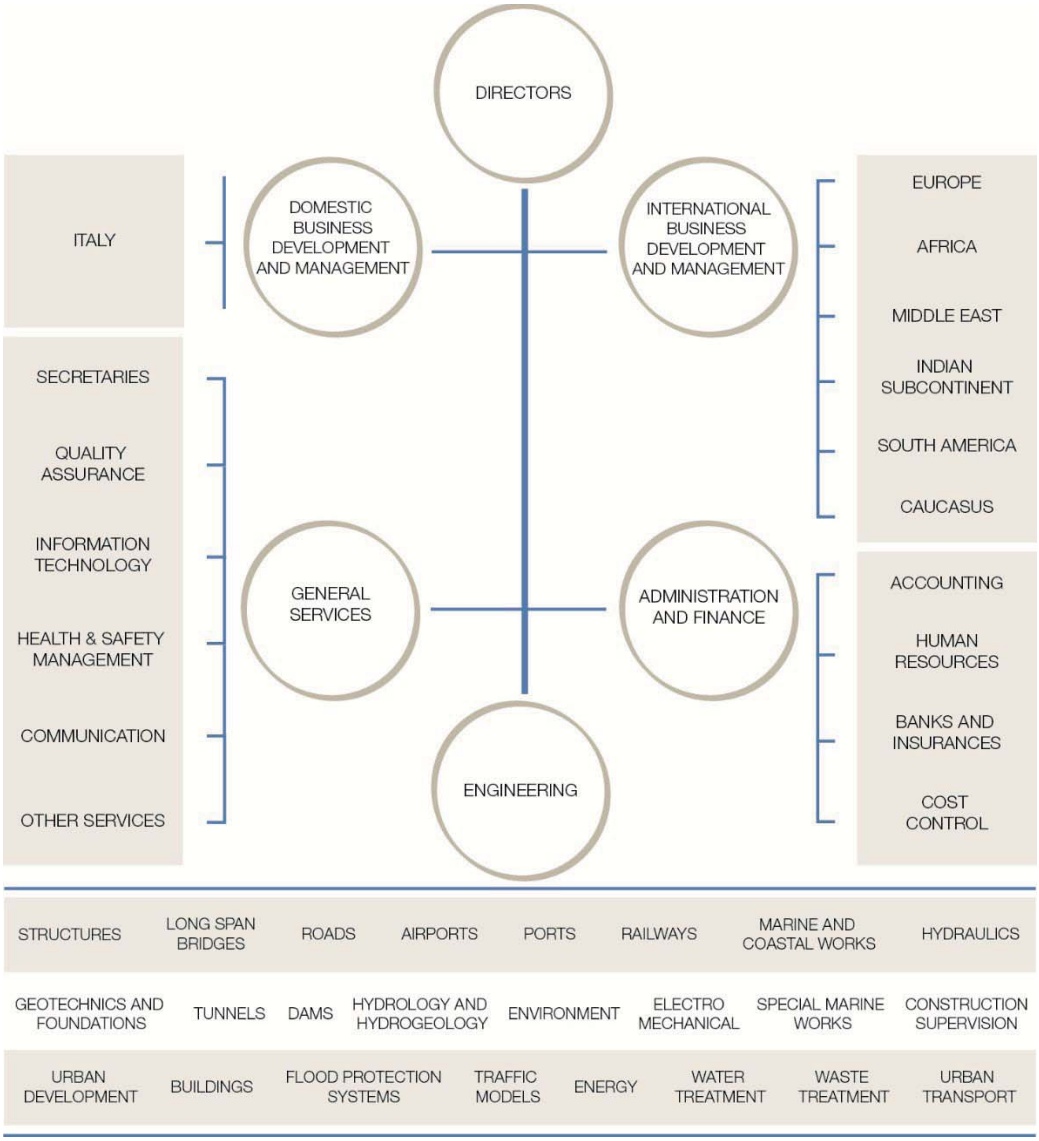
The company covers the full range of services, from planning and feasibility studies through to detailed design, works supervision and technical assistance:

- project management
- planning and economic-financial evaluation of investments
- feasibility studies and technical-economic evaluations
- all levels of design
- environmental impact assessment and studies
- traffic studies
- procurement and assistance with tenders
- construction supervision, quality assurance, testing and commissioning
- co-ordination and supervision of research and laboratory tests
- development of hydrodynamic and hydrogeological analysis and simulations
- development and application of analysis methods and computer modelling.

TECHNITAL has worked in several countries world-wide: Afghanistan, Albania, Algeria, Angola, Argentina, Armenia, Australia, Austria, Bahamas, Benin, Bolivia, Bosnia & Herzegovina, Brazil, Bulgaria, Burkina Faso, Burundi, Cayman Islands, Colombia, Croatia, Cuba, Cyprus, Czech Republic, Democratic Republic of Congo, Denmark, Djibouti, Dominican Republic, Egypt, Ethiopia, Georgia, Germany, Ghana, Greece, Guatemala, Hungary, India, Iraq, Italy, Jordan, Kenya, Kosovo, Libya, Madagascar, Malawi, Malaysia, Mali, Mauritania, Monaco, Montenegro, Mozambique, Nicaragua, Niger, Norway, Panama, Peru, Poland, Qatar, Republic of Haiti, Romania, Russia, Rwanda, Saudi Arabia, Senegal, Slovenia, Somalia, Spain, Sudan, Syria, Tanzania, Togo, Trinidad & Tobago, Turkey, Uganda, Ukraine, U.A.E., United Kingdom, U.S.A., Uruguay, Venezuela, Yemen, Zambia.

Organization and staffing

TECHNITAL's multidisciplinary staff is organized according to the following chart:



TECHNITAL's multidisciplinary staff includes about 250 professional employees covering the various aspects of the engineering services: Transport, Hydraulics, Geotechnical, Marine & Coastal, Environmental Studies & Territorial Analysis, Structures, Electronic Data Processing & Systems Analysis, Quantity Surveying & Cost Estimation, Electromechanics, BIM/CAD/CAE, Works Supervision, etc.

The above staff is integrated by consultants and specialists, both Italian and foreign. Seeking support and advice from colleagues, scientists, and academics all over the world is part of TECHNITAL's policy of excellence.

Given the firm's considerable international experience, TECHNITAL's staff is proficient in the use of international engineering standards (BS, ASTM, AASHTO, ASME, API and the like) and contract conditions (FIDIC and others).

Quality control

TECHNITAL's activity is ISO 9001:2015 Quality System Management certified. The company is also certified ISO 14001:2015 Environmental Quality Management, ISO 45001:2018 Occupational Health and Safety Management System and SA 8000:2014 Social Accountability Management System.

TECHNITAL has developed a company policy regarding quality control which is constantly being updated and applied, taking into account the costs to be sustained to achieve the objectives of quality and maximum benefit for both the Company and the Client. Thanks to its Quality Control System, TECHNITAL is capable of guaranteeing the quality of its services and of ensuring the Client that these services satisfy the required quality standards.

Code of Ethics

Ethical and responsible decision making is very important for the company in terms of risk management and in order to keep actions within the ethical and legal boundaries.

For that reason, the company is adopting a Code of Ethics (available from the web site of the company) and conduct for its Executives and Directors and for all the Employees able to fulfil requirements for responsible decision taking. Such code aims at reducing the possibility of stepping outside behavioral limits set by the company.

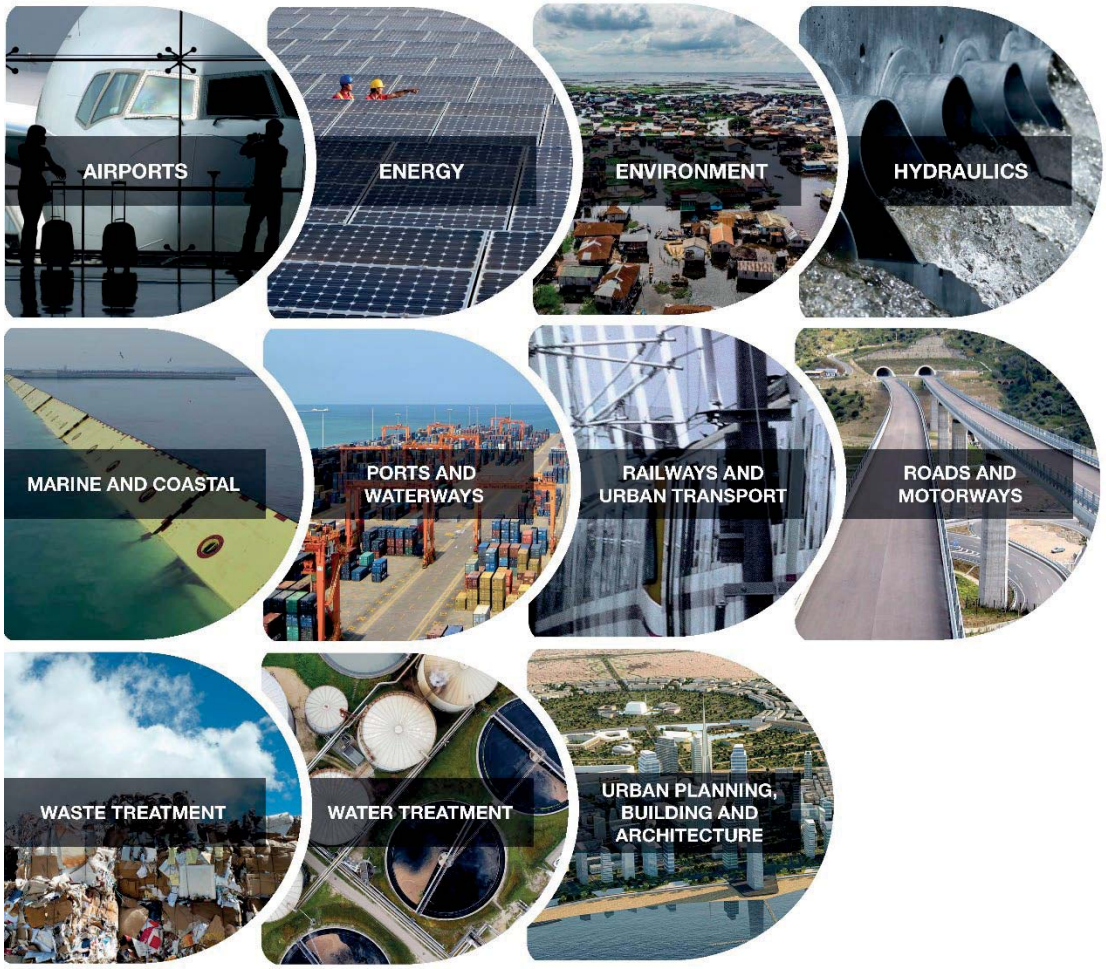
The Code of Ethics the company is adopting also meets the Organization, Management and Control Model pursuant to Italian Legislative Decree n. 231/2001.

Sectors of Specialization

TECHNITAL provides high-quality consultancy services in different areas of specialization: Roads and Motorways, Railways and Urban Transport, Airports, Ports and Waterways, Marine and Coastal Engineering, Environmental Engineering, Urban Planning, Buildings and Architecture, Hydraulic Engineering, Water Treatment, Waste Treatment, Energy.

In each of these sectors, TECHNITAL provides innovative project solutions to Government Agencies, International Financial Institutions and Private Sector Organizations.

Services provided by TECHNITAL include master plans, feasibility studies, techno-economical evaluations, traffic studies, mathematical and physical modeling, all phases of design from concept to detailed design, environmental impact studies and monitoring plans, tender document preparation and assistance in the procurement of works, construction supervision.



2 Our Experience

Experience in Ports and Waterways

TECHNITAL has a vast international expertise in all engineering consultancy services related to maritime transportation, providing state-of-the-art solutions for ports and waterways infrastructure.

(For marine and costal engineering projects, please refer to "Marine and Costal Engineering" brochure).

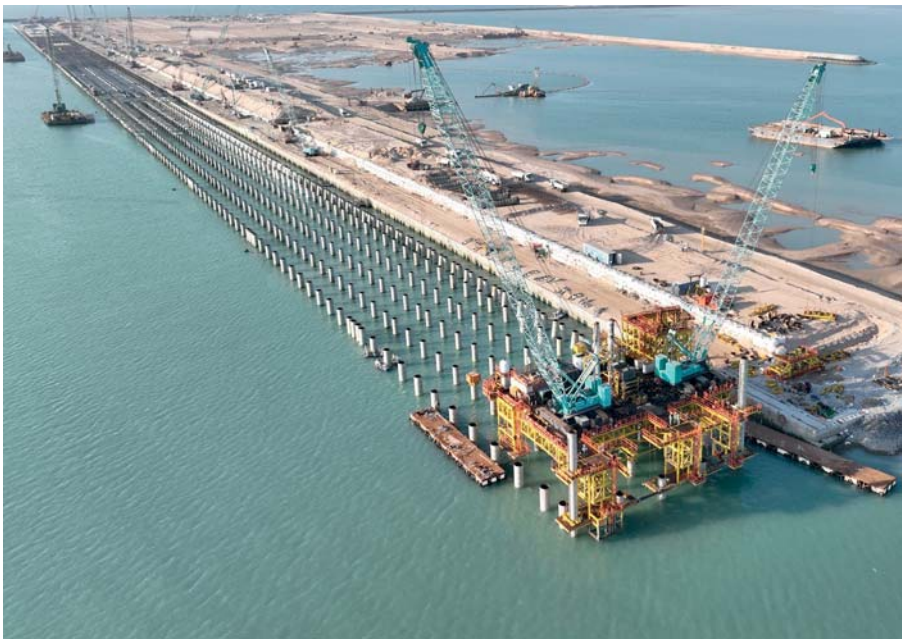
Port engineering is a multi-disciplinary expertise which incorporates logistical, nautical, environmental, topographical, geotechnical and structural aspects. TECHNITAL provides tailor-made solutions for industrial and commercial ports, terminals, quays and breakwaters, small harbours and marinas, navigation locks and refuge harbours, port master plans and logistic studies.

Following the feasibility study for the **New Al Faw Grand Port in Iraq** completed in 2008, TECHNITAL was awarded in 2010 the Contract for the Engineering Consultancy Services for the new port consisting in design services, tender documents, assistance during tender and work supervision. The port will be located along the Kawr Abdallah Channel, near the Shatt Al Arab mouth, in Iraq. The new port shall be capable to move about 36 million tons of containerized freight (4 million of TEU) and about 22 million tons of dry bulk by 2028, to be increased respectively to 7.5 million of TEU and 33 million of tons respectively by 2038. The depth of the quays (-17.5 m) will allow the operation of the new generation of container ships. The special quays for the operation of container ships will be 7,000 m long (about 20 berths). The quays specialized in moving dry bulk will be 3,500 m long (about 12 berths). A dredged channel 400 m wide and 24 km long will connect the new port to the deep water; dredged volumes will be approximately 60.000.000 m3 for the navigation channel and 82.000.000 m3 for the port basins, protected by rubble mound breakwaters approximately 15 km long. The project includes 2.000.000 m2 of yard for terminal container stacking, 600.000 m2 for dry bulk yards and 1.000.000 m2 of land yard for buildings and warehouses 200.000 m3 of silos for wheat. A double lane road (2.000-3.000 commercial vehicles during peak hours) and a double track railway (80-90 couples of train/day) will connect the new port to the existing transport network.

At present, TECHNITAL is carrying out the works supervision. The works are implemented in lots and they are deemed to last some years due to the size of the investment (i.e. estimated to be around 10,5 billion Euro in the final configuration).

East Breakwater at Al Faw Port – Iraq

Caissons under construction - Al Faw Port, Iraq



Front view of quay wall - Al Faw Port – Iraq

As a particular case study, it is worth mentioning the new “unmanned” **Multipurpose Platform in Vado Ligure in Italy**, designed by TECHNITAL from preliminary through to detailed design for the Port Authority of Savona (Italy). The works designed include a platform 700 m long and 300 m wide, including container, oil and bulk cargo quays, to comprise a mainly open structure with a filled area at the landward end. The structural solution for the open part of the platform consists of reinforced concrete caissons, pre-cast and flooded, founded on a rock layer placed on a transition granular layer overlying the existing soil, which must be properly consolidated. For the upper deck, a system of pre-cast and pre-stressed beams has been designed.

Multipurpose Platform in Vado Ligure– Italy

The company has recently started the activities for the rehabilitation of **Ravenna Port Hub.** The project consists in the detailed design of the dredging of the port of Ravenna (of about 5 mil cubic meters including main channel and secondary channels), of the rehabilitation and structural upgrading of 2,5 km of existing quays, of new container terminal (1.0 km length approximately).

Layout of the Ravenna Port Hub – Italy

The company has also recently undertaken the **Feasibility Study of the new Breakwater of the Port of Genova.** The new breakwater will be 6.200 m long and the demolition of the existing breakwater of 3.900 m is part of the project. The breakwater will reach 50 m of depth and it will be made by a mixed structure between rubble mound and caissons. The breakwater will also host a wind farm for a length of 3.0 km. The overall cost is estimated to be 1,2 billion euro.

New Breakwater of the Port of Genova - Italy

TECHNITAL has also carried out two contracts related to the yard extension works in the container terminal of **Port of Constanta in Romania**, on behalf of DP World, involving a pavement evaluation study, and the Design review and construction supervision of a new container yard.

Port of Constanta - Romania

For the same client TECHNITAL carried out the design verification and the works supervision of the new industrial and commercial port at Doraleh in Djibouti, which involved the partial relocation of the existing port facilities at a new site away from the urban area of Djibouti and the re-organization and expansion of port-handling operations to cope with the new traffic demands.

The old port of Djibouti, which was the sole outlet for Ethiopia, was no longer capable of handling the growing traffic demand and represented a serious environmental hazard to the adjacent urban areas. The new port has been located at a safe distance from the urban development and include new oil and container terminals, storage areas, access roads, port handling facilities etc.

The Doraleh Container Terminal is now considered the most important container port of the Red Sea and it's the southern gateway to Suez Canal.

New industrial and commercial port at Doraleh - Djibouti

Doraleh Container Terminal – Djibouti

For the **new industrial Port of Ras Laffan in Qatar**, TECHNITAL carried out the preliminary design of the layout, the preliminary design of the breakwaters in natural and artificial materials; the basic and preliminary design of a jetty with four LNG berths for gas carriers of the 135.000 m^3 class; the basic and preliminary design of two (out of six planned) LPG and other liquid products berths for tankers ranging in size between 20.000 and 70.000 DWT; and the environmental impact study of the new port, especially in relation to the modifications to the littoral drift and to the interference with the outfalls of industrial plants.

Port of Ras Laffan-Qatar

Breakwater – Port of Ras Laffan -Qatar

TECHNITAL has recently completed the **Feasibility Study for the Dredging of Dar es Salaam Port Entrance Channel and turning basin in Tanzania** and It has started a new contract for the **Detailed Design and Tender Documents** preparation for the same. The project aimed at ensuring the possibility for post-Panamax to access to the port facilities. The activities have covered all surveys (bathymetry, hydrodynamics, geotechnics, water quality), mathematical models for the hydrodynamic and sedimentation aspects, real-time simulation of manoeuvring, alternatives assessment and their comparison by a cost-benefits analysis.

Entrance Channel and turning basin of Dar es Salaam – Tanzania

Recently, TECHNITAL has been awarded a number of Port projects including the Preliminary Design for Galeota Port (Phase II) and the Master Plan and Preliminary Design for Brighton Port in Trinidad and Tobago, the Works Supervision for Port Goubet and the Post-Contract Professional General and Site Supervision for the Port of Tadjoura in the Republic of Djibouti.

Other significant international projects include:

- dredging of port basins and channels at **Al Wakrah and Al Khor in Qatar**
- rehabilitation works in the **Ports of Poti and Batumi in Georgia** (European Union – TACIS Program), including breakwater restructuring, wrecks salvaging, procurement and installation of navigation equipment, staff training;
- rehabilitation works in the **Port of Durres in Albania** (World Bank), including the detailed design for the rehabilitation of quay walls, breakwater, service areas, port accesses;
- design and environmental impact study for the implementation of a **new bunkering plant at Troiza Bay, Russia.**
- Design review and construction supervision of new container yard in **Constanta Port, Romania.**

Expansion of Al Wakrah port - Qatar

In Italy, TECHNITAL has also carried out numerous marine engineering projects, among which:

- design of quays for the **container terminals of Civitavecchia**, **Vado Ligure** (Savona), **Gioa Tauro** and **Livorno**
- new **master plans** for the ports of **Trieste** and **Livorno**
- design of the breakwater rehabilitation in the port of Gela (Sicily)
- new **ferry terminal at Tremestieri** (Messina - Sicily) for the traffic crossing the Messina Strait between Sicily and the mainland)
- **tourist harbour at Chiariventi** in Liguria.

Port of Trieste – Italy

Port of Livorno (Leghorn) - Italy

In the field of **inland waterways** TECHNITAL was responsible for the preliminary (218 km) and final design (149 km) of the inland waterway canal connecting the Ticino River with Mincio River via Milan and links to lakes Maggiore, Como and Iseo; the final design of the navigable canal connecting Lake Garda with the Mantuan Lakes of 37 km.; and the final design of Trevenzuolo, Masetti and S. Leone locks, all Italian projects. The company has also carried out the detailed and construction designs and environmental impact study in relation to upgrading a section of the Po valley waterway in the province of Ferrara (approx. 10 km), and the construction design and technical assistance during construction for the rehabilitation works in relation to the Venetian littoral waterway.

Valpagliaro navigation lock – Italy

The services provided by TECHNITAL include:

1. Consulting
   - Master Plan
   - Traffic studies
   - Technical-economic feasibility studies
   - Technical assessments and due diligence
   - Financial analyses
   - Socio-economic analyses
   - Logistic studies and planning
   - Transport system planning
2. Design
   - All phases of design from preliminary up to construction design
   - Preliminary and final architectural design
   - Preliminary and final design of plants and equipment
   - Preliminary and final design of electrical and mechanical installations
   - Technical specifications, contracts, construction planning, cost estimates
   - Environmental impact studies
   - Tender documents preparation
3. Supervision
   - Construction management and supervision
   - Technical assistance during tender stage
   - Works supervision
   - Coordination and supervision of research and laboratory tests
   - Environmental monitoring

It is worth to say that the design of marine and coastal structures normally requires the ability to analyze the environmental conditions to properly define the design criteria and evaluate the environmental stresses on the works. To support these studies TECHNITAL uses physical models and a series of state of the art well tested mathematical numerical models, which enable the interpretation of the data collected in the field and the prediction of the likely effects on the new structures as well as induced by the new structures on the marine environment and on the coast/water.

As far as physical models are concerned, company's staff is normally involved in the design of

the models and in the numerical results interpretation and analysis. On the contrary, mathematical models are managed directly by the company's staff and they can be operated in a 2D or 3D configuration depending on the type of phenomena to be studied.

Among the numerical models usually applied, are:

- hydrodynamic models, able to reproduce the all the main hydrodynamic phenomena (drying and flooding of tidal flats, density driven flows, wave induced stresses and mass fluxes, flow through hydraulic structures wind driven flows including cyclonic / hurricane / typhoon winds etc.);
- morphological models, to study the solid transport, the sediment distribution patterns, the erosion /deposition phenomena;
- shoreline evolution model used in the analysis of the large scale morphology of coastal systems to provide insight into the causes of coastal erosion or to predict the impact of planned coastal infrastructure, such as a port on the coast. It is possible to evaluate the shoreline evolution around coastal protection works, such as groynes, revetments, river mouth training works and to some extent detached breakwaters;
- numerical model based on the wave SMB hindcasting procedure to reconstruct in a defined location a wave time series when local wind measurements are available. The model also allows to transfer directional wave recordings between two points having a similar exposition to prevailing winds;
- wave propagation model for the simulation of waves in deep, intermediate and shallow water. The model is a 3rd generation spectral model that accounts for (refractive) propagation due to current and depth and represents the processes of wave generation by wind, dissipation due to bottom friction depth-induced wave breaking and non-linear wave-wave interactions;
- Wave propagation model into harbours, able to predict the short wave penetration around coastal structures (e.g. breakwaters) and the resonant behavior of enclosed areas to incident long waves. This model allows to define the wave disturbance at the berthing facilities and the downtime in the loading/unloading operations.

TECHNITAL's staff, is also versed to specific simulation models for:

- vessels navigation, for evaluating the maneuvering aspects and the navigational safety along navigation channels and within port basins; the simulations are carried out using fast time simulation mathematical model, that allows to simulate the maneuvering behavior of ships, taking into account the influence of ship's maneuvering characteristics, kind of maneuver and desired track, rudder and engine actions, tug assistance, wind, waves and currents, shallow water and bank suction effects.
- vessels mooring, for analyzing the feasibility of mooring a vessel at a berth in various circumstances and to confirm the suitability of mooring layout and equipment by controlling mooring lines loads, bollards loads and fenders performance; mooring analysis allows also to verify that vessel movements at the berth do not exceed the allowable movements recommended by international standards; analyses are carried out computing the mooring forces produced by defined wind, wave, current and other forces and changes in draft and tide ,and results are calculated considering the short period vessel motions in all six degrees of freedom (surge, sway, yaw, roll, pitch, heave) due to waves.

The following table and related projects sheets give full details of the main projects performed in this field.

TABLE A – COMPANY'S EXPERIENCE (For titles in **bold** type see project sheets in Appendix A)

PROJECT	CLIENT	PERIOD		ACTIVITIES	COST OF SERVICES €	COST OF WORKS €
		FROM	TO			
INDUSTRIAL & COMMERCIAL PORTS						
Engineering Consultancy Services for Al Faw Grand Port – Iraq	Ministry of Transport - General Company Ports of Iraq (GCPI)					
Construction of the Khowr Al Zubair Immersed Tunnel		12/2020	Ongoing	PMC, Works Supervision	15,471,053	521,130,201
Construction of the Quay Wall - Container Terminal A		12/2020	Ongoing	PMC, Works Supervision	10,748,310	427,489,618
Construction of the Infrastructures Phase 1 - Dredging and Reclamation Works		12/2020	Ongoing	PMC, Works Supervision	11,692,859	594,414,135
Construction of the Infrastructures - Phase 1 – Construction of Navigation Channel		12/2020	Ongoing	PMC, Works Supervision	2,556,795	258,122,302
Construction of the Port Revetment		04/2019	Ongoing	PMC, Works Supervision	4,410,000	177,000,000
Construction of the Western Breakwater		02/2014	12/2022	PMC, Works Supervision	25,480,000	604,068,837
Construction of the Staging Pier Eastern Breakwater		12/2012	08/2018	PMC, Works Supervision	6,408,000	204,166,506
Engineering Consultancy Services for Al Faw Grand Port (design including Oil Terminal and Navy Base)		05/2011	12/2014	Master Plan, FEED, Tender Documents	59,546,650	10,500,000
Construction of a confined dumpsite to be used as new container terminal in the port of Naples, Italy	Naples Port Authority	05/2003	12/2023	Preliminary Design, Detailed Design, Works Supervision, EIA	18,009,540	424,210,514
Brcko Port - Procurement and Contract Implementation Support – Bosnia and Herzegovina	Public Company Port of Brcko	06/2020	06/2023	Tender Documents, Works Supervision	949,134	9,300,000

PROJECT	CLIENT	PERIOD		ACTIVITIES	COST OF SERVICES €	COST OF WORKS €
		FROM	TO			
Project Management Consultancy (PMC) for the Doraleh Multipurpose Port in Djibouti - Djibouti	Port de Djibouti S.A. (PDSA)	11/2015	08/2022	Works Supervision, Contract Management	1,675,000	428,000,000
Detailed Dredging Design and Disposal of Dredging Material for Dredging of the Entrance Channel, Harbour Basin and Turning Circle of Dar Es Salaam Port - Tanzania	Tanzania Ports Authority	08/2018	07/2019	Detailed Design; Tender Documents, Environmental Investigations	1,099,640	109,833,044
Supervision of the Construction of "Lake Assal Salt Export Terminal" (LASET) - Djibouti	Djibouti Port Authority	11/2013	12/2018	Works Supervision	1,576,260	57,720,000
Post-Contract Professional General Site Supervision and Quantity Surveying Consultancy Services of Construction Works for the Port of Tadjoura – Djibouti	Port Autonome International de Djibouti	06/2013	12/2018	Works Supervision	2,753,384	66,000,000
Security Infrastructures for the Port of Brindisi – Italy	Brindisi Port Authority	09/2009	12/2017	Preliminary Design, Detailed Design, Works Supervision	560,255	7,185,643
Consulting services for feasibility study including bathymetric hydrodynamic and geotechnical surveys for Dredging of Dar es Salaam port entrance channel and turning basin – Tanzania	Tanzania Ports Authority (TPA)	12/2015	12/2016	Feasibility Study; Concept Design; EIA	2,683,847	To be tendered (confidential)
Work supervision for Port Goubet – Djibouti	Ministry of Equipment and Transport	12/2013	02/2016	Works Supervision	955,900	56,558,842
New Port of Nador West Med - Morocco	GLF	06/2015	09/2015	Tender Design	107,000	537,319,536
Container Terminal of the Port of Augusta – Italy	Eastern Sicily Port Authority	03/2009	07/2014	Preliminary Design, Detailed Design, EIA	5,546,936	113,770,000
Consultancy Services for the Phase 2 Development of the New Port of Tadjoura – Djibouti	Port Autonome International de Djibouti	10/2012	07/2014	Preliminary Design	426,000	91,587,588

PROJECT	CLIENT	PERIOD		ACTIVITIES	COST OF SERVICES €	COST OF WORKS €
		FROM	TO			
Consultancy Services for Preliminary Design for Galeota Port Phase II – Trinidad & Tobago	National Energy Corporation	10/2013	03/2014	Preliminary Design	305,000	96,140,000
Extension and restructuring of Port Galeota – Trinidad & Tobago	GLF Construction Corporation (U.S.A.)	09/2008	12/2014	Preliminary Design, Detailed Design, Technical Assistance during Construction	950,000	55,493,500
Works for the Rehabilitation of the Port of Shengjin – Albania	Delegation of the European Commission in Tirana	12/2009	05/2014	Detailed Design, Tender Documents, Works Supervision	452,320	3,200,177
New Exxon berth and modification of PetroLig Berth for oil products in Vado Ligure	Port Authority of Savona	08/2009	02/2014	Feasibility Study, Preliminary Desing, Detailed Design, Tender Documents	630,000	9,273,703
Marine structures for the expansion of commercial port of Piombino - Italy	GLF Construction Corporation (USA) for Piombino and Elba Port Authority	08/2013	10/2013	Tender Design	100,000	101,250,000
Doraleh Oil Terminal Rehabilitation - Djibouti	DP World	03/2011	07/2013	Detailed Design	445,000	2,000,000
Pre-contract consultancy and general supervision services for development of Al-Wakrah Beach, Stage 2 - Al Wakrah Jetty - Qatar	Private Engineering Office	10/2011	09/2012	Concept Design, Preliminary Design, Detailed Design, Works Supervision	1,155,000	150,000,000
La Brea - Port of Brighton Project: Alutrint Material Storage and Handling Facility – Trinidad & Tobago	GLF Construction Corporation (USA)	12/2008	05/2012	Preliminary Desing, Detailed Design, Works Supervision	4,988,000	71,000,000
Feasibility study for a new port infrastructure in Aguadulce – Panama	Panama Marine Authority	05/2011	12/2011	Feasibility Study	56,368	43,520,000
Techno-economic study, preliminary and detailed designs and preparation of tender documents for the Port of Tadjoura – Djibouti	Government of Djibouti	05/2010	12/2011	Economic and Financial Study, Preliminary Design, Detailed Design, Tender Documents	671,400	126,149,500

PROJECT	CLIENT	PERIOD		ACTIVITIES	COST OF SERVICES €	COST OF WORKS €
		FROM	TO			
Lake Assal Marine Terminal: Supervision of construction works – Djibouti	Salt Investment SA	08/2009	06/2010	Technical Assistance, Tender Documents; Works Supervision	356,500	6,750,000
Independent Engineer Services for the Construction of the Doraleh Container Terminal – Djibouti	DP World	12/2008	10/2009	Independent Engineer's Certification	120,000	163, 000,000
Construction of Doraleh Container Terminal (DCT) – Djibouti	DP World	06/2007	10/2009	Design Review; Works Supervision	1,100,000	163,000,000
New marine terminal in Ghoubbet gulf for salt export – Lake Assal – Djibouti	Salt Investment SA	09/2008	01/2009	Preliminary Design, Detailed Design	330,000	6,750,000
Feasibility engineering study of a container terminal at Puerto Mariel - Cuba	DP World	02/2008	08/2008	Feasibility Study	98,500	238,200,000
Lake Assal marine terminal - Djibouti	PACE - Pan Arab Consulting Engineers	04/2007	12/2007	Preliminary Design	55,000	n.a.
Constanta South Container Terminal (CSCT): Supervision of Yard Extension works - Romania	DP World	05/2006	11/2006	Works Supervision	135,500	5,548,900
Marine structures and building for the Yemen Coast Guard Authority in the Port of Aden - Yemen	Yemen Coastguard Authority - Aden	09/2003	12/2004	Preliminary Desing, Detailed Design, Tender Documents, Works Supervision	200,000	5,000,000
New industrial and commercial port at Doraleh - Djibouti	Djibouti Port Authority and Dubai Ports International	12/2000	12/2002	Design Verification; Preliminary Design	219,000	200,000,000
Port safety in Poti and Batumi - Georgia	European Commission – TACIS Programme	02/1999	01/2000	Detailed Design	989,585	20,000,000
Rehabilitation works in the Port of Durres - Albania	Ministry of Public Works & Transport (fin. WB)	11/1997	12/1999	Detailed Design	420,800	40,000,000

PROJECT	CLIENT	PERIOD		ACTIVITIES	COST OF SERVICES €	COST OF WORKS €
		FROM	TO			
Feasibility study for the location of an LNG port on the Mediterranean coast - Egypt	Snamprogetti	06/1997	08/1997	Feasibility Study, EIA	33,000	n.a.
Port of Ras Laffan - Qatar	Condotte & Partners, for Qatar General Petroleum Corporation	01/1991	12/1994	Master Plan, Preliminary Desing, Detailed Design	694,100	694,118,000
Navy Port Located at the Industrial LNG Port of Ras Laffan - Qatar	Condotte & Partners, for Qatar General Petroleum Corporation	01/1992	12/1992	Feasibility Study; Tender Design	180,000	26,000,000
Bunkering station in Troiza Bay - Vladivostok, Russian Federation	Grandi Lavori Fincosit and Fertre for Dalryba of Vladivostok	08/1991	02/1992	Preliminary Design, EIA	143,600	86,764,800
TERMINALS, QUAYS AND BREAKWATERS						
Detailed design of the works for the completion of the Ro-Ro Terminal in the western outport of the Port of Cagliari (Sardinia) – Italy	Cagliari Port Authority	09/2023	Ongoing	Detailed design	2,269,326	288,701,470
Works Supervision for the upgrading of the marine terminal at “Petroli” dock in the Port of Naples – Italy	Q8 Italia	10/2022	Ongoing	Works Supervision	177,000	7,423,000
Widening of the internal quays of the outer pier in the section between the root and the eastern peninsula in the port of Catania – Italy	Eastern Sicily Port Authority – Port of Catania	10/2022	Ongoing	Detailed Design, Works Supervision	412,615	8,000,000
Al Ruwais Port: deepening of access channels, making good of basins and extension of outer quay wall – Qatar	Mwani Qatar	12/2021	Ongoing	Preparation of Market Study, Preliminary Design, Detailed Design, Tenders Documents, Works Supervision	3,935,000	n.d.
Extension and upgrade of the eastern passenger terminal “Ponte dei Mille” in the port of Genoa – Italy	Port Authority of the Western Ligurian Sea	10/2021	Ongoing	Detailed Design	435,458.10	n.a.

PROJECT	CLIENT	PERIOD		ACTIVITIES	COST OF SERVICES €	COST OF WORKS €
		FROM	TO			
Consulting services for the upgrading and extension of the Ro-Ro Terminal of Sjeverna Luka within the port of Split – Croatia	Split Port Authority	09/2018	Ongoing	Preliminary Design, Detailed Design	538,901	32,000,000
Upgrading and strengthening of the breakwater of the port of Catania – Italy	Consorzio Stabile Grandi Lavori Scarl	02/2023	03/2024	Detailed Design	600,000	56,659,915
Consulting services for Ravenna Port Hub Project: dredging of Candiano and Baiona channels, adaptation of existing quays, new terminal container, sediment management– Italy	Consorzio Stabile Grandi Lavori s.c.r.l – Dredging International s.v.	02/2020	06/2023	Detailed Design	1,773,752	197,848,915
Design of a new cruise terminal in Bari Port – Italy	Authority of the Port System of the Southern Adriatic Sea	04/2020	09/2022	Detailed Design	380,089	9,390,000
New Breakwater for the Port of Genoa – Sampierdarena Basin – Italy	Autorità di Sistema Portuale del Mar Ligure Occidentale	02/2020	09/2022	Feasibility Study Preliminary Design	5,048,333	900,000,000
Detailed design for the construction of a new shipyard inside the Genoa Sestri Ponente oil port ("Porto Petroli") and hydraulic works on the Molinassi stream – Italy	Municipality of Genoa	07/2021	02/2022	Detailed Design	747,808	71,256,380
Preliminary and detailed design for the development of Calata Bettolo in Genoa Port – Italy	Consorzio Bettolo S.p.A.	12/2018	07/2021	Preliminary Design, Detailed Design	955,000	Confidential – to be tendered
Consulting services for the extension of the West quay of the Garibaldi pier in the port of La Spezia – Italy	LSCT La Spezia Container Terminal	03/2018	03/2020	Detailed Design	745,615	72,918,968

PROJECT	CLIENT	PERIOD		ACTIVITIES	COST OF SERVICES €	COST OF WORKS €
		FROM	TO			
Engineering consultancy services related to the construction of the cruise ship docking facilities at the Ocean Cay MSC marine reserve – Bahamas	GLF Construction Corporation	07/2016	10/2019	Detailed Design, Technical Assistance during Construction	530,640	25,000,000
New Multipurpose Platform (Dry Bulk, Oil, Container Terminal) in Vado Ligure – Italy	Port Authority of Savona	02/2006	07/2019	FEED, Detailed Design	10,934,770	336,520,801
LNG Jetty and Maritime and Harbour Infrastructures of the Hydrocarbons Terminal in the Port of Skikda - Algeria	ORASCOM and BESIX	06/2018	09/2018	Feasibility Study; Preliminary Design	130,000	595,039,372
Consultancy services for the development of marine transport infrastructure on lakes Bangweulu and Mweru in Luapula province – Zambia	Ministry of Transport, Works, Supply and Communications - Government of Zambia	06/2015	03/2018	Feasibility Study, Detailed Design, Tender Documents	415,000	5,000,000
Engineering consultancy services related to the reconstruction of the North Quay of the international Port of Port-au-Prince - Haiti	Grandi Lavori Fincosit	07/2013	11/2017	Preliminary Design; Detailed Design	1,130,000	66,000,000
Red Sea Gateway Terminal – Phase 1A Expansion works – Saudi Arabia	Saudi Archirodon Limited.	06/2015	04/2017	Detailed Design	397,625	50,025,000
Supervision of works for the extension and rehabilitation of the passenger wharves on the other side of the breakwater of the City Port of Split - Croatia	Split Port Authority	06/2014	07/2018	Works Supervision	688,478	22,531,205
Engineering construction services for the Eastport development port of Tampa Bay – Florida, USA	GLF Construction Corporation	04/2015	06/2016	Construction methodologies drawings; site assistance	140,000	15,000,000

PROJECT	CLIENT	PERIOD		ACTIVITIES	COST OF SERVICES €	COST OF WORKS €
		FROM	TO			
Consultancy Services aiming to the investigation of damage Causes at the breakwater cronwall of Civitavecchia - Italy	Contractor Pietro Cidonio	07/2015	09/2015	Consultancy Services	46,800	n.a.
West bank of the West Industrial Channel as mooring quay in their Grandi Molini and Cereal Docks sections (Marghera Port – Venice) – Italy	Venice Port Authority – Grandi Molini Italiani – Cereal Docks	04/2015	12/2016	Preliminary Design, Detailed Design	140,000	n.a.
Works aimed at ensuring the stability and the tightness relevant to the polluted west bank of the West Industrial Channel in its Cereal Docks section (Marghera Port – Venice) – Italy	Consorzio Venezia Nuova	07/2014	03/2015	Preliminary Design, Detailed Design, Tender Documents	100,000	7,280,475
Loading Equipment Study (ship loader & conveyor belt) of Tadjoura Port Phase I - Republic of Djibouti	Port de Djibouti SA	01/2014	12/2014	Concept Design, Preliminary Design, FFED Design; Tender Documents, Technical Assistance	70,000	20,000,000
New Exxon berth and modification of PetroLig berth for oil products In Vado Ligure	Savona Port Authority	08/2009	02/2014	Feasibility Study; Preliminary Desing, Detailed Design	630,000	9,273,703
New livestock terminal at Damerjog – Djibouti	Port of Djibouti	01/2012	12/2013	Concept Design, Preliminary Design, Detailed Design	648,000	37,750,000
Post Contract Consultancy Services for Construction Supervision of Redevelopment for Doha Shiokh Project – Qatar	Private Engineering Office	02/2011	04/2012	Works Supervision	618,000	24,236,000
Structural restoration and quay utilities reconfiguration for the dry dock n.3 in the Arsenale of Venice - Italy	Venezia Nuova Consortium for Ministry of Public Works – Water Board – Venice	07/2011	09/2011	Detailed Design	27,100	22,209,600

PROJECT	CLIENT	PERIOD		ACTIVITIES	COST OF SERVICES €	COST OF WORKS €
		FROM	TO			
Detailed Design for the New Commercial Shipyard Ro-Ro and Containers Within the Port of Catania - Italy	Port Authority of Catania	03/2010	12/2010	Detailed Design	645,000	62,488,558
Expansion of the existing Port for ferries - Ro/Ro at Tremestieri (Messina) – Italy	Municipality of Messina	12/2009	06/2010	Detailed Design, EIA	170,000	53,500,000
Quay of the north abutment for the mobile surge barrier at Lido San Nicolò Inlet, Venice Lagoon – Italy	Venezia Nuova Consortium for Ministry of Public Works - Water Board - Venice	01/2006	12/2008	Detailed Design	1,283,900	52,345,300
Quay of the south abutment for the mobile surge barrier at Lido San Nicolò Inlet, Venice Lagoon – Italy	Venezia Nuova Consortium for Ministry of Public Works - Water Board - Venice	01/2005	12/2008	Detailed Design	1,319,700	53,805,600
Multipurpose quay in Port of Taranto: upgrading and re-qualification of the mooring quay – Taranto, Italy	Taranto Container Terminal S.p.A.	01/2004	12/2008	Preliminary Design, Detailed Design	502,000	69,188,000
New oil terminal on the multipurpose platform in Vado Ligure - Italy	Port Authority of Savona	08/2008	11/2008	Preliminary Design	98,000	16,662,000
Design of rehabilitation / reconstruction of Quays 7 and 8 – Port of Durres, Albania	Ministry of Transport and Telecom	05/2007	12/2007	Feasibility Study; Preliminary Design, Detailed Design; Tender Documents	348,000	14,000,000
Rehabilitation of Container Quays in the Port of Gioia Tauro – Italy	Grandi Lavori Fincosit for Port Authority of Gioia Tauro	09/2006	06/2007	Detailed Design	370,000	31,800,000
Strengthening of the landside end of the south breakwater at Lido S. Nicolò inlet – Venice lagoon - Italy	Venezia Nuova Consortium for Ministry of Public Works - Water Board - Venice	01/2006	12/2006	Detailed Design	51,980	2,100,000

PROJECT	CLIENT	PERIOD		ACTIVITIES	COST OF SERVICES €	COST OF WORKS €
		FROM	TO			
Conversion of quays into a new container terminal for ships in the Port of Naples – Italy	Port Authority of Naples	01/2004	04/2005	Concept Design, Preliminary Design	4,600,000	280,000,000
Design of rehabilitation / reconstruction of Quays 10 and 11 – Port of Durres, Albania	Ministry of Transport and Telecom	05/2004	12/2004	Feasibility Study; Preliminary Design, Detailed Design; Tender Documents	406,370	23,400,000
New Container Terminal in the port of Civitavecchia – Italy	Grandi Lavori Fincosit	02/2003	08/2003	Detailed Design	314,000	31,408,000
Outer breakwater at Chioggia inlet - Venice Lagoon - Italy	Venezia Nuova Consortium for Ministry of Public Works - Water Board - Venice	03/2003	08/2003	Detailed Design	440,000	28,700,000
Outer breakwater at Malamocco inlet - Venice Lagoon - Italy	Venezia Nuova Consortium for Ministry of Public Works - Water Board - Venice	06/2002	11/2002	Detailed Design	738,700	58,430,000
Design review of new quays in the Port of Durres - Albania	Ministry of Transport and Telecom	11/2000	12/2002	Design Review	106,500	12,538,400
SPMT offshore for oil products handling in Civitavecchia - Italy	Compagnia Italpetroli	01/1998	12/2001	Preliminary Design, Detailed Design; Works Supervision	n.a.	n.a.
New ferry terminal at Tremestieri (Messina) – Italy	Amadeus S.p.A.	11/1998	04/2000	Detailed Design, EIA	774,600	41,316,500
Breakwaters at the entrances of the ports of the Venice lagoon - Venice, Italy	Venezia Nuova Consortium for Ministry of Public Works - Water Board - Venice	04/1991	12/1997	Hydrodynamic Studies, Physical Modelling; Preliminary Design, Detailed Design	2,006,900	71,787,500
Quay walls for fishing and coastal vessels, barges, ferries and general cargo - Venice lagoon - Italy	Venezia Nuova Consortium for Ministry of Public Works - Water Board - Venice	05/1990	12/1997	Preliminary Design, Detailed Design	6,363,000	113,620,500

PROJECT	CLIENT	PERIOD		ACTIVITIES	COST OF SERVICES €	COST OF WORKS €
		FROM	TO			
New quay "Molo Italia" for the port of Livorno - Italy	Port of Livorno Authority	07/1997	11/1997	Detailed Design	257,700	12,395,000
Quay walls for the new industrial port of Ras Laffan - Qatar	Condotte & Partners, for Qatar General Petroleum Corporation	01/1993	12/1994	Detailed Design	694,100	22,992,600
SPMT and 40" sealine offshore at Falconara Marittima – Italy	API - Anonima Petroli Italiana	01/1971	12/1973	Works Supervision	n.a.	n.a.
SMALL HARBOURS AND MARINAS						
Consolidation and expansion of the eastern pier of the fishing harbour in the port of Catania – Italy	Eastern Sicily Port Authority – Port of Catania	10/2022	ongoing	Detailed Design, Works Supervision	412,615	43,000,000
Widening of San Leone marina in Agrigento (Sicily) – Italy	Municipality of Agrigento	10/2022	ongoing	Detailed design	403,785	19,050,000
Design of restoration and reinforcement works of the main breakwater of the touristic port Carlo Riva in Rapallo, Italy	Porto Turistico Internazionale di Rapallo S.p.A.	01/2019	04/2020	Preliminary Design, EIA, Detailed Design	300,000	22,080,387
Design Review and Post-Contract (General Supervision, Site Supervision and Quantity Surveying) Consultancy Services for Banana Island - Qatar	Private Engineering Office	09/2012	09/2014	Design Review; Works Supervision	1,235,695	266,391,000

PROJECT	CLIENT	PERIOD		ACTIVITIES	COST OF SERVICES €	COST OF WORKS €
		FROM	TO			
Design Review and Post-Contract (General Supervision, Site Supervision and Quantity Surveying) Consultancy Services for Navigation Channel, Coast Guard Base and Secondary Navigation Channel - Qatar	Private Engineering Office	10/2012	01/2014	Design Review; Works Supervision	765,000	135,765,541
Cruise Terminal Puerto Plata – Dominican Republic	GLF Construction Corporation (USA)	01/2013	03/2013	Tender Design	70,000	54,545,500
Marina on Garda Lake at Brenzone - Italy	Municipality of Brenzone	11/2011	02/2013	Feasibility Study; Preliminary Design	265,000	8,622,000
Expansion of marina/fishing port at Al Wakrah - Qatar	Private Engineering Office	10/2011	09/2012	Concept Design, Preliminary Design, Detailed Design; Tender Documents	1,155,000	150,000,000
Cruise port for the largest Carnival and Royal Caribbean ships - Grand Cayman	GLF Construction Corporation (USA)	10/2010	04/2011	Feasibility Study; Preliminary Design	225,386	128,008,125
Fishing Harbour and Marina at Al Ruwais - Qatar	Building Affairs	09/2007	04/2010	Preliminary Design, Detailed Design; Tender Documents	70,000	7,500,000
New marina and requalification of waterfront at Vado Ligure – Italy	Savona Port Authority	10/2008	02/2010	Concept Design, Preliminary Design	710,000	63,349,249
Marina and waterfront development at Zuwarah – Libya	ODAC Organization for Development of the Administrative Centers - Tripoli	05/2009	10/2009	Feasibility Study	70,000	155,435,084
Marina on Garda Lake at Torri del Benaco - Italy	Municipality of Torri Del Benaco	07/2008	12/2008	Feasibility Study; Preliminary Design	353,000	15,328,000

PROJECT	CLIENT	PERIOD		ACTIVITIES	COST OF SERVICES €	COST OF WORKS €
		FROM	TO			
Noli – Spotorno tourist harbour: Chiariventi marina – Liguria, Italy	Grandi Lavori Fincosit S.p.A.	11/1999	12/2004	Preliminary Design, Detailed Design	1,032,900	24,445,000
NAVIGATION LOCKS AND REFUGE HARBOURS						
Project Management and Post Contract Quantity Surveying Services for Expansion of the Navigation Channels & Turning Basin at Simaismah and Marine Protection Works, Beaches and Access Channels for Lusail Islands 1, 2, 3A, 3B, 3C and 3D – Qatar	Private Engineering Office	01/2014	02/2017	Works Supervision, Technical Assistance, Contract Management	2,400,000	815,025,439
MOSE system - detailed design of Chioggia refuge port - seaside basin - Italy	Consorzio Venezia Nuova	02/2012	09/2014	Detailed Design	480,000	15,900,000
Fishing vessels navigation locks at Chioggia inlet– Venice lagoon - Italy	Consorzio Venezia Nuova	02/2004	09/2014	Navigation Study; Concept Design, Detailed Design	2,576,500	69,684,770
Navigation lock at lido Treporti inlet– Venice lagoon - Italy	Consorzio Venezia Nuova	06/2006	06/2012	Navigation Study; Concept Design, Detailed Design	1,237,000	32,981,200
Navigation lock for 150 dwt. ships at the port entrance of Malamocco – Venice Lagoon - Italy	Venezia Nuova Consortium for Ministry of Public Works - Water Board - Venice	01/2004	05/2012	Detailed Design; Tender Documents	9,919,500	266,060,000
Refuge harbour and navigation lock at the port entrance of Chioggia – Venice Lagoon – Italy	Venezia Nuova Consortium for Ministry of Public Works - Water Board - Venice	07/2003	12/2006	Preliminary Design, Detailed Design; Tender Documents	3,211,400	125,458,500
Feasibility study for new lock for cargo vessels at Chioggia inlet – Venice lagoon - Italy	Venezia Nuova Consortium for Ministry of Public Works - Water Board – Venice	09/2004	09/2005	Navigation Study; Feasibility Study	220,000	n.a.

PROJECT	CLIENT	PERIOD		ACTIVITIES	COST OF SERVICES €	COST OF WORKS €
		FROM	TO			
Refuge harbour and navigation lock at the port entrance of Lido Treporti – Venice Lagoon - Italy	Venezia Nuova Consortium for Ministry of Public Works - Water Board - Venice	07/2003	01/2004	Preliminary Desing, Detailed Design; Tender Documents	3,018,500	108,459,500
PORT MASTER PLANS AND LOGISTIC STUDIES						
Upgrading of port infrastructures in Messina (quay Peloro – Rizzo) and in Tremestieri (Sicily) – Italy	Strait of Messina System Authority	10/2022	ongoing	Master Plan, Feasibility Study, Preliminary Design	133,500	7,000,000
Port Master Plan for the stretch of coast including Ex Arsenale - Punta Chiara - Cala Balbiano - Punta Tegge in Venice – Italy	Municipality of La Maddalena	06/2022	03/2023	Master Plan	138,500	30,000,000
Calata Bettolo Master Plan Study – Italy	TIL – Terminal Investment Ltd (Ginevra)	06/2017	10/2017	Master Plan	86,000	50,000,000
Master Plan and Preliminary Design for Brighton Port – Trinidad & Tobago	National Energy Corporation	10/2013	07/2014	Master Plan; Preliminary Design	490,000	72,189,250
Revision of the Master Plan for the port of Livorno (Leghorn) - Italy	Port Authority of Livorno	11/2004	12/2013	Master Plan; EIA	617,000	1,371,655,000
Oil Terminal Master Plan for Al Faw Port – Iraq	IECAF – Consortium Italian Engineers and Consultants for Al Faw	01/2011	07/2013	Preliminary Studies; Master Plan	1,600,000	691,000,000
Navy Base Master Plan for Al Faw Port – Iraq	IECAF – Consortium Italian Engineers and Consultants for Al Faw	01/2012	06/2013	Preliminary Studies; Master Plan	1,968,000	510,000,000
Study of the Adriatic Gateway – Italy and Slovenia	Ministry of Transport - Italy	02/2012	12/2012	Traffic and Market Study; Feasibility Study; Concept Design	550,000	n.a.

PROJECT	CLIENT	PERIOD		ACTIVITIES	COST OF SERVICES €	COST OF WORKS €
		FROM	TO			
New Gioia Tauro Port Master Plan - Italy	Gioia Tauro Port Authority	06/2007	03/2010	Master Plan	294,000	890,000,000
Concept and Preliminary Designs for the Harbour Area of Porto Levante on the Po River - Rovigo	Sistemi Territoriali	11/2011	12/2011	Concept Design, Preliminary Design	700,988	41,907,657
Logistic Assessment and Exceptional Package Handling at Umm Qasr Port - Iraq	Saima Avandero	09/2011	10/2011	Technical Studies	40,000	n.a.
Feasibility Study of the New "Europe Platform" of the Port of Leghorn - Italy	Port Authority of Livorno	11/2010	09/2011	Feasibility Study	183,350	1,234,276,500
LNG jetty upgrading in Panigaglia - Italy	Sofregaz	11/2008	05/2009	FEED	85,000	20,000,000
Master Plan for the Harbour Area of Porto Levante on Po River – Rovigo - Italy	Sistemi Territoriali	11/2007	05/2008	Preliminary Studies; Master Plan	100,000	40,000,000
Feasibility Study of the new Basrah Grand Port and rehabilitation of the existing Iraqi ports – Iraq	CIITI - Consorzio Italiano Infrastrutture e Trasporti per l'Iraq	09/2007	03/2008	Feasibility Study EIA	167,600	4,393,000,000
Updating of master plan for the port of Trieste - Italy	Port Authority of Trieste	10/2004	01/2006	Master Plan	298,000	980,000,000
Master Plan for the Port of Trieste - Italy	Port of Trieste Authority	11/1998	02/2000	Preliminary Studies; Master Plan	810,000	980,000,000
PORT STUDIES AND EVALUATIONS						
LNG Jetty in Gioia Tauro – Italy	LNG Medgas Terminals S.p.A.	07/2009	10/2009	FEED	135,000	160,000,000
Naval Traffic Monitoring System in Venice Lagoon and its Inlets – Italy	Venezia Nuova Consortium for Ministry of Public Works - Water Board - Venice	04/2006	12/2008	Detailed Design	70,000	n.a.

PROJECT	CLIENT	PERIOD		ACTIVITIES	COST OF SERVICES €	COST OF WORKS €
		FROM	TO			
Constanta South Container Terminal (CSCT) : Study of pavements for Yard Extension Project - Romania	DP World	10/2005	02/2006	Detailed Design	42,000	n.a.
Navigation Study for LNG Terminal at Panigaglia – La Spezia - Italy	Tecon S.r.l. (Milan)	09/2005	10/2005	Navigation Study	20,000	n.a.
Navigation study for new container terminal in the port of Naples - Italy	Port Authority of Naples	07/2003	10/2003	Navigation Fast Time Simulator	70,000	n.a.
Navigation study for new lock for cargo vessels at the port inlet of Malamocco – Venice Lagoon - Italy	Venezia Nuova Consortium for Ministry of Public Works - Water Board - Venice	04/2001	03/2002	Navigation Study; Traffic Study; Feasibility Study	671,400	n.a.
INLAND WATERWAYS & CANALS						
Proposal of Project Financing for the Restoration of Po River Between the Secchia River Mouth and Ostiglia – Italy	Cave di Quingentole S.r.l.	02/2015	04/2018	Preliminary Design	60,000	Condifdential
Padua – Venice Waterway – Navigable Channel and Spillway of the Bacchiglione Brenta System – Italy	Veneto Regional Authority	04/2015	06/2016	Preliminary Design	700,000	330,000,000
Upgrading to Class V traffic of the Ferrarese waterway - Lot 2: Final di Rero - Migliarino - Italy	ARNI - Azienda Provinciale di Ferrara	11/2001	03/2016	EIA; Preliminary, Detailed, Detailed Design; Works Supervision	2,401,000	23,452,000
Removal of the bottlenecks of Ponte S. Giorgio, Ponte Porta Reno, Ponte Prinella and Ponte Ferrovia Bologna-Padova within the project of the Ferrara waterway - **Italy**	Province of Ferrara	12/2015	12/2015	Preliminary Design	157,500	46,685,137
Venetian Littoral Waterway: rehabilitation works – Italy	Sistemi Territoriali S.p.A.	08/2008	10/2009	Detailed Design, Site Assistance	563,800	18,326,500

PROJECT	CLIENT	PERIOD		ACTIVITIES	COST OF SERVICES €	COST OF WORKS €
		FROM	TO			
Shore protection works for the east bank of the West Industrial Canal in Marghera industrial port – Venice - Italy	Venezia Nuova Consortium for Ministry of Public Works - Water Board - Venice	06/2001	12/2007	Detailed Design	688,800	47,885,970
Environmental protection of the River Sarca - Lake Garda - River Mincio - Mantuan lakes system - Italy	Po River Basin Authority	02/1996	02/1997	Environmental Studies	126,000	n.a.
Dredging works, land reclamation and disposal of polluted soils for the shaping of the navigation channels of the Venice ports and lagoon – Italy	Venezia Nuova Consortium for Ministry of Public Works - Water Board - Venice	04/1987	09/1997	Preliminary Design; EIA	9,259,200	232,405,600

Appendix A – Company's Experience

Industrial and Commercial Ports

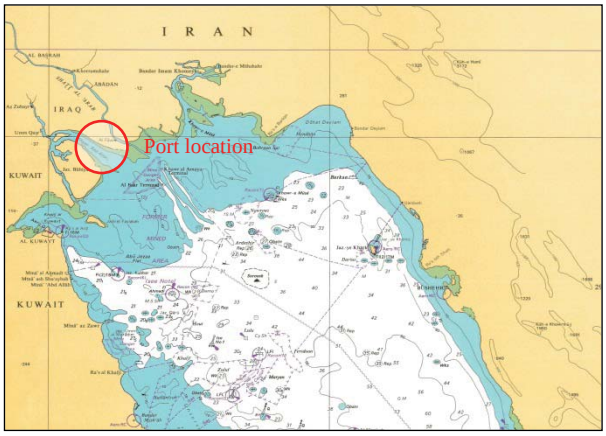
ENGINEERING CONSULTANCY SERVICES AND WORKS SUPERVISION FOR THE AL FAW GRAND PORT

Location:	Iraq
Client:	Ministry of Transport of the Republic of Iraq
Services:	Master plan of the port; FEED design, Assistance during tender and supervision during construction, project management and control
Period:	05/2011 – on going
Construction cost:	€ 10,5 billion Euro in final configuration

Project Description:

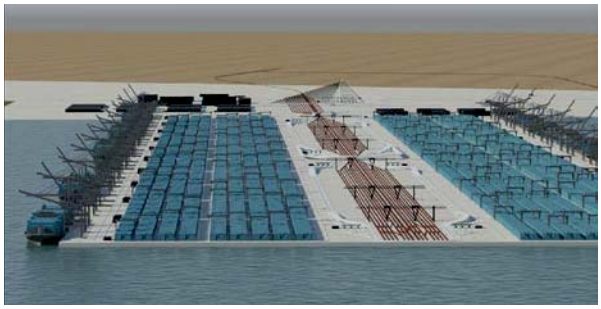
The Al Faw Grand Port will be located along the Kawr Abdallah Channel, near the Shatt Al Arab mouth, in Iraq.

The new port is designed in order to move about 36 million tons of containerized freight (4 million of TEU) and about 22 million tons of dry bulk by 2028, to be increased respectively to 7.5 million of TEU and 33 million of tons respectively by 2038.



The depth of the quays (-17.5 m) will allow the operation of the new generation of container ships. The special quays for the operation of container ships will be 7,000 m long (about 20 berths). The quays specialized in moving dry bulk will be 3,500 m long (about 12 berths).

A dredged channel 400 m wide and 24 km long will connect the new port to the deep water; dredged volumes will be approximately 60.000.000 m3 for the navigation channel and 82.000.000 m3 for the port basins, protected by rubble mound breakwaters approximately 15 km long.

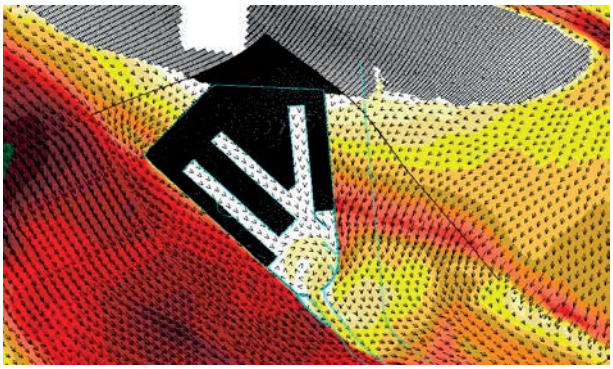


The project includes 2.000.000 m2 of yard for terminal container stacking, 600.000 m2 for dry bulk yards and 1.000.000 m2 of land yard for buildings and warehouses 200.000 m3 of silos for wheat.

A double lane road (2.000-3.000 commercial vehicles during peak hours) and a double track railway (80-90 couples of train/day) will connect the new port to the existing transport network.

Description of the activities:

The port layout and position have been optimised, considering the interferences with other projects under execution in the area, the possible effects on the hydrodynamics and morphology of the site, and navigational aspects. The activities included the review of the findings of the Feasibility Study carried out by the Consortium CIITI completed on 2008 considering the updated information available on the existing traffic and the future demand in the country, in terms of roads, railways and ports.

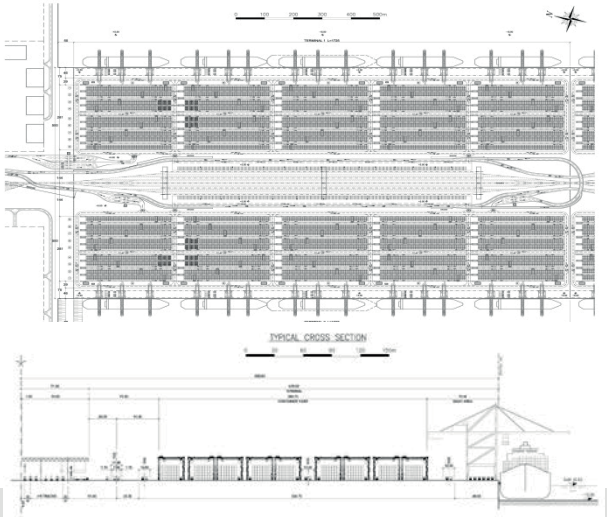


The master plan of the port was developed in consideration of quays and yard extension, quay and channel depth, equipment, buildings, etc., technical requirements discussed with the Client, and also considering the results of specialist technical studies, geotechnical and hydrodynamic in particular.

The facilities needed for the port to be operative at the first stage of construction (2028) were designed at the FEED (Front End Engineering Design) level and to be sufficient to prepare the design and construction tender documents to be implemented under a FIDIC Yellow Book contract, to obtain comparable offers and to award the contract.

The port will be implemented in different stages. At the date 2 stages of construction have been awarded the East Breakwater/Staging Pier and the West Breakwater.

Technital is in charge of assistance during the tender stage until the negotiation and signature of the contract for design & build and is in charge of the supervision of works.



PROJECT MANAGEMENT CONSULTANCY (PMC) FOR THE DORALEH MULTIPURPOSE PORT IN DJIBOUTI

Location:	Doraleh, Djibuti
Client:	Port de Djibouti S.A. (PDSA)
Services:	Construction Supervision, Contract Management.
Period:	11/2015 – 09/2022
Construction cost:	Confidential

Project Description:

The project for the construction of the Doraleh multipurpose port, located in Doraleh region of Djibouti.

Port De Djibouti S.A. (PDSA) plan is to build the Doraleh Multi-purpose Port (DMP) in Djibouti. The total proposed quay line of the DMP will accommodate 16 berths and will be built in two phases. The Works in this contract comprise of Phase 1 of the port development. The Phase 1 quay line is 1,375m long for 6 berths with a maximum berthing vessel up to 100,000 DWT, in addition a service/RoRo berth and a floating dock will be built. The design annual throughput capacity of the Doraleh Multi-purpose Port (Phase I) shall be 7.08 million tons plus 200,000 TEUs.

The Doraleh Multi-purpose Port (phase 1) includes:

- Main quay 1,200 m long and -15.3 m depth, for 6 berths to berth vessel up to 100,000 DWT, built by n. 63 concrete precast caissons;
- East quay 175 m long -12m depth built by n. 12 concrete precast caissons
- Multipurpose stock yard: coal. general cargo, cement and fertilizer, grain, vehicle, sugar and fertilizer warehouse
- Buildings;
- Excavation and dredging works
- Land reclamation works

The project is developed under the International Federation of Consulting Engineers (FIDIC) “Conditions of Contract for Plant and Design-Build for Electrical and Mechanical Plant and for Building and Engineering Works Designed by the Contractor, First Edition 1999”, supplemented and amended by Particular Conditions.

The Project Management Consultancy (PMC) supports Djibouti Port Authority (The Client) objectives and to deliver the above said project with outstanding control of all aspects and performance, meeting cost, schedule and quality targets.

Description of actual services provided:

- Liaising with the Client and, on his behalf, with the Engineer and the Contractor;
- Managing the Value Engineering process.

- Prepare, evaluate and analyze all the correspondence, instructions, minutes meetings, notifications and the like
- Analyze the necessary documentation for claims submitted by the Contractor and the Engineer, evaluate contract claims/variations and all necessary notification within set time limits
- Co-coordinating and integrating the construction programs of the various direct contracts into an overall construction programme, including ensuring timely procurement of the direct contracts
- Control the execution of the construction processes to ensure adherence to overall construction programme.
- Control the successful execution of the project within approved duration, scope of work and budget and advise the Employ
- Evaluate project budget
- Ensuring that all necessary inspections are carried out by the Supervision Consultant(s).
- Advise the client regularly on progress, area if concerns, recommendation, forecasted date of completion, required budget for projects
- Monitors and controls all contractual aspects of the projects
- Checking instructions, payment certificates, financial statements and certificates of completion prepared by the Engineer
- Preparing and presentation of a confidential monthly Project status Report to the Client
- Checking the execution of the Project in Accordance with the approved planning documents
- Checking of D&B tender documents and employer’s Requirements, with reference to the ongoing activities, for their respect and implementation.
- Preparing D&B tender documents for addenda and Variation Orders to the Project.
- Preparing D&B tender documents for site surveys and quality control monitoring (i.e. on concrete, reclamation settlements etc.) by third Parties.

DETAILED DREDGING DESIGN AND DISPOSAL OF DREDGING MATERIAL FOR DREDGING OF THE ENTRANCE CHANNEL, HARBOUR BASIN AND TURNING CIRCLE OF DAR ES SALAAM PORT

Location:	Dar es Salaam, Tanzania
Client:	Tanzania Ports Authority (TPA)
Services:	Detailed design of dredging including: environmental site investigation and laboratory analysis (physical, chemical and eco-toxicological test); Preparation of bidding documents.
Period:	08/2018 – 07/2019
Construction cost:	109,833,044

Project Description:

The Port of Dar es Salaam (DSM) (pictured below) is the main port of Tanzania and is located at the mouth of rivers Kizinga and Mzinga within the Dar es Salaam bay. Port traffic volumes are growing by 9 per cent per year, with containerized volumes increasing even faster. This rapid growth is placing considerable strain on Dar-es-Salaam Port. As a consequence, Dar-es-Salaam Port has implemented plans so develop Port capabilities including facilitating access to Panamax and, in the future, possibly Post-Panamax capacity container vessels as well as larger dry bulk vessels. At the moment this kind of vessels are constrained by the width and depth of the channel, the depth at the quay, and the available turning basin. These plans require the entrance channel and the port basin to be dredged, and the dimensions of the entrance channel and the turning basin(s) adapted accordingly. The Consultant has already carried out the feasibility study and the preliminary design for the upgrade of the port area, which foresees the dredging of approx. 16 million m3 of sediments from the port and the approaching channel and their disposal offshore.
A preferred design option supported through economic evaluation and appraisal was accepted by the TPA.
This assignment however, concerns the dredging detailed design of only phase 1 of this preferred design option, which includes the dredging (widening / deepening) of the Port Entrance Channel, First Turning Circle and Harbor Basin up to Berth 11.

Scope of this assignment is to perform an additional environment assessment and analysis to determine practicable solutions for the disposal of dredged polluted /unpolluted sediments related to the envisaged expansion works and establish a detailed working methodology for dredging and disposal of dredged material, detailed dredging design as well as tender documents for the dredging works:

- Site investigation and laboratory analysis: physical, chemical and eco-toxicological characterization of polluted sediments to better understand the potential environmental risk of their disposal in the ocean
- Analysis of the dispersion patterns of the sediments dumped in the Ocean: Dispersion study of the dredged sediments (improving numerical models - 3D models- of the area where the sediments have to be discharged); Assessment of dispersion mechanism & comprehensive assessment of the risk, identifying the optimised depth at which the sediments will have to be discharged; turbidity monitoring plan to minimize the risk of impairing marine.

Detailed design of dredging of the port of Dar es Salaam: Option B – Phase 1 – General layout

In the **detailed design the option B phase 1** will be developed starting from the results of the Environmental Assessment: the deepening of the 5km long approach channel to -16.50m and of the 3.0km long inner channel/harbour basin to -15.50m in order to safely receive a Post-Panamax design ship 305m long, 40m wide and with a draft up to 14.5m without tidal restrictions. The total dredging volume of the phase 1 amounted to approx. 10,35 million m^3 (considering vertical and horizontal dredging tolerances) consisting mainly of clayey silt, sand and coral deposits.

The assignment also included the **preparation of bidding documents for works**.

POST-CONTRACT SITE SUPERVISION AND QUANTITY SURVEYING CONSULTANCY SERVICES OF CONSTRUCTION WORKS FOR THE PORT OF TADJOURA – DJIBOUTI

Location:	Tadjoura, Djibouti
Client:	Djibouti Ports Authority
Services:	Supervision of works
Period:	06/2013 – 10/2017
Construction cost:	€ 66,000,000

Project Description:

The new Port facilities will be developed in a suitable area located west of the town of Tadjoura along 1.5 km of eastern Walwallè wadi outlet, on the north coast of Tadjoura Gulf and connected to Djibouti by the national road RN9.

The new Port of Tadjoura will be able to handle 35% of the future volume of merchandise exchanged with Ethiopia, estimated at approx 3.5 M t/year. For this reason a new road connecting Tadjoura with the Ethiopian border, passing through the towns of Randa, Dorra and Balho, is currently under design. A phased development of the new Port of Tadjoura has been planned.

Phase 1 envisages the construction of a General Cargo quay 435 m long and a Ro-Ro Terminal 190 m long, able to handle a total of about 1.7÷2.3 M t/y (0.2÷0.3 M t/y of General Cargo and 1.5÷2.0 M t/y of Ro-Ro handling). The General Cargo quay consists of a circular cell structure. The Ro-Ro terminal consists of 4 mono-pile breasting dolphins and 4 catwalks connecting the breasting dolphins, each made of tubular welded truss of about 45 m length. The total port area is about 30 ha. of which approximately 14.5 ha. are not paved but well compacted to be suitable for heavy materials' stevedoring.

The Phase 1 layout also includes the wadi flood protection measures (gabion walls and artificial trench for an initial wadi diversion), the construction of 22 buildings (gates, warehouse, Port Authority building, Control Tower, Harbour Master building, etc), the fencing and the execution of the external parking areas and finally the supply of the required port equipment (truck mounted cranes, ambulance, fire truck, etc.).

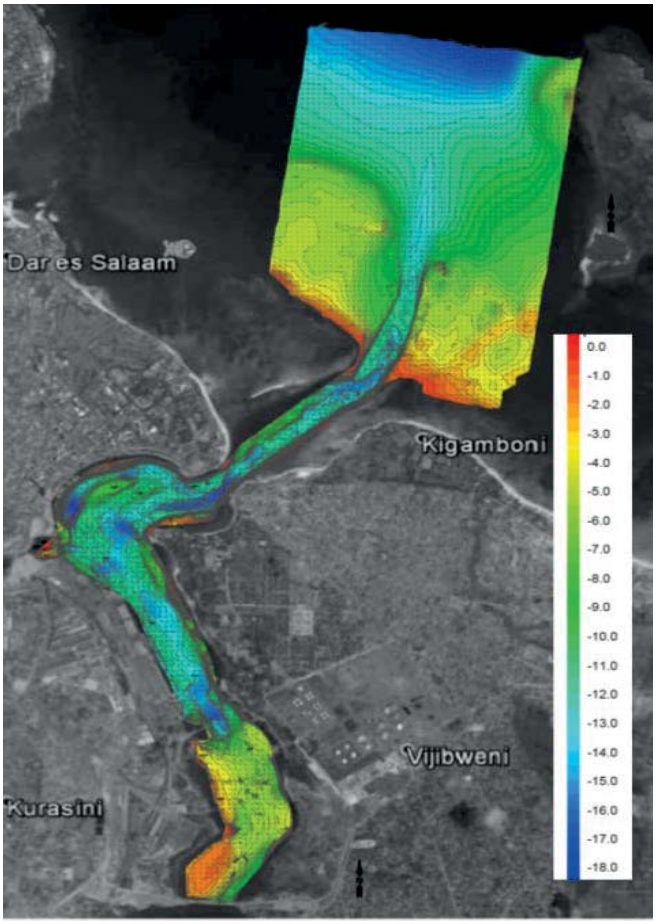
The cost of the entire Phase 1 is about € 66,000,000 (including also the fire-fighting system, and the yard lighting system).

CONSULTING SERVICES FOR FEASIBILITY STUDY INCLUDING BATHYMETRIC, HYDRODYNAMIC AND GEOTECHNICAL SURVEYS FOR DREDGING OF DAR ES SALAAM PORT ENTRANCE CHANNEL AND TURNING BASINS

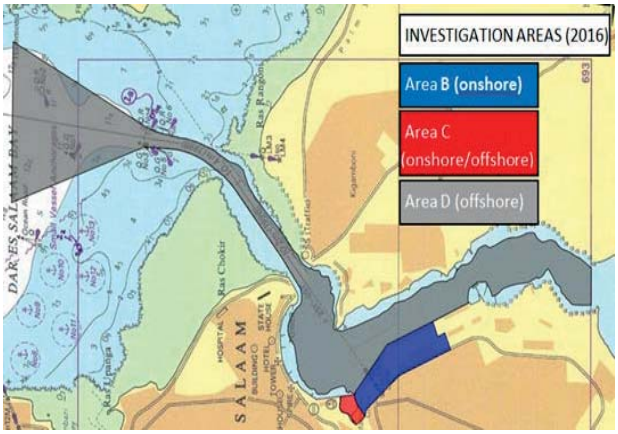
Location:	Port of Dar es Salaam, Tanzania
Client:	Tanzania Ports Authority (TPA)
Services:	Field Data Collection, Bathymetric and Geotechnical Surveys, Feasibility Study, Concept Design of Entrance Channel, Real Time Navigation Simulations, Hydrodynamic and Sedimentation Study, Cost Estimates, Scoping of the ESIA (by Technital), Financial feasibility and Economical Appraisal (by Others).
Period:	12/2015 – 05/2017
Construction cost:	To be tendered (confidential)

Project Description:

The Port of Dar es Salaam (DSM) is the main port of Tanzania. Volumes handled reached 14.5 million tons in 2013/14 and are growing by 10% per year, with containerized volumes increasing even faster. The port has 11 berths (for a total length of approximately 2,000m), two tanker berths and handles a vast array of cargo, including containerized, dry bulk, Ro-Ro, and liquid bulk cargo. As part of the port development plan, the Tanzania Port Authority (TPA) has developed plans to ensure the access of Panamax and, in the future, possibly Post-Panamax capacity container vessels, as well as larger dry bulk vessels, which are currently constrained by the width and depth of the channel (currently -10.0m/-10.2m CD), the depth at the quay and the available turning basins. These plans require the 5km long entrance channel and port basin to be dredged, and the dimensions of the entrance channel and turning basins adapted accordingly.



Scope of the assignment was to assess the current and future demand of DSM port aimed at defining the size of future vessels calling at the port and to undertake the feasibility study of **several dredging options** of the port basin and entrance channel, comprising the concept design of each option, the definition of the most suitable dredging and disposal methodology taking into account technical, economic and environmental aspects including **water quality assessments**, a hydrodynamic and sedimentation study to determine the most viable strategy for maintenance dredging, a cost-benefit analysis of the proposed options and the selection of the optimum alternative to be recommended to TPA for further action.

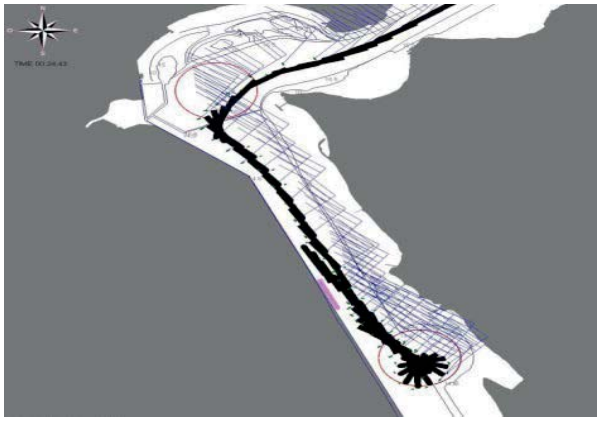


AREAS OF SITE INVESTIGATIONS

The assignment also included the execution of bathymetric, hydrodynamic, environmental and geotechnical surveys of the access channel and harbour basin to thoroughly assess the properties of the soil to be dredged and to determine the most appropriate dredging and disposal methods.

Three dredging design options associated with different development alternatives of port infrastructures were investigated, considering the access to the harbour in both tide restricted and tide unrestricted conditions for several design vessels. The most promising option in terms of technical, financial and economic feasibility implied the deepening of the 5km long approach channel to -16.50m and of the 3.0km long inner channel/harbour basin to -15.50m in order to safely receive a Post-Panamax design ship 305m long, 40m wide and with a draft up to 14.5m without tidal restrictions. The recommended option also included the provision of two new turning circles of 500m and a 1.2 km long extension of the inner channel to enable the access to new Berths 12-14. The total dredging volume amounted to approx. 20 million m^3, consisting mainly of clayey silt, sand and coral deposits, 1.7 million m^3 of which were contaminated sediments. The management of dredged material included the transport of contaminated sediments to an upland confined disposal facility to be built along the coast, the re-use of suitable material within planned port reclamation projects and the discharge of the remaining soil in

open water at dedicated offshore disposal areas. Suitable offshore dumping sites located 10km and 15km NE of the existing channel were selected through a specific hydrodynamic study.



REAL TIME NAVIGATION SIMULATION

OPTION B) LAYOUT WITHOUT TIDAL RESTRICTIONS

Description of actual services provided:

The consultancy services included the following tasks:

Feasibility study, including: field data collection inside and outside the port basin (site recorded metocean and meteorological data), geotechnical (off-shore, on-shore) and bathymetric surveys, assessment of the current and future traffic demand, entrance channel concept design, real time navigation simulations, hydrodynamic and sedimentation study, dredging and disposal methodology, dredging cost estimates, environmental aspects, and scoping of the ESIA

CONSTRUCTION OF A CONFINED DUMPSITE TO BE USED AS NEW CONTAINER TERMINAL IN THE PORT OF NAPLES

Location:	Naples, Italy
Client:	Naples Port Authority
Services:	Preliminary, Final and Detailed Design, EIA, Works Supervision
Period:	05/2003 – 12/2016
Construction cost:	€ 424, 215, 000

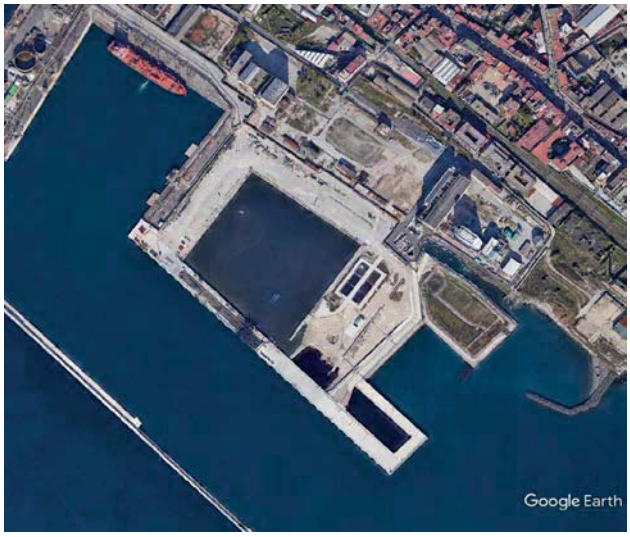
Project Description:

The design of the new container terminal at the Levante Dock (Port of Naples) is based upon the closure of the dock with land filling of about 1.3 million cube metres of sediment dredged from the whole Port area. Thanks to the low permeability of the boundaries the site was designed to be used also as a confined disposal facility. The port dredged materials in fact are potentially polluted.

The new quay for container ships is to be built by converting an existing quay with the following features:

- 650 m length, 14 m depth which could be increased to 16 m for future needs;
- capacity to host two 6,000 TEU ships at the same time, or one ship of 11,000 TEU
- storage and handling area for containers including backup area of 230,000 m2;
- availability of areas for road and rail connections, port services and workshops for dockers.

The new quay structure consisting of a double wall of steel piles connected with Larssen type joints, with polyurethane waterproof sheathing up to the impermeable tufa layer. Backwards, the boundaries are made by means of cement-bentonite mix diaphragms.



The project comprises the clean-up of bottom sediments (characterization and confinement of hot spot soils to a disposal site), protection of the area by a cut-off wall in order to prevent polluted groundwater to enter in the CDF, re-design of existent structures, dredging and land reclamation activities.

As far as Environmental Impact Assessment is concerned, noise and air modelling were used to evaluate impacts induced by the construction site. Further to the Environmental Impact Assessment, environmental risk analyses were performed to properly manage polluted material and avoid detrimental effects to environment and human health, due to the vicinity of the port to the city of Naples.

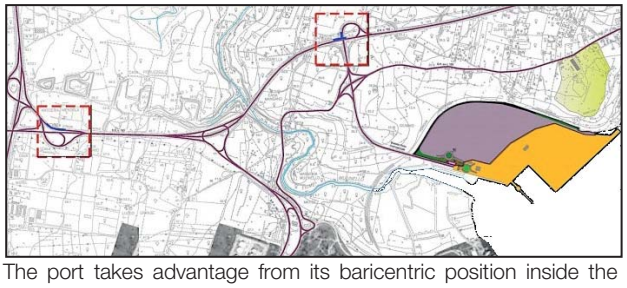
The design of the Terminal has been approved by the Italian Ministry of Infrastructures and Ministry of the Environment. Regarding as far as environmental protection.

PREMILINARY, DETAILED DESIGN, AND EIA FOR THE CONTAINER TERMINAL OF THE PORT OF AUGUSTA

Location:	Augusta, Italy
Client:	Autorità del Sistema Portuale della Sicilia Orientale
Services:	Preliminary Design, Detailed Design, EIA
Period:	03/2009 – 07/2014
Construction cost:	€ 113,770,000

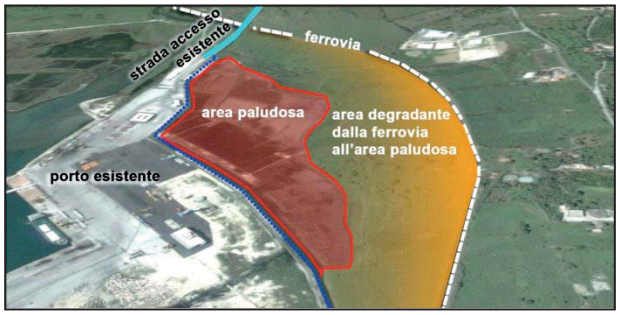
Project Description:

The intervention falls within the administration of the Province of Syracuse. It is located into the Rada of Augusta, located within the Bay of the same name. The is about 8 km long and about 4 km wide with an average depth of 14.9 m. The Rada of Augusta is divided into three main areas: Porto Xifonio (external harbor), Porto Megarese (internal harbor); Seno del Priolo, between the southern dam and the Magnisi peninsula.

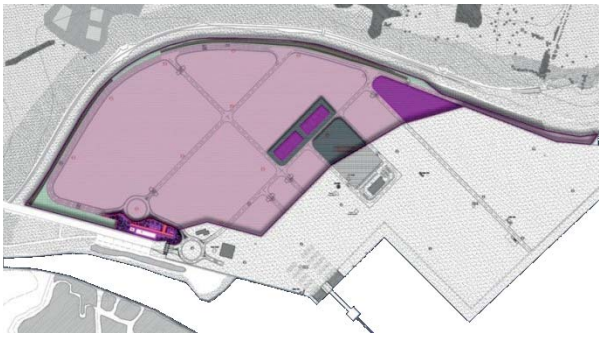


The port takes advantage from its baricentric position inside the Mediterranean sea. It is one of the most important port for bunker operations, crew change, ship repair and maintenance, pleasure craft, loading/unloading various goods to and from Sicily.

The project of the second and last phase of the works of the Augusta Commercial Port located in the North-West part of the homonymous Rada, concerns the acquisition of new areas and the construction of new equipped area in the commercial port.



The intervention allows the construction of a port terminal for container handling specifically dedicated to transshipment activity, and the possibility for the port of Augusta to constitute one of the southern poles of access to large transoceanic and intercontinental routes.



The expansion covers an area of about 366,00 square meters. The area was in a complete state of abandonment; morphologically it has a flat part to the south, of a predominantly marshy nature that rises in altitude until it reaches its border.

The foreseen interventions concern: the acquisition of the new area; reclamation Works; excavations and fillings; yards paving; power supply; lighting; sewerage, fire fighting for the a whole area of about 6,100.00 square meters; internal road; realization of containment works in reinforced earth (terramesh) and stabilization works on the slope near the railway through naturalistic engineering systems, with the realization of reinforced earthworks for the containment and stabilization; fencing of port areas; 6 gates; realization of pre-cast sheds for a total of about 2,500 square meters.

The overall project has envisaged environmental monitoring Works (such as: Noise Monitoring, Air Monitoring; Land monitoring); replanting interventions and anti-noise barriers.

EXTENSION AND RESTRUCTURING OF THE PORT OF GALEOTA

Location:	TRINIDAD & TOBAGO
Client:	GLF Construction Corporation
Services:	Preliminary, final and detailed design, and safety coordination and technical assistance
Period:	09/2008 – 12/2014
Construction cost:	€ 55,493,500

Project Description:

The port of Galeota is located near the village of Guayaguayare in the Claro/Mayaro region, at the south-east tip of the Island of Trinidad, some 11 km from the north-east coast of Venezuela. It is located on a peninsula extending south and the main quay (355 m long) runs east-west and serves also as a seawall protecting the port basin from the Atlantic waves. The port is used mainly by British Petroleum Trinidad and Tobago (bpTT) as a service berth for the offshore gas and oil explorations (East Blocks). The port area is also the location of hydrocarbon treatment plant connected by pipeline to the offshore platform where the oil is extracted. Lastly the port is used by the Coast Guard, which has a berth and part of the onshore area at its disposal.

The present berthing facilities consist of 5 quays, 2 of which equipped for loading-unloading operations, while the others are used exclusively for berthing. Given the numerous deficiencies: insufficient depths, sedimentation problems, limited space behind the quays to guarantee safe loading-unloading operations, the evident state of deterioration of the quays (corroded sheet-piles and damaged paving), frequent overtopping of the main quay, major upgrading works are require and the competent local authority, N.E.C. (National Energy Corporation) has therefore requested the drawing up of a port master plan and a detailed design of the new port structures.

After extensive topo-bathymetric surveys of the area and geotechnical investigations to define the material to be dredged and the foundation soils, the following works envisaged are: no. 5 quays with a total length of 520 m; dredging of the access channel, the turning basin and the port basin; backfilling of an area of 27,000 m^2 using dredged material; rehabilitation of the existing vertical wall on the sea side; and new fishing port on the north side of the gulf of Guayaguayare.

The **quays** are vertical sheet-pile walls embedded at depths ranging from -7.60 to -12.80 m a.s.l. with a height of +2.60-2.80 m a.s.l. connected by t20 m long tie-rods ⌷5 at intervals of 1.40-2.80 m. The sheet-piles are joined at the head by a reinforced concrete curb cast in-situ. Behind the sheet-piling there will be a cable-duct for the installations. The quays are fitted with fenders, bollard and ladders.

The paving behind the quays consists of a 700 mm thick compacted stone layer with a 76 mm asphalt coating.

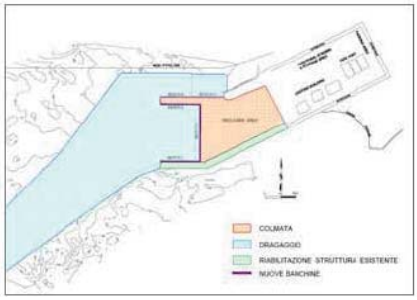
The quays are designed to sustain a uniformly distributed load ranging from 15 kN/m2 to 50 kN/m2, the load generated by the crane (model Liebherr LHM 180), the actions caused by the waves and the ship mooring , and take into consideration the seismicity of the area (Seismic Zone 3 = medium-high seismic risk).

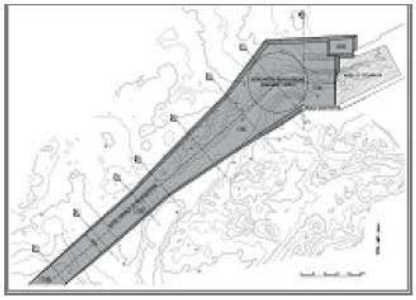
Dredging of the port basin, the 200 m turning basin and the 80-200 m wide access channel will be effected to -7.60 m a.s.l. for a total volume of some 550,000 m^3. The dredged material making up the natural sea be has been defined, to the final dredging depth, by means of 5 boreholes which demonstrated the suitability of the dredged material fro the backfill. The backfill will use some 300,000 m^3 of dredged sediment while the remainder will be used elsewhere.

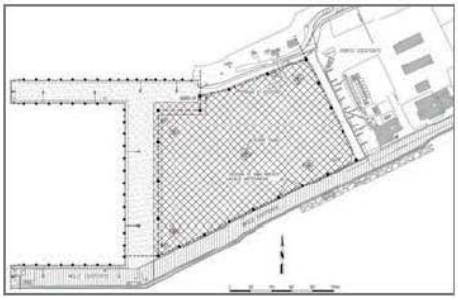
The **backfill area** of approx. 27,000 m^2 is achieved entirely with dredged material. From 50 cm below the final height of the backfill, the area is levelled and compacted with an 18t vibrating roller. The successive 30 cm of backfill (max. thickness of the compacted layer) is levelled by light bulldozers or similar over the whole backfill area to permit adequate drying of the sediments, and overlaid with paving of suitably sized granular material. Settlements are expected to occur mainly during works construction and therefore no particular interventions have been envisaged to accelerate the consolidation process.

The services carried out by TECHNITAL concerned:

- no. 5 quays (total length 520 m) , of which some 340 m new quays on sea bottoms dredged to -7.60 m a.s.l. for larger vessels, 80 m for the Coast Guard (depths of -5.60 m a.s.l.) and the remaining 100 m including restructuring of the existing breakwater;
- dredging of the access channel, the turning basin and the port basin;
- backfilling of 27,000 m^2 area using dredged material;
- rehabilitation of the existing vertical wall on the sea side.







REHABILITATION OF THE PORT OF SHENGJIN

Location:	Albania
Client:	Delegation of the European Union to Albania
Services:	Phase 1: Preliminary design review, detailed design, tender and contract documents for a new quay for general cargo and new paved and fully equipped operating yard. Phase 2: Supervision of construction.
Period:	12/2009 – 05/2014
Construction cost:	€ 3,200,177

Project Description:

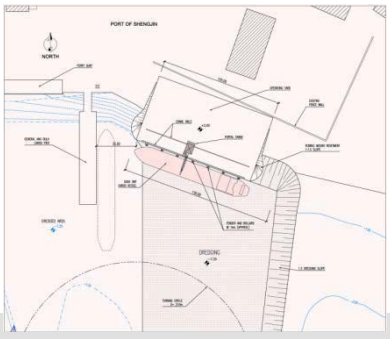
The project for the rehabilitation of the Port of Shengjin was part of the huge scheme to develop and upgrade the Albanian transport network, being implemented in accordance with the National Transport Master Plan of 2006 and the Albanian National Transport Strategy. The project's overall objective was to promote the improvement of Albanian Maritime Sector by modernizing and developing the existing port infrastructure, thereby contributing to the integration of Albania in the European Maritime System.

The rehabilitation project was integral to the implementation of the Port Master Plan, and comprised engineering consultancy services for the construction of a 105 m long new quay for general cargo with design depth of 7.35 m below MSL, and a new paved and equipped operating yard of approx. 6,500 m2. The placing of a preloading surcharge of approx. 45,000 m3 of dredged/mined fill was provided for to improve the conditions of foundation soil over the whole project site.

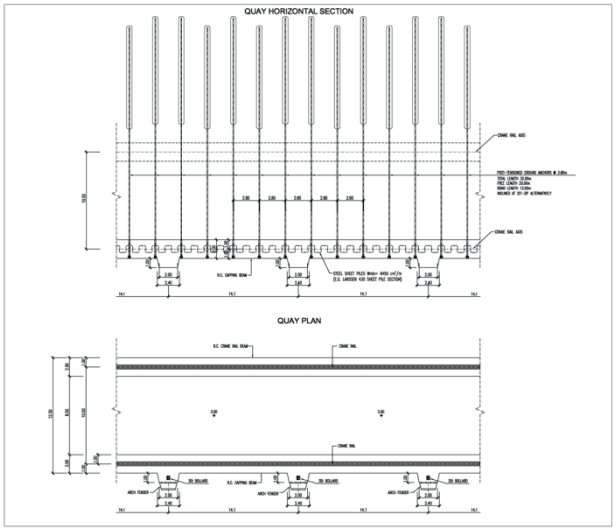
The consultancy services were divided into two distinct phases, as follows:

- Phase 1: Review of the existing preliminary design, preparation of detailed design and tender dossier;
- Phase 2: Supervision of the construction works including a 12 months defect liability period..

In the preliminary design review three options for the quay were examined: open piled berth, steel sheet pile quay, reinforced concrete diaphragm wall, from which the best alternative proved to be the solution using steel sheet piles.



Detail design activities comprised detailed engineering design of the quay and yard infrastructures, including specific definition of the new works layout and cross sections, design of dredging and filling works, settlements and overall stability analyses, as well as the design of paving, quay furniture and installations (bollards, fenders, access ladders etc.), crane rails, drainage system and required utilities (electrical and lighting, potable water supply and fire-fighting system), corrosion protection system, and the definition of construction stages.



The overall rehabilitation project were organized, for tendering and construction purposes, in two separate works packages:

- Works Package PHASE A, including all main structural and civil works involved in the project, funded by the European Union under the IPA 2008 National Programme for Albania;
- Works Package PHASE B, including paving, surface water drainage, water supply and fire-fighting systems, electrical and lighting system, yard finishing works, financed by the Albanian State Budget.

A full set of tender documents was provided by the Consultant for the works contract funded by the EC IPA Programme, in compliance with the PRAG (Practical Guide to Contract Procedures for EC External Actions) procedures and annexes.

NEW EXXON BERTH AND MODIFICATION OF PETROLIG BERTH FOR OIL PRODUCTS IN VADO LIGURE

Location:	Italy
Client:	Port Authority of Savona
Services:	Feasibility Study and definition of design criteria, Basic Design, Detailed Design, Tender Document and Cost Estimate for construction and operation of new Exxon berth and modification of PetroLig berth for oil products
Period:	08/2009 - 02/2014
Construction cost:	€ 9.273.703

Project Description:

The operations to erect the New Multipurpose Platform at Vado Ligure Port would interfere with the efficiency of existing PetroLig and Exxon berths.

After the evaluation of different possible alternatives, a new Exxon berth, in substitution of the existing one (to be dismantled), and modifications to the PetroLig jetty mooring system (dolphins instead of buoys) appeared the best solution.

New Exxon berth

Project requirements:

- berth operational limits unchanged;
- handling the same products as at the existing berth;
- products loading/unloading by means of flexible hoses;
- piping connection between the new platform and the existing Exxon ashore piping;
- berth operational procedures unchanged.
- tankers displacement range 5.000 ÷ 12.000 DWT;

The new infrastructures are:

- steel platform with equipment for products loading/unloading and related utilities;
- 3 steel mooring dolphins, the fore one shared with PetroLig berth;
- 2 steel breasting dolphins;
- new dedicated piping along PetroLig jetty, from the platform to jetty root, and interconnecting with existing ashore piping.

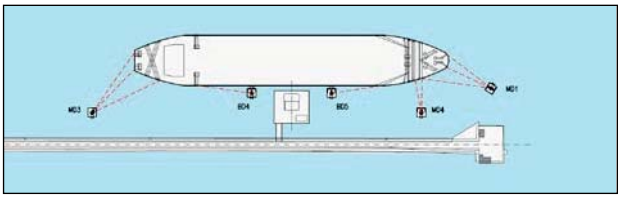
PetroLig berth modifications

Project requirements:

- berth operational limits unchanged;
- use of existing loading/unloading system, as a consequence the present distance between the tanker stern and the jetty platform shall be maintained;
- tankers displacement range 12.000 ÷ 25.000 DWT.

The new infrastructures are:

- 2 steel mooring dolphins;
- 3 steel breasting dolphins.



New Exxon berth - Plan view

PetroLig berth modifications - Plan view

New Exxon berth - View

DORALEH OIL TERMINAL REHABILITATION

Location:	Djibouti
Client:	Dubai Ports World
Services:	Inspection: criteria and extent, execution, reporting; Detailed Engineering of repair and maintenance works: specifications, drawings, B.o.Q.; Detailed Design of improvements to mooring dolphins: calculation report, drawings, specifications, B.o.Q.; Cost Estimate; Tender Document packages for maintenance and repair works; Assistance to bid and contract award; Supervision to rehabilitation works
Period:	03/2011 - 07/2013
Construction cost:	€ 2,000,000

Project Description:

The Terminal includes:

- a Causeway, 1,060 m long, from shore, on a rubble armored backfill;
- a Trestle, 197.5 m long, to connect the causeway to Platform 1;
- a main platform (Platform 1), 71.25 m *15.50 m, on the offshore side, to berth oil tankers ranging from 5,000 DWT to 80,000 DWT;
- a secondary platform (Platform 2), 56.25 m * 15.00 m, on the shore side, to berth oil tankers ranging from 1,000 to 30,000 DWT;
- a Connection Bridge, about 73 m long, between Platform 1 and Platform 2;
- 4 Mooring Dolphins;
- 5 Catwalks, to connect platforms and mooring dolphins each others.

Technital was charged for inspecting the oil terminal structures and providing the documentation to tender and award a contract for the execution of maintenance and repair works.

The survey was carried out on the superstructures (including fittings and secondary components) and foundation piles (including underwater survey and anodes).

The following occurrences were detected:

- damage and defects on steel structures and components
- need for paint repair or touch-up of steel components
- need for substitution or protection and/or tightening of bolts
- damage, marine growth and coat failure of steel piles
- missing or exhausted anodes
- missing or worn fender panels and bolts
- damage, wear and defects in concrete structures and components
- functionality of mooring hooks

The findings were classified in importance and in type of required intervention, i.e. substitution, repair or maintenance.

Specifications and drawings were prepared to detail required rehabilitation works, their procedure and recommended products/systems, including:

- concrete repair (mainly to overcome spalling, cracks, surface deterioration) and surface protection (for deck slab underside and side panel);
- steel structure repair or substitution (mainly bolts, ladders, gratings);
- repair or re-coating of steel structures;
- piles cleaning, coat maintenance, substitution of anodes.

A mooring dolphins, damaged by vessel impacts against a foundation pile, was checked in its actual condition and a detailed design of structural improvements to prevent future accident was carried out.

Djibouti – Doraleh Oil Terminal Layout

EXPANSION OF MARINA/FISHING PORT AT AL WAKRAH

Location:	Qatar
Client:	Private Engineering Office (QATAR)
Services:	Concept, Preliminary and Detailed design
Period:	10/2011 - 09/2012
Construction cost:	€ 150,000,000

Project Description:

The main purpose of the pre-contract design activities was to investigate and design the expansion of the existing fishing port and facilities at Al Wakrah (on the west coast of Qatar) to accommodate n° 380 fishing dhows, n° 700 small boats, MoE/Coast Guard vessels, PEO wooden dhows and traditional dhows, and in a manner that will resolve the current inadequacies and problems concerning coastal water quality and sedimentation all around the existing port. The existing port facilities can accommodate only 150 fishing dhows.

Three design stages were performed: a Concept Stage, Preliminary Stage and Detailed Stage including the preparation of tender documents for the construction of the marine works.

In the Concept Design Stage the following activities were carried out for the comprehension of present situation:

- a topographic and bathymetric survey;
- an environmental study based on site investigations;
- a preliminary geotechnical site assessment;
- a jetty structural assessment study based on several site inspections;
- a meteomarine study for the assessment of winds, waves, sea levels and currents at the site;
- a coastal morphological study
- an hydrodynamic and water quality study.

Different alternative configuration concepts for port expansion were identified on basis of port requirements and a comparative analysis of the proposed solutions was performed in order to support the Client in selecting the most promising development option in terms of technical-economic feasibility.

The final solution, developed in the Detailed Design, envisages the demolition of the existing jetty and the construction of a new main port characterised by 2 different basin at a depth of -4 m MSL (fishing dhows basin) and -3m MSL (small boats basin). The traditional dhows are to be accommodated in a mini port located close to the coast and along the north edge a public beach has been located. The final configuration of the port includes:

- concrete blocks quay walls for an extension of 5,900 m in the Main Fishing Port and 500 m in the miniport
- 1,700,000 m3 of total dredging, including Northern (L=2,300 m) and Southern (L=2700 m) Channels
- rubblemound breakwaters for an extension of 2,400 m in the Main Fishing Port and 530 m in the Miniport
- 700 m long and 70 m wide beach
- 84,600 m3 of beach sand fill
- 175m long access causeway made of box culverts.

LA BREA - PORT OF BRIGHTON PROJECT: ALUTRINT MATERIAL STORAGE AND HANDLING FACILITY

Location:	Trinidad & Tobago
Client:	Grandi Lavori Fincosit
Services:	Geotechnical studies and investigations, foundation design. Preliminary and Final Engineering Design, Procurement, Construction Management
Period:	12/2008 – 05/2012
Construction cost:	€ 71,000,000

Project Description:

The project concerns the construction of a facility for the distribution of alumina and coke. On the outer edge area, a port facility will be built and connected to the storage buildings by means of a conveyor system in so that the material can be loaded and unloaded from the boats moored at the port.

Project layout

The layout envisages the following structures and facilities:

- reinforced concrete storage silos (dia. 38.5 m x 60 m high)
- coke storage building (79 x 75 m)
- transfer towers
- conveyors
- warehouse buildings, 36 x72 m
- custom bonded area, 36 x72 m
- covered pitch storage, 30 x40 m
- liquid pitch and heating area, 40 x 60 m
- administration building, 13 x 30 m
- coke and alumina truck load out structures.

The scope of the services includes:

1. Preliminary engineering

Geotechnical-geological services:

- investigation and characterization works for the evaluation of the geology at the facility site;
- the foundation design for the silos, the coke storage buildings and the conveyor system;
- on-site support during pile driving tests and granular material compaction.

These tasks were achieved through specific geological and geotechnical visits to the site, which were combined with and completed by design computational analysis and evaluations based on the data gathered.

Excavation works

Preliminary design:

- development of preliminary Process Flow Diagrams, and preliminary Piping and Instrumentation Diagrams, for alumina, petcoke, pitch handling systems, utilities, and balance of plant functions in relation to receiving and storage systems
- development of preliminary General Drawings (including site plans, structural and mechanical details, etc.).
- development Preliminary Design Drawings and Specifications for Civil/Site works; Structures, Mechanical equipment .

Pile driving

- Preparation of Plan and Elevation drawings for buildings, conveyor system, loading/unloading facilities, rails, storage complex and warehouse, mechanical plants.

- Preparation of Preliminary Design Drawings and Installation Specifications for
    - Electrical power distriubution systems
    - Instrucmentation and controls
- Preparation of Preliminary Software Designs and Drawings for the automation control system.
- Preparation of Perfomance, Equipment and Construction Specifications
- Quantity and cost estimates

Silo construction

2. Final Engineering

The services of the second phase include:

- Completion of the foundation design arrangements and the site plan;
- Preparation of final quotation requests for major equipment suppliers;
- Production of all the final engineering designs, design drawings and specifications for the works including Civil/Site works, Foundations, Structures, Mechanical works and process piping, Electrical works, Control and operation software
- Liaison with the main Contractor and the Client;
- Preparation of final Plans and Elevations drawings for all equipment, facilities, operating areas, and structures;
- Monitoring, Testing and reporting.

3. Procurement

The task includes:

- Preparation of Bidder's list in conjunction with the Contractor
- Preparation of the bidding documents, evaluation of bids and negotiation with bidders, through to recommendation for award of the works contract
- Preparation, issuance and administration of purchase orders/contracts
- Preparation and issuance of chang orders and addendums.

4. Construction Management Services

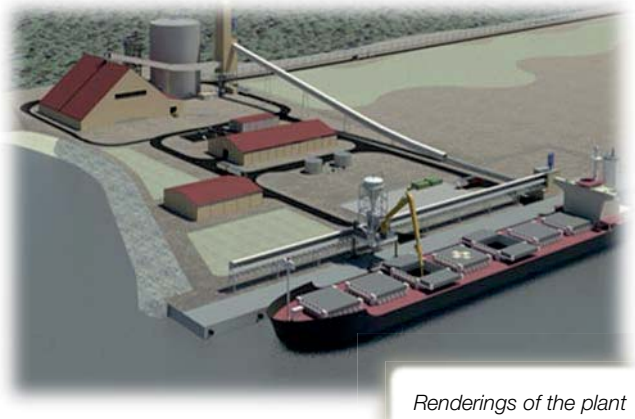
The CM services cover the final engineering phase and the construction phase and include:

- Review and updating of the project execution plan
- Preparation of monthly progress reports
- Review and refining of the project budget on the bassis of updated quantities and scope of work
- Management of the process for the receipt, review, approval, and return of the Contractor's requests for payment
- Checking conformity of construction materials equipment and procedures
- Monitoring, checking and coordination of the Contractors' activities and methods.
- Maintentance of project records and activity logs.
- Review permits, change orders, claims, etc.
- Manage the process of partial and final completion through to the final handover of the works.

5. Shop observation & surveillance

The services carried out under this heading concern:

- checking and reporting on the status of current orders with the various suppliers to ensure timely delivery of goods,
- evaluation of schedules,
- definition of expediting requirements,
- quality surveillance of equipment and materials.



Renderings of the plant

NEW PORT INFRASTRUCTURE AT AGUADULCE

Location:	Panama
Client:	Autoridad Marítima de Panamá
Services:	Feasibility study
Period:	05/2011 - 12/2011
Construction cost:	€ 43,520,000

Project Description:

The Panama Maritime Authority charged Technital SpA with the "Development of feasibility studies required for the implementation of a new port infrastructure, in the district of Aguadulce, Cocle Province - Republic of Panama".

Aguadulce is a town with a population of approximately 20,000 inhabitants, about 200 km from Panama City and 10 km from the Bay of Parita, on the Pacific Ocean.

In short, the objectives to be achieved by the approach of the new port of Aguadulce are:

- encourage the development of exports of agricultural products (increased trade will, in turn, further the development of agricultural activities in the central regions, creating more jobs and reducing the migration of the population to the capital);
- promote a better distribution of the fertilizer and fuel imports required by the central regions (with some obvious savings in transport time and costs, and consequent reduction of the congestion of the Port of Balboa);
- stimulate economic development in the region, also encouraging any processing industries for agricultural products.

The purpose of this study is to define the location of the structure, configuration, standard sections of the port structures and costs for its implementation.

Three alternative locations of the port were analysed (see figure), in order to achieve the following objectives:

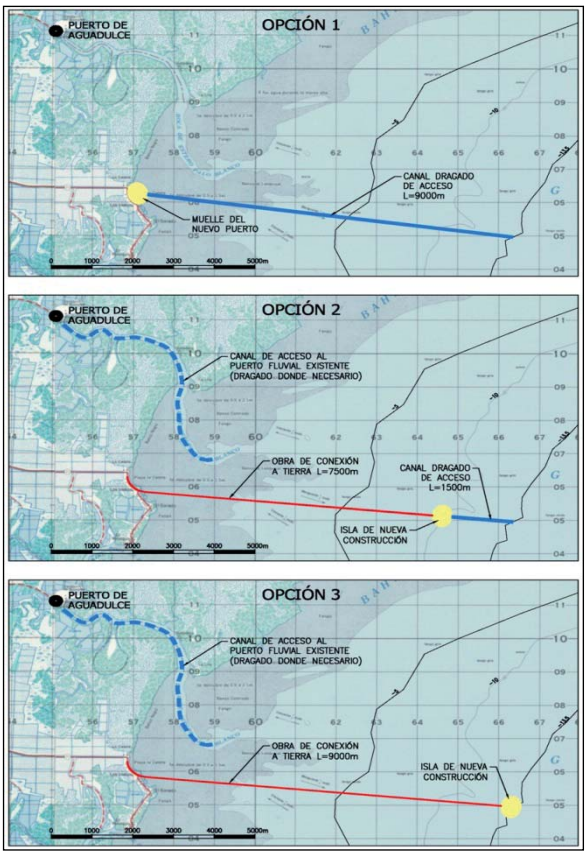
- minimize dredging, taking into account the assumptions made on geotechnical conditions;
- minimize, if the port location is on an island, the distance between the port and the mainland;
- ensure the best use of the existing port of Aguadulce;
- minimize the risk of sedimentation in the port and in Rio Blanco;
- ensure adequate protection of structures and berthing ships in case of waves;
- ensure stopping distance, an operation area and a width of entry to the port allowing safe mooring operations;
- allow the partial recovery of the land using dredged material;
- choose a port location which will allow further expansion.

The *first option* considered is a location on the coast, so that the port can be accessed directly from the existing road and does not need any additional link road. This solution requires considerable capital dredging works.

The *second option* involves the construction of a harbour island at a suitable depth and the restructuring

of the existing Port of Aguadulce. In this case, the scope of works includes the construction of the island, the dredging of the channel and construction of the connection.

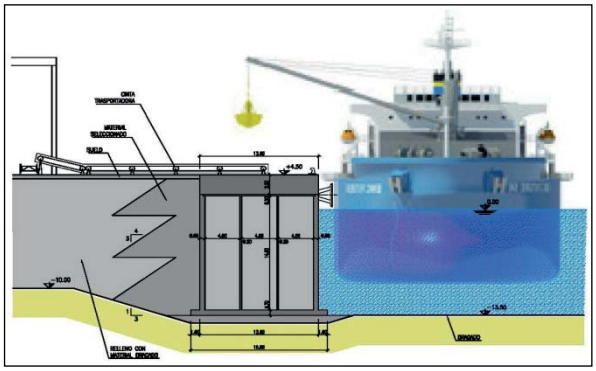
The *third option* is in "deep water" where capital dredging works are not required.



The costs-benefits analysis led to the choice of the intermediate solution of a port on an island at appropriate depths to 'balance' the volume of dredged material from the capital dredging for the navigation channel and from maintenance dredging of the channel to the Port of Aguadulce, against the volume needed for construction of the island.

The preliminary analyses led to a preference for pre-cast concrete caissons, rather than cellular cofferdams or open berths, for geotechnical, bathymetric and economic reasons.

The construction cost, excluding the connection, is expected to be around € 43,520,000.



TECHNO-ECONOMIC STUDY, PRELIMINARY AND DETAILED DESIGNS AND PREPARATION OF TENDER DOCUMENTS FOR THE PORT OF TADJOURA

Location:	Djibouti
Client:	Government of Djibouti
Services:	Economic and Financial Study, Preliminary and Detailed Designs and Preparation of Tender Documents
Period:	05/2010 - 12/2011
Construction cost:	€126,149,500 (US$179 M)

Project Description:

TECHNITAL was appointed by the Ministry of Equipment and Transport of the Government of Djibouti (the Client) to provide the Concept Design for the extension of the existing port of Tadjoura.

The new Port facilities will be developed in a suitable area located west of the town of Tadjoura along 1.5 km of eastern Walwallè wadi outlet, on the north coast of Tadjoura Gulf and connected to Djibouti by the national road RN9.

The location of the Project is shown in the figure below:

The Client is focusing on the development of roads, ports, airports and telecommunications of the northern area of the country in order to make Djibouti the hub of the regional traffic, connected to foreign countries of the CO.M.E.S.A. (Common Market for Eastern and Southern Africa).

The new Port of Tadjoura will be able to handle 35% of the future volume of merchandise exchanged with Ethiopia, estimated at approx 3.5 M t/year. For this reason a new road connecting Tadjoura with the Ethiopian border, passing through the towns of Randa, Dorra and Balho, is currently under design.

A phased development of the new Port of Tadjoura has been planned: the Phase 1 layout is shown below:

Phase1 layout

Phase 1 envisages the construction of a General Cargo quay 435 m long and a Ro-Ro Terminal 190 m long, able to handle a total of about 1.7÷2.3 M t/y (0.2÷0.3 M t/y of General Cargo and 1.5÷2.0 M t/y of Ro-Ro handling). The General Cargo quay consists of a circular cell structure. The Ro-Ro terminal consists of 4 mono-pile breasting dolphins and 4 catwalks connecting the breasting dolphins, each made of tubular welded truss of about 45 m length.

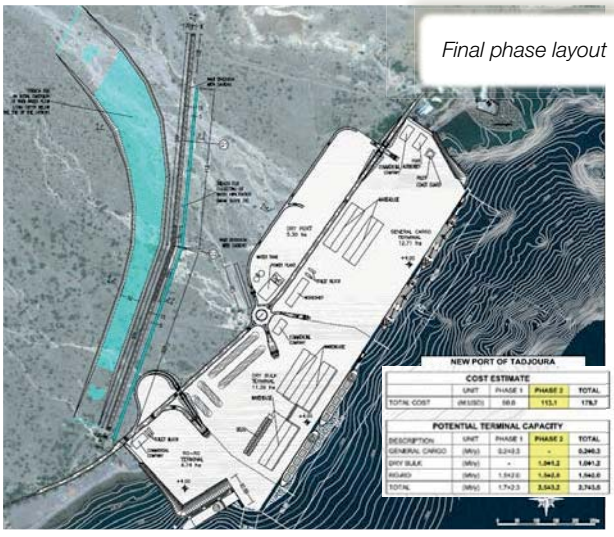
The total port area is about 30 ha. of which approximately 14.5 ha. are not paved but well compacted to be suitable for heavy materials' stevedoring. The Phase 1 layout also includes the wadi flood protection measures (gabion walls and artificial trench for an initial wadi diversion), the construction of 22 buildings (gates, warehouse, Port Authority building, Control Tower, Harbour Master building, etc), the fencing and the execution of the external parking areas and finally the supply of the required port equipment (truck mounted cranes, ambulance, fire truck, etc.).

The cost of the entire Phase 1 is about € 46,513,200

The above cost includes also the fire-fighting system, the yard lighting system.

Port Authority building

The layout of the Final Phase is shown below:



Final phase layout

With the Final phase the total throughput is increased up to 2.7÷3.5 M t/y by means the execution of a complete (with modern packing lines, silos, warehouse, conveyors, gates and relevant buildings) Bulk Terminal 450 m long, able to handle about 1.0÷1.2 M t/y. The total Port area is increased by about 17 ha. for a total of about 47 ha.

The cost of Phase 2 is about €79,636,300.

LAKE ASSAL MARINE TERMINAL: SUPERVISION OF CONSTRUCTION WORKS

Location:	Djibouti
Client:	Salt Investment
Services:	Construction Supervision
Period:	08/2009 – 06/2010
Construction cost:	€ 6,750,000.

Project Description:

Part 1:

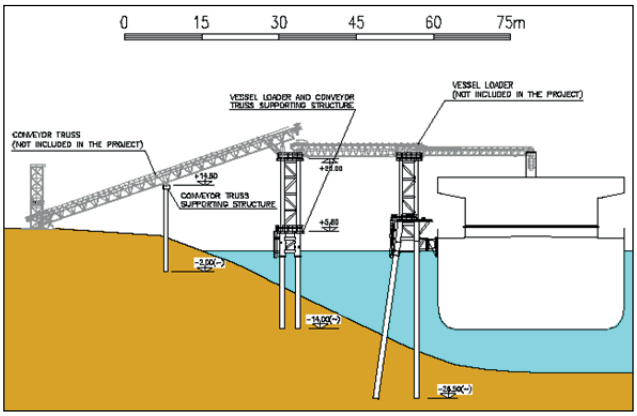
The initial project discussed below ceased during the construction period (1st Quarter) due to the advent of the financial crisis in the later part of 2008.TECHNITAL S.p.A has been appointed by SALT INVESTMENT SA (the Client) to provide the Preliminary Design and the Detailed Design, including the Tender Documents, for the construction of a new marine terminal in the Ghoubbet Kharab Gulf to export salt coming from Lake Assal.

The Engineering Services included in TECHNITAL scope of work were the design of the civil marine works and of all other related civil works necessary for the installation of the conveyor belt, of its supporting structure, of the loader and of the related utilities.

The services comprised data collection, design criteria definition, geotechnical assessment, meteo-marine and hydrodynamic study, navigation desk study, identification of the alternative solutions and selection and development of the most promising one, Preliminary Design of the civil marine works, Detailed Design of the civil marine works, Tender Documents

The dimensions of the ships involved in the salt transportation vary from 40,000 to 100,000 DWT, and the breasting and mooring devices have been designed accordingly. The design of the structure was carried out taking also into account the relatively high risk of seismicity of the area (Seismic Zone 3 of UBC) and the specific soil characteristics (alveolar basalt/vescicular lava flows and hard/sound basalt).

The berthing structures consisted of 5 breasting dolphins, 2 mooring dolphins and 6 mooring points on land, and 2 offshore buoys, necessary to assist the vessel to shift along the berth. Each dolphin is made by 4 steel piles 1016 and 25.4 mm thick, embedded into the sea bed basalt rock for a minimum length of approximately 10 m.



Due to the strength of the basalt, the piles have to be socketed into the rock using an oversize drill. The procedure consists on the execution of the pre-drilling, which creates a socket for the pile, the pile placing and the embedment of the pile with grout in order to increase the adhesion between the pile and the basalt

Following the awarding of the Contract for the construction of the new marine terminal, TECHNITAL S.p.A. was appointed for the Supervision of the construction Works.

The Supervision services carried out were intended to be the following but were curtailed due to the financial crisis in 2008::

- provide services to ensure that the Works are executed in accordance with the Contract;
- determine requirements for the soil survey and foundation investigations and supervise the specialised firm selected by the Contractor;
- examine proposals by Contractors for performance of the Contract as on their adequacy;
- give all the necessary instructions to the Contractor in accordance with the authority delegated by the Employer;
- witness normal tests and commission the works;
- advise the Employer of need for inspection of equipment during manufacture and prior to shipment;
- adequately administer, timely and financially, the construction of the Works;
- provide Post Contract Quantity Surveying;
- check all data gathered for the preparation of the s-built drawings by the Contactor;
- deliver to the Client, on completion of the services, the complete file system indexed and cross referenced, together with the original drawings produces during the works;

CONSTRUCTION OF DORALEH CONTAINER TERMINAL (DCT)

Location:	Djibouti
Client:	Dubai Ports World
Services:	Design review and Supervision of construction works
Period:	06/2007 - 10/2009
Construction cost:	€ 163,000,000

Project Description:

Localisation of the future reclaimed area

The Doraleh Container Terminal is considered to be most important container port of the Red Sea and is the southern gateway to Suez Canal. Due to its strategic location it has been designed to become a transhipment hub for the entire Mediterranean region.

Driving of foundation piles

The project is located on the west side of Djibouti. The new yard will be constructed through a massive land reclamation, while a road will join it to the mainland. The portion of land reclaimed is located where there was a small sandbank ("Banc des Salines").

450 t cranes shipped-in the new port

The area has been enlarged with dredged material to reach an impressive surface of 630.000 m².

The works supervised by TECHNITAL consisted in the following:

- land reclamation of a rectangle of approximately 1,400 m x 450 m to be used as off-shore quays and container stacking yard;
- the preparation of area to be used for new section of the yard through preload;
- the off-shore platform is linked to the main land by a joining double carriageway 2 lane road of approximately 800 m;
- the construction of the new Container stacking yard including:
  - foundation piles
  - container staking beams
  - foundation beams for RTG operations
  - pavement with interlock blocks fabricated in situ
  - drainage
  - reefers area for refrigerated containers
- the construction of all electrical network and IT network;
- the construction of all buildings and amenities (offices, maintenance warehouses, etc.);

NEW MARINE TERMINAL TO BE BUILT IN THE GHOUBBET GULF FOR THE LAKE ASSAL SALT EXPORT

Location:	Djibouti
Client:	Salt Investment SA
Services:	Preliminary and Detailed Design
Period:	09/2008 - 01/2009
Construction cost:	€ 6,750,000

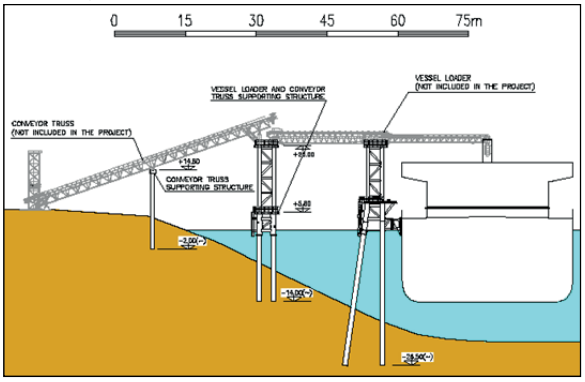
Project Description:

TECHNITAL S.p.A was appointed by SALT INVESTMENT SA (the Client) to provide the Preliminary Design and the Detailed Design, including the Tender Documents, for the construction of a new marine terminal in the Ghoubbet Kharab Gulf to export salt coming from Lake Assal.

The Engineering Services included in TECHNITAL scope of work are the design of the civil marine works and of all other related civil works necessary for the installation of the conveyor belt, of its supporting structure, of the loader and of the related utilities.

The requested services comprise data collection, design criteria definition, geotechnical assessment, meteo-marine and hydrodynamic study, navigation desk study, identification of the alternative solutions and selection and development of the most promising one, preliminary design of the civil marine works, detailed design of the civil marine works, tender documents

Based on the topo-bathymetric available data, the geotechnical and the meteo-marine studies, the preliminary assessments concerning location, manoeuvring conditions and structural alternative solutions, the layout presented in the following figure was developed.

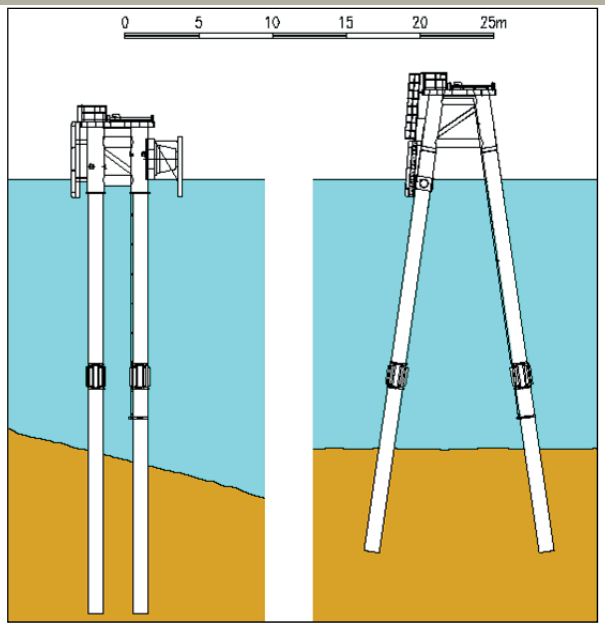


The dimensions of the ships involved in the salt transportation vary from 40,000 to 100,000 DWT. Therefore the breasting and mooring facilities have been designed to withstand the 100,000 DWT vessel loads, while the mooring layout should allow berthing of vessels with dimensions ranging between 40,000 and 100,000 DWT.

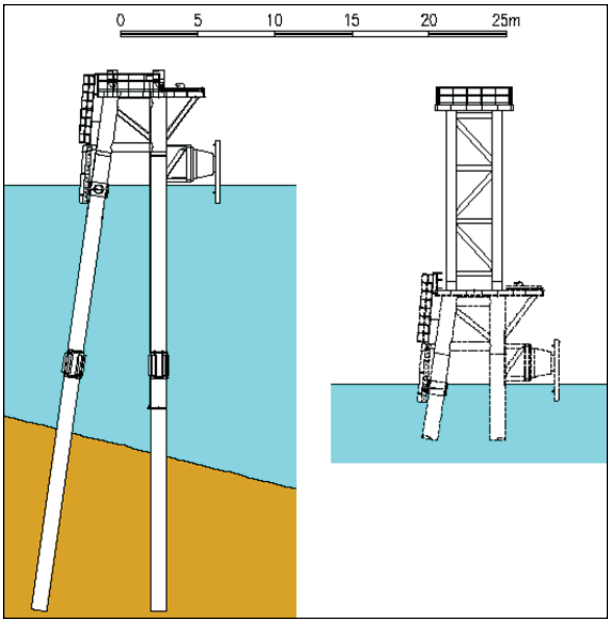
The design of the structure was carried out taking also into account the relatively high risk of seismicity of the area (Seismic Zone 3 of UBC) and the specific soil characteristics (alveolar basalt/vesicular lava flows and hard/sound basalt).

The berthing structures consist of 5 breasting dolphins, 2 mooring dolphins and 6 mooring points on land, and 2 offshore buoys, necessary to assist the vessel to shift along the berth.

Each breasting dolphin is made by 4 vertical steel piles 1016 and 25.4 mm thick, embedded into the sea bed basalt rock for a minimum length of approximately 10 m. Due to the strength of the basalt, the piles have to be socketed into the rock using a large diameter drill rig. The procedure consists on the execution of the pre-drilling, which create a socket for the pile, the pile placing and the embedment of the pile with grout in order to increase the adhesion between the pile and the basalt Each breasting dolphin is equipped with a supercone fender type SCN 1400 E2.7 and a 150 t bollard.



The mooring dolphins are made of n. 4 inclined steel piles 1016 and 25.4 mm thick, with total length varying **between 31 and 37 m** according to the local water depth. Each pile is embedded into the sea bed rock for a minimum length of 7 m. Each mooring dolphin is equipped with a 150 t bollard, access ladder, guard cable, etc.



The Project includes also n. 2 towers carrying the vessel loader and the conveyor belt truss. The cost for the proposed solution is in the range of €10,000,000 with a construction time of approximately 8-9 months.

FEASIBILITY ENGINEERING STUDY OF A CONTAINER TERMINAL AT PUERTO MARIEL

Location:	Cuba
Client:	DP World
Services:	Feasibility study
Period:	02/2008 - 08/2008
Construction cost:	€ 238,200,000

Project Description:

TECHNITAL S.p.A was appointed by DP World (the Client) to execute the Feasibility Study of a new container terminal at Puerto Mariel, a natural well-sheltered pocket bay along the northern coast of the Republic of Cuba.

At present the bay is accessible by means of a narrow entrance channel leading into a basin with a depth that allows the safe navigation of 9 m draught vessels directed to the berthing facilities on the eastern side of the bay.

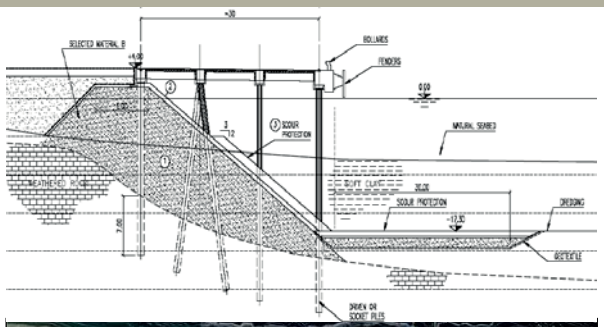
With the Feasibility Study the Client intends to examine the possibility to start a container terminal operation in the area located in the Western side of the bay along the Peninsula Angosta. In agreement with Client's Commercial Team statements the study has been executed taking into account a phased development of the terminal: the Phase 1 terminal development have to be suitable to handle a design ship of 6,000-7,000 TEU (Loa=347m, Beam=42.91, Draught=14.5m); the Phase 2 terminal layout has been agreed with the Client as the maximum possible long-term expansion capability of the new terminal, suitable to handle a design ship of 10,500 - 12,000 TEU (Loa = 366m, Beam = 48.4m, Draught = 15.5m). The quay length of the Phase 1 terminal is 700m: With Phase 2 the quay length increases by 1,000m.

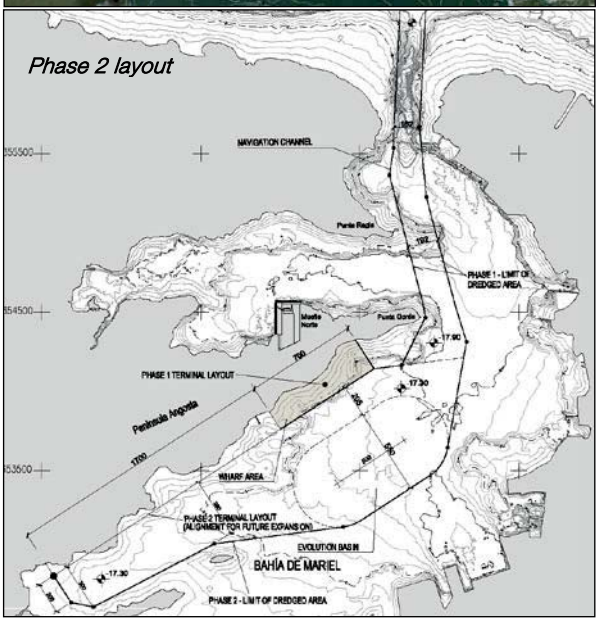
The main activities in which the present study has been broken down are the following:

- data collection;
- pre model Nautical Risk Assessment (NRA);
- hydrodynamic study for the evaluation of the typical current circulation in the bay. During this activity set-up and calibration of hydrodynamic model 3D-FLOW has been carried out;
- geotechnical study (including a field investigation);
- navigation study (with fast time simulation model SHIPMA);
- feasibility study of the most promising solution.

Important dredging works have been envisaged in Phase 1 terminal layout: 6,000,000m^3 of soft clays, 480,000m^3 of sand and 320,000m^3 of rock. Soil stratigraphy was derived by 12 new boreholes executed during the field investigation campaign in the wharf area and in the areas of the navigational channel and the turning basin.

A typical cross section of the proposed quay is presented in the following figure.



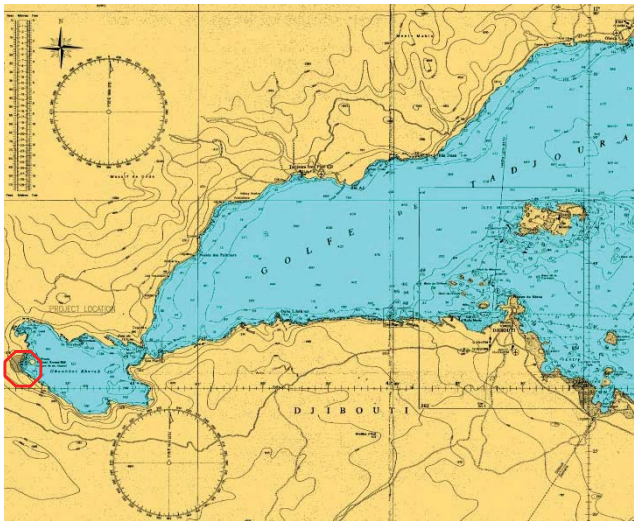


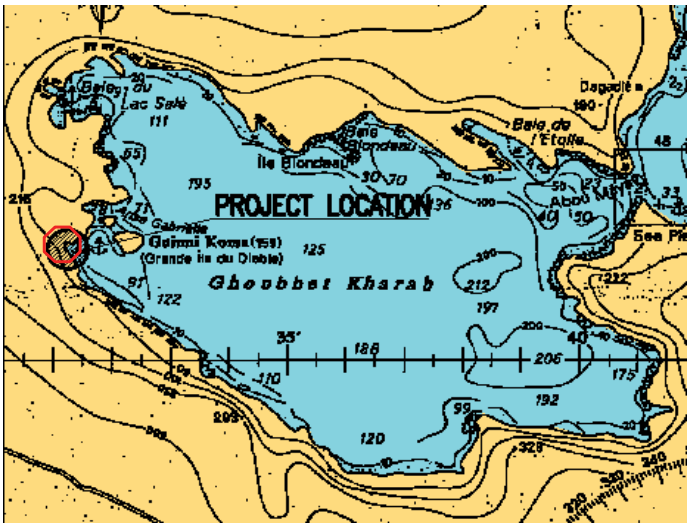
The magnitude of the investments for implementation of Phase 1 terminal is in the range of 238,200,000 €, of which 165,500,000 € for quay structure execution and 72,700,000 € for dredging works.

LAKE ASSAL MARINE TERMINAL

Location:	Djibouti
Client:	PACE Pan Arab Consulting Engineers
Services:	Preliminary Design
Period:	04-12/2007
Construction cost:	n.a.

Project Description:





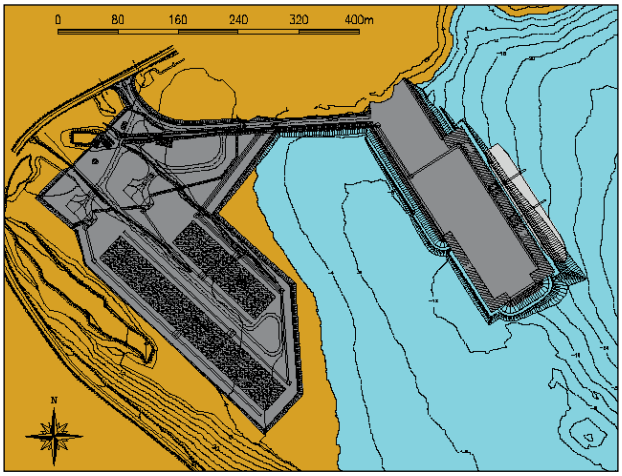
TECHNITAL Djibouti S.a.r.l. was appointed by P.A.C.E (Pan Arab Consulting Engineers) to provide the Preliminary Design and related engineering services of a marine terminal in the inner part of the Ghoubbet Kharab, to allow the export of salt and perlite resulting from the exploitation of the salt deposit of Lake Assal and the nearby volcanic formations.

The location of the Project is indicated in the following figure.

The requested services comprise the following:

- topographic and bathymetric survey;
- geotechnical desk study;
- desk studies on wind climate, waves, currents and tides;
- preliminary design of port berthing facilities;
- preliminary design of warehouse;
- preliminary design of minerals loading equipment;
- preliminary design of roads, parking and backyards.

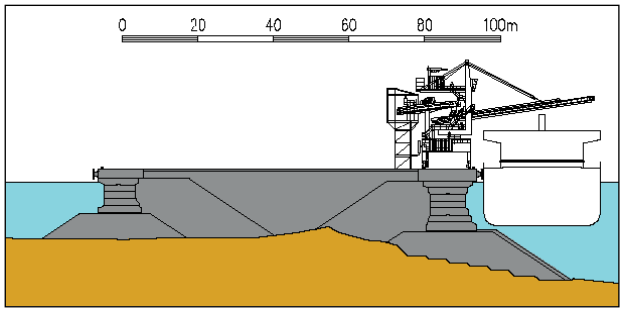
Based on the topobathymetric survey, the geotechnical and the meteomarine studies, and preliminary assessments concerning location, manoeuvring conditions and structural alternative solutions, the layout presented in the following figure was developed.



The definition of the design vessel has been subject of discussion with all the parties involved in the Project. Following a rough estimate of the cost of the marine component of the terminal for 4 different options of design vessels (20,000 to 100,000 DWT), local authorities recommended to develop the Preliminary Design for an intermediate option, the 30,000 DWT vessel.

The design of the structure was carried out taking also into account the relatively high risk of seismicity of the area (Seismic Zone 3 of the Uniform Building Code).

The quay is made by concrete blocks with length varying from 13.30 to 9.20 m and height between 1.80 and 2.50 m, over a natural sea bottom with depth comprised between -10.60 and -18.00 m C.D. The top of the structure is finished with a cast in situ concrete block equipped with the gantry crane, fenders and bollard. The service quay has a similar structure but over a water depth of -6.30 m C.D.

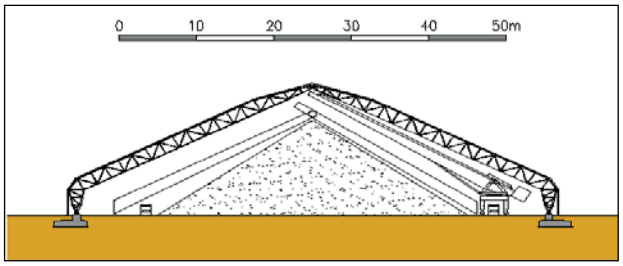


The minerals loading equipment and the warehouse have been designed based on a quantity of salt exported over a year of 2,000,000 ton and assuming that the design vessel can be loaded in 48 hours. The stocking warehouse is 302 m long, 61 m wide and 20 m high.

No information was available for the perlite production. A stockpile of about 150 m length, 40 m wide and 15 m high was proposed.

For each product (salt and perlite) the plant for storage and loading consists of:

- the truck unloading station;
- a stacker connected by conveyor belts to fill up the stockpile;
- a sheltered stockpiling area;
- a bridge-scratcher to grab the material from the stockpile;
- conveyor belts to transport the material from the stockpiles to the ship loader.



The Project is completed with a 360 m long road connecting the site to the National Road N. 9, the backyard equipped with parking area for the port vehicles, 200 m^2 office, weighting bridge, firefighting system, diesel power plant and relevant electrical and lighting system, and water network.

The cost for the proposed solution is in the range of 110,000,000 USD. The cost of the terminal could be reduced to 36,000,000 USD in case of reduction of the design life of the quays, elimination of the salt warehouse and of the inner quay and reduction of the platform width, phasing of the implementation of the mechanical system.

CONSTANTA SOUTH CONTAINER TERMINAL (CSCT): SUPERVISION FOR CONTAINER YARD EXPANSION IN AREA B

Location:	Romania
Client:	Constanta South Container Terminal (CSCT) – Dubai Ports World
Services:	Supervision of CSCT yard extension works
Period:	05/2006 - 11/2006
Construction cost:	€ 5,548,900

Project Description:

The Port of Constanta is the largest container port of the Black Sea and is the natural southern gateway to Eastern and Central Europe. Due to its strategic location it has become a transhipment hub for the Black Sea region.

The project is located on the South Side of the Port. The new yard will be constructed adjacent to the existing stacking yard serving the present port operations of CSCT.

In accordance with the Port's development plan, the location of the project is in area "B".

The works carried out by TECHNITAL consisted in the following:

- Demolition of existing "Empty Yard"
- Preparation of area to be used for new section of the yard.
- Construction of new section of Container stacking yard including:
  - Container staking beams
  - foundation beams for RTG operations
  - Pavement
  - Drainage
  - Refers area
  - Electrical Installations
- Construction of a new Empty Yard, adjacent to the new container stacking area.

DEVELOPMENT OF MARINE STRUCTURES AND SERVICE BUILDING FOR THE YEMEN COAST GUARD AUTHORITY IN ADEN

Location:	Yemen
Client:	Yemen Coast Guard Authority - Aden (Financing: EBRD)
Services:	Concept, Preliminary and Detailed Design, Tender Documents, and Works Supervision of works
Period:	09/2003 – 12/2004
Construction cost:	€ 5,000,000

Project Description:

As a recently constituted body the Yemen Coast Guard Authority urgently needed to provide for the required land and marine infrastructures from which to operate and maintain its boats and equipment. The base in Aden is the first and several others will be developed in the near future in other important localities along the

Yemen coast.

The Project consisted in the provision of engineering services for the implementation of the following works for the operating base of the Yemen Coast Guard Authority in Aden:

- A mooring facility for up to 20 crafts of up to 25 m. in length. Said facility should be constituted of floating berths with all necessary services and utilities (i.e: anchor piling, water, electrical and communication hook-ups, fire and emergency control systems, etc.)
- Two piers from which to operate a 50 tons lifting capacity movable boat lift crane
- A Service Building of approximate size of 20 X 45 X 12 m. to include the YCG offices, the crane storage, the workshop and spare parts stores.

The Project involved expertise in different aspects of marine engineering, geotechnical engineering, utilities engineering, structural and civil engineering, technical specifications, tender documentation and construction supervision. Specifically the engineering services provided by the Consultant were the following:

Phase 1: Concept Design

Phase 2: Preliminary and Detailed Design, Tender Documents

Phase 3: Pre-Contract Services

Phase 4: Construction Supervision.

The aim of the first phase of the Project was to identify every possible development alternative of the marine and civil works and, for each alternative, to provide criteria and suitable information to allow the Client to choose the most attractive development solution.

The main tasks in the second Phase were the preparation of the Preliminary and Detailed Design, and of a full set of Tender Documents, which will allow the Client to prepare and launch the Construction Tender.

The pre-contract services involved assistance to the Client in managing the Construction Tender Phase, including the incorporation of any agreed changes to the drawings, BoQ and/or specifications arising from queries, the revision of all electronic copies of drawings to “Approved for Construction” status and issue of a full revised set of Construction Documents to the Client.

The works supervision was carried out in accordance with FIDIC rules and best engineering practice.

The Supervision Team consisted of :

- 1 Resident Engineer (Marine Engineer), full time.
- 1 Site Inspector (Civil engineer), full time.
- 1 Surveyor, employed part time during the positioning of the anchor piles and structures.
- One Electromechanical Engineer, part time during the installation of electromechanical apparatus.
- 1 Senior Architect, part time during the construction of the Service Building

NEW INDUSTRIAL AND COMMERCIAL PORT AT DORALEH

cation:	Djibouti
Client:	Djibouti Port Authority and Dubai Ports International
Services:	Design verification of the General Master Plan of the new Doraleh Port and Industrial Zone; Preliminary Design and Feasibility Study of the new Refined Products Receiving Terminal
Period:	12/2000 – 12/2002
Construction cost:	€ 200,000,000

Project Description:

During the last decade Djibouti became the major import/export port of Ethiopia and since the outbreak of the recent war with Eritrea, Djibouti is practically its only gateway. Even when Massawa and Assab ports re-open to Ethiopian traffic, the Djibouti will remain the preferred port owing to its greater proximity and to the rail and road connections that are being refurbished.

View of the existing oil storage area

The oil traffic has increased enormously in recent years, going from a maximum 350,000 tons/year in 1992 to over 1,250,000 tons/year in 2000. Although the port infrastructures can cope with this traffic, the location of the terminal and the storage areas is an increasing environmental and safety hazard. The present port is surrounded by housing and almost all the oil products are transported to Ethiopia by truck, passing through the streets of Djibouti before they join the MD1 motorway, or railway.

Computer rendering of the new oil terminal at Doraleh

The relocation of the **Oil Terminal** to a new site outside the towns, and clean-up and restoration of the entire area occupied today by the oil facilities, is therefore urgently required.

The new oil terminal in operation

The **Container Terminal** has two berths offering approx. 10 meters of water and associated container stacking areas. In the last decade there has been a considerable increase in the commercial traffic, especially containers, which in 1999 exceeded 2.5 million tons (14% increase over 1998 and 100% increase over 1989 volumes). Again, while the existing infrastructures are capable of dealing with the present demand, in view of the traffic growth trend and the development of transhipment operations due to a new management system, introduced by Dubai Port International (DPI), both the quayside facilities and the storage areas will be inadequate.

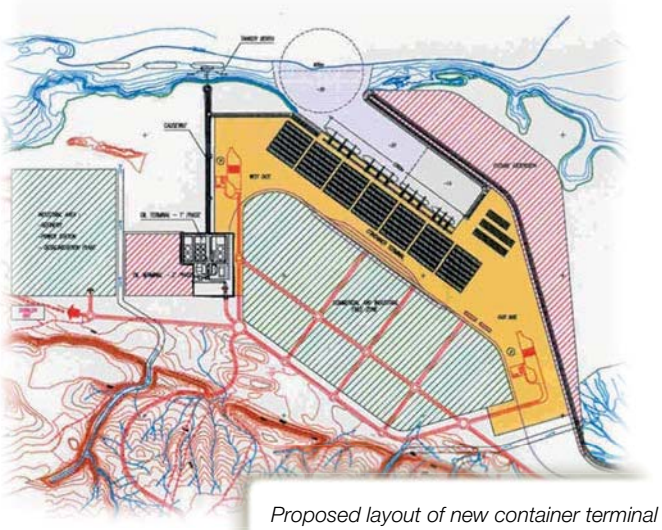
Existing container terminal at Djibouti

In view of all these considerations the Government of Djibouti decided to study the possibility of developing a new port/industrial area at Doraleh, to provide the following main facilities:

- a new Refined Products Receiving Terminal
- a deep water Container Terminal,
- a future Petroleum Refinery, and
- a Commercial and Industrial Free Zone.
- efficient road and rail connections.

In particular, the services included:

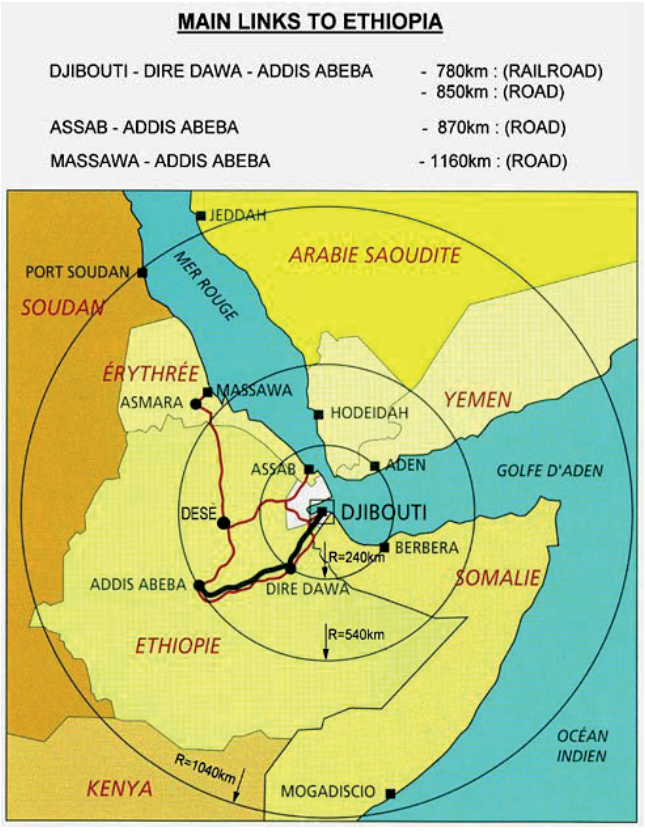
- Bathymetric, topographic, geotechnical and meteo-marine studies and surveys, General Master Plan of the Doraleh New Port Infrastructure;
- Preliminary Design of the Oil Terminal including Preliminary Environmental Impact Assessment, Cost Estimates and Preliminary Economic Evaluation.



Proposed layout of new container terminal

The first tanker in new port at Doraleh

Execution of geotechnical bores at sea



PORT SAFETY IN POTI AND BATUMI

Location:	Georgia
Client:	Commission for the European Communities – TACIS Programme
Services:	Final design of rehabilitation works, procurement and installation of navigation equipment, wrecks salvaging, staff training
Period:	02/1999 – 01/2000
Construction cost:	€ 20,000,000 (breakwater refurbishment)

Project Description:

TECHNITAL, in association with Arcadis Bouw/Infra BV (Netherlands) and PTC Bremen (Germany), was awarded a contract by the European Union for the rehabilitation of the two Black Sea ports of Poti and Batumi which had been reduced to a state disrepair and neglect as a result of wars and the political upheaval in the former Soviet Union. The ports were obstructed by shipwrecks and the marine works badly damaged., while the navigation equipment was obsolete and largely inadequate.

The aim of the project is to contribute to the rehabilitation of the marine infrastructures of these two major Georgian ports and improve safety standards in order to increase their physical and operational capacity to cope with the increasing traffic demand on the Traceca route. In particular, the consultant is required to:

- provide qualified engineering expertise to investigate the current status of the Poti Port main breakwater, propose rehabilitation works and prepare detailed Tender Documents.

- investigate the current status of some of the major marine structures in the ports of Poti and Batumi and to prepare a general rehabilitation plan.
- investigate the presence of shipwrecks in the port basins and prepare a detailed Salvage Plan for their removal and disposal.
- improve and promote the work of the Maritime Administration of Georgia by providing task oriented practical training in the field of General Maritime Administration, organisation of maritime safety in ports, pollution prevention and combating.
- provide some urgently needed Hydrographic Survey Equipment and GMDSS Communication Equipment.

The services to be executed by TECHNITAL include:

- detailed design and tender documents for the rehabilitation and improvement of the Poti port breakwater
- detailed hydrographic surveys and underwater inspections of the marine works in both ports and a general plan for their rehabilitation
- location and assessment of old shipwrecks within the two port basins and documentation for tendering for their removal and safe disposal.
- study of the sedimentation process along the coast near the port of Poti, and definition of mitigation measures or long-term actions to minimise port siltation.
- training programme for selected personnel of the Port Authorities and Marine Administration selected personnel, particularly in the field of navigation and shipping safety and marine environmental protection.
- procurement of some urgently needed equipment for hydrographic surveys safety communications.

REHABILITATION WORKS IN THE PORT OF DURRES

Location:	Durres – Albania
Client:	Albanian Ministry of Public Works and Transport
Services:	Detailed design and tender documents
Period:	11/1997 – 12/1999
Construction cost:	€ 40,000,000

Project Description:

The Government of Albania has requested assistance from the World Bank, International Development Association, and other donors to implement a program of rehabilitation and strengthening infrastructure facilities in the Port of Durres.

The Port of Durres is located on the Adriatic coast, some 40 km. west of the capital, Tirana.

The existing port comprises some 2000m. of quays. Long-term development of the port includes for provision of a multi-modal container facility and a roll-on/roll-off ferry terminal as well as improvements to the existing general, break-bulk and bulk cargo handling facilities.

The development of the port of Durres, Albania's principal port on the Adriatic coast, is considered of prime importance for the economic development of the country.

The contract, carried out in 1997-98 in association with Sogreah Ingenierie of France, concerned the detailed engineering design and bidding documents for rehabilitation works including quay walls, breakwaters, warehouses, service areas and port accesses. Some of the works are sub-contracted to the Albanian company, Port Projekt.

The drawing up of the **Detailed Design** respecting a very tight time schedule (3 months) involved, firstly:

- assessment of the present state of the port structures
- topographic, bathymetric and geotechnical surveys
- meteo-marine surveys (wind, currents, waves)
- survey and evaluation of shipping (ship characteristics and traffic)
- survey of existing warehouses and lifting facilities.

On the basis of this information the detailed design of each component was drawn up, indicating the most suitable technologies and materials. In some cases alternative solutions were offered, thereby allowing the Contractor a certain degree of freedom and flexibility in the selection and development of the most suitable methodology of intervention according to the situation found.

The works are divided into 7 lots and the Consultant prepared reports, specifications, drawings, bills of quantities and cost estimates for each lot, as well as a full set of **Tender Documents**.

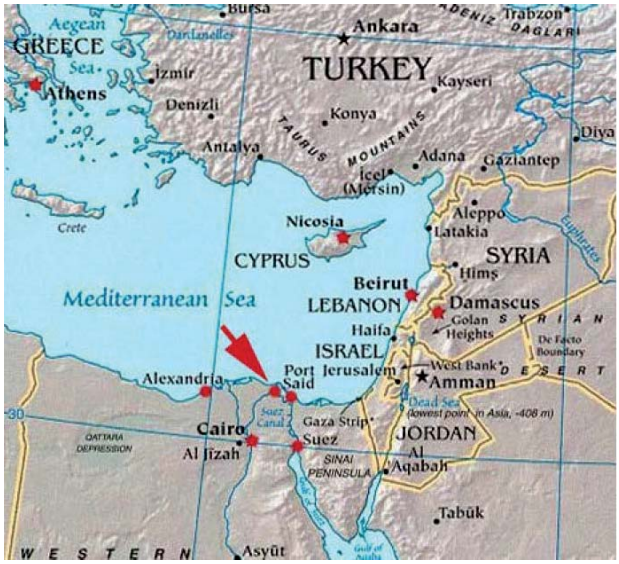
FEASIBILITY STUDY OF AN LNG TERMINAL

cation:	Mediterranean Coast Of Egypt
Client:	Snamprogetti
Services:	Feasibility Study and Preliminary Design
Period:	06 - 08/1997
Construction cost:	N.A.

Project Description:

Feasibilty study of three alternative sites for an LNG export terminal. The proposed sites were:

- Damietta, in the Nile Delta area
- east of Damietta, near Al-Harish
- west of Damietta, near El-Hamra.



The comparative study involved the preliminary analysis of the environmental aspects and exposure to wave action, the distance between the terminal loading platform and on-shore plant area, the length of the water intake pipes, and construction and operating costs. The possibility of future extension of each site was also considered.

Following the meteo-marine studies (wind, waves and tidal characteristics) a preliminary design of the terminal was drawn up, including, besides the marine works, all the related plant systems (loading arms and piping system, telecommunications, control, electrical, fire-fighting, etc.)

The cost estimates, considering marine works (jetties, berths, breakwaters), topside works, water intake works and dredging/reclamation works, were drawn up for 3 different scenarios and two construction phases.

INDUSTRIAL PORT OF RAS LAFFAN

cation:	Qatar
Client:	Condotte and Partners for Qatar General Petroleum Corporation (Q.G.P.C.)
Services:	Hydrodynamic and navigational mathematical model studies, Preliminary Design of port layout, Basic, preliminary and detailed design of the main breakwater preliminary design of the jetties, Environmental impact studies. Environmental impact assessment study of the work and definition of the measures to mitigate the effects.
Period:	01/1991 - 12/1994
Construction cost:	€ 694,118,000

Project Description:

The port of Ras Laffan, which was completed in 1995, is at present the most important LNG port in the world.

The design and construction of the Industrial Port of Ras Laffan, included:

- Main and Lee Breakwaters (respectively 6 and 4,5 km long) protected by armour rock and antifer blocks;
- Ro-Ro Berth, Dry Cargo/ Container Berth
- 2 LNG Berths (4 planned);
- Embankment leading to LNG Berths;
- 2 LPG Berths (6 planned);
- Harbour Basin dredged to -13,5 metres;

- Navigational approach channel dredged to -15 metres;
- Land Reclamation (10.2 million cu. m.)

Construction activities were successfully completed in 1995, ahead of schedule.

TECHNITAL was awarded a Contract by Condotte Qatar JV, the nominated Contractor, for the performance of the following engineering services:

- review of the preliminary design of the layout;
- review of the preliminary design of the main and lee breakwaters;
- review of the preliminary design of the access channel and of the dredging works;
- basic and preliminary design of quay walls and berths
- basic, preliminary and detailed design of the main breakwater.

These activities involved the execution of studies with hydrodynamic and navigational mathematical models and the preparation of specifications and supervision of execution of physical model for the optimisation of the layout and 2 and 3 dimensional physical models for the design of the breakwater.

The layout was selected by comparing several alternative solutions (developed starting from the solution shown in the Master Plan), by means of a "weighted" comparison of the behaviour of the following indicators:

- "downtime" due to wave motion at the berths;
- "downtime" due to access difficulties along the canal;
- the balance between dredged material and material needed for implementation, by filling, of the harbour yards;
- the rationality of the access to the various harbour terminals;
- the possibility of further development of the port.

The Layout Design also included studies aimed at assessing the environmental impact of the new port, such as the variations in the littoral drift and the interference with the discharge outlets of industrial plants, due to the considerable hydrodynamic changes.

The Preliminary Design of the breakwaters was performed in close collaboration with the construction contractors. It also involved the programming and co-ordination of tests on a two-dimensional physical model. Since a part of the breakwater core was constructed using dredged material with a very fine granulometry, particular care was taken over the design and checking of the filtering layers. The cladding was constructed using Antifer blocks of sizes varying from 1.9 to 4.5 cubic metres.

The Preliminary Design of the jetties also made use of the results of model tests, in this case of a 3-D hydrodynamic model, where the propagation of the wave motion was reproduced and the strains at the moorings were measured.

NEW BUNKERING STATION IN TROIZA BAY

cation:	Vladivostok - Russia
Client:	BPO Dalryba - Vladivostok - Russia
Services:	Basic design for a bunkering station, jetty and annexed infrastructures. Environmental impact assessment study of the work and definition of the measures to mitigate the effects.
Period:	08/1991 – 02/1992
Construction cost:	€ 86,764,700

Project Description:

In 1991 Technital was commissioned by the Russian industrial Fisheries Consortium *BPO Dalryba* to develop the basic design for a bunkering station with related jetty, in the bay of Troiza, located in the Vladivostok region.

The design was accompanied by a study of the impact of the new installation on the environment and of the measures required to mitigate these effects.

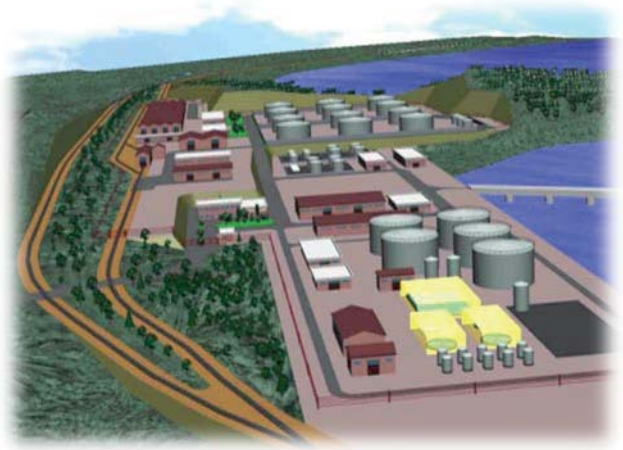
Following collection and evaluation of the available data on the climate and the coastal hydrodynamics of the area, Technital first proceeded to reconstruct the local conditions of current circulation and wave motion by means of a series of simulations using a finite elements hydrodynamic model and a ray wave propagation model, the latter integrated by a simple model for calculating wave motion generated locally by wind action.

Once the elements for selecting the location and defining the design conditions for the new jetty had been obtained, the various possible locations for the sea effluent of polluted water, inside and outside the bay, were examined.

In this phase the Lagrangian module for analysing the paths of discharged substances was applied to the hydrodynamic model and it unquestionably proved the advantages of discharge into the sea outside the bay.

The measures for mitigating the effects on the environment, defined within the terms of the study, included:

- the definition of the appropriate methods for minimizing risks of accidental spillage;
- indications of the level of detail of the treatment plants needed to maintain the prescribed standards, even around the discharge zone;
- the definition of an adequate location for the vegetation belt, to "mask" the new installations, with the criterion of blending them in as much as possible with the local countryside.



A preliminary study of the flora was useful for these proposals.

The more strictly design part was preceded by a forecast analysis of marine and land traffic to define the dimensions of the berths and the storage areas.

The jetty was then designed, developing two different types of construction (piles and cylindrical caissons) and defining the selection criteria based on the results obtained by a more detailed study of into the geotechnical conditions.

The design includes: berths, loading/unloading facilities, electrical and fire prevention plants, telecommunications plant, navigational aids and the measures to prevent and control accidental spillage.

The design for the part on land, on the other hand, includes the storage tanks and the piping networks for fuel oil and diesel oil, the networks and treatment plant for dirty water from washing the tanks and the road and rail access.

laboratory tests. The recycled materials are suitably processed and mixed depending on the layer and the structural requirement they must comply with. Possible additional supply of aggregates is based upon the correction of the grain size distribution curve.

Terminals, Quays and Breakwaters

RAVENNA PORT HUB PROJECT: DREDGING OF CANDIANO AND BAIONA CHANNELS, ADAPTATION OF EXISTING QUAYS, NEW TERMINAL CONTAINER, SEDIMENT MANAGEMENT

Location:	Italy
Client:	Consorzio Stabile Grandi Lavori s.c.r.l – Dredging International s.v
Services:	Final and Detailed Design
Period:	02/2020 - ongoing
Construction cost:	€ 197,848,915

Project Description:

The assignment consists of the "Deepening of the Candiano and Baiona channels, adaptation of existing operational quays, new terminal on the peninsula Trattaroli, dredging of the port of Ravenna and the reuse of the dredged material".

The activities include the Final and Detailed Design of the dredging of the port of Ravenna - 1st phase (4.7 million cubic meters), management of sediments (emptying of reclaimed areas and land reclamation of logistic areas), structural adaptation of existing quays (2.9 km of quays), new container terminal (about 0.6 km); geotechnical and seismic investigations; quay and apron surveys (sonar, 3D multibeam, lidar, 3D laserscan, seismic refraction), aerial photogrammetric surveys with drone, and bathymetric surveys (with multibeam), sub-bottom profiler, sides scan sonar; sedimentation tests.

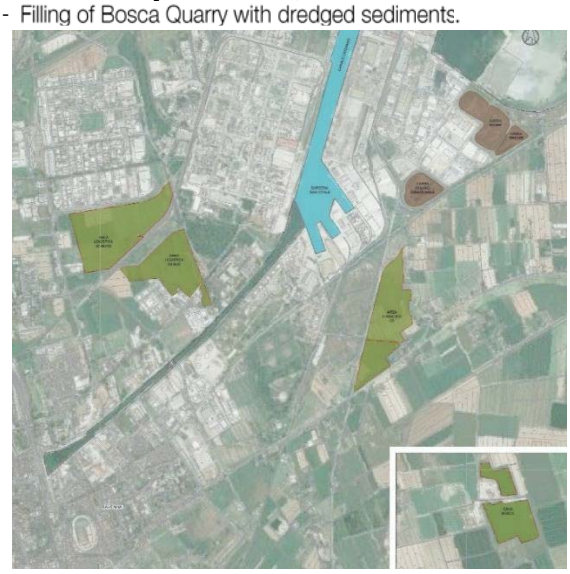
The Detailed Design was divided into functional stages.

The **1st stage** consists in functional and structural adaptation works of the existing quays of the Candiano channel and of the San Vitale channel, new terminal container for an overall development of about 3.6 km.

In this stage is also included the emptying of the Trattaroli area, functional to the construction of the new container terminal, and the reclamation of the S3Sud logistics area.

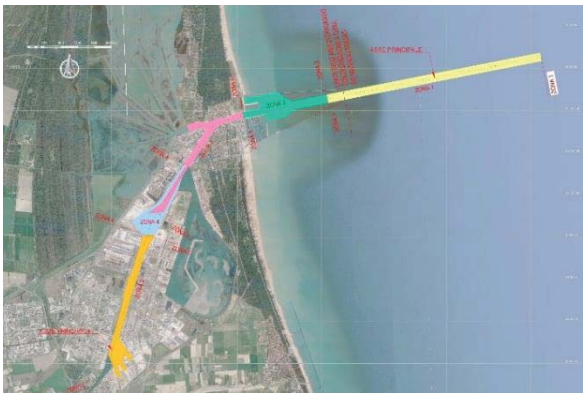
The works of the **2nd stage** concern:

- Emptying of the reclaimed area Nadep;
- Land reclamation of Logistics area L2 and logistics area S3 Sud with dredged sediments;
- Filling of Bosca Quarry with dredged sediments.



The **3rd and 4th stages** consist in the following works:

- Dredging of 4,7 million cubic meters: outer and inner channel, and internal harbour, till -13.5 and 12.5 m.s.l. wader depth
- Management of dredged sediments: most of dredged materials from outer channel (zone 1) into the sea; for the remaining zone 1 and Zones 2-5 the dredged sediments will be transported in the reclaimed areas (logistic areas);
- Land reclamation of Logistics areas L2 and logistics areas S3 Sud S3Nord with dredged sediments
- Filling of Bosca Quarry with dredged sediments



In detail, the services provided by TECHNITAL include the Final and Detailed design of existing quays, new terminal container, and dredging, as well as site investigation and laboratory analysis:

- topographic surveys (aerial photogrammetric and topographic) of existing quays, land for the new terminal container, reclaimed areas and logistic areas for land reclamation.
- geoelectric and seismic spreads with electro magnetometer
- 3D georadar surveys
- Geotechnical investigations to define the stratigraphic structure, geotechnical parameters, seismic classification and the groundwater level (SCPTU, CPTU, survey with piezometer, dissipation tests, sampling, laboratory analysis, geophysical tests and penetration tests)
- Bathymetric survey with Multibeam survey of the existing seabed of outer and inner channel and harbour
- Side-scan sonar surveys
-

The following activities have been performed to support:

- Use of the ACONEX document platform
- WBS Work breakdown structure
- BIM
- the definition of the geotechnical characteristics of the foundation soils, with the elaboration of the geological and geotechnical models
- resistance parameters in seismic conditions
- definition of the basic seismic hazard and study of local seismic response
- study of liquefaction
- structural analysis and checks (Plaxis)
- checks on the existing plants for the preparation of new plants
- check of the fenders
- calculation via STR on the cloud platform
- calculation of volumes with 3D Digital Terrain Model (DTM) and detailed/constructive design of the reclaimed areas and relevant construction methods
- calculation of volumes with with a 3D Digital Terrain Model (DTM) and design of logistic areas with relevant construction methods
- Detailed design of dredging, volume calculation with a 3D Digital Terrain Model (DTM) based on the results of multibeam echosounder bathymetric survey and on the planned dredging layouts, sediment management and use plan (dredging methodology and the inland and offshore disposal area)
- Traffic impact study.

CONSULTING SERVICES FOR THE UPGRADING AND EXTENSION OF THE RO-RO TERMINAL OF SJEVERNA LUKA WITHIN THE PORT OF SPLIT

Location:	Split, Croatia
Client:	Split Port Authority
Services:	Preliminary, Main and Detailed Design, Designer Supervision.
Period:	10/2018 – ongoing
Construction cost:	€ 32,000,000 approx.

Project Description:

The subject of this project is the drafting of the project documentation for: Reconstruction and extension of Northern port in the port area of the Vranjic-Solin basin, under the management of Split Port Authority.

Northern port (Stinice area) is situated in the Vranjic-Solin Basin of the Port of Split, on the territory of the City of Split in the Split-Dalmatia County.

Fig.1 – Arial view of the Stinice area

Area of Stinice which is the subject of this project, has been a neglected port space unused for decades, devoid of purpose and devastated

Fig.2 - View of the site towards east

The conceptual solution envisages construction of the port infrastructure, i.e. the construction of berths for the reception of ro-ro ships, for the purpose of transferring domestic and international freight traffic from the Split City Port to the Northern port of Stinice. The infrastructure should also be able to accept one large cruise ship, and since the North Port is protected and not subjected to weather conditions as external berths in the City Port are, berthing would be possible during most of the year and also under unfavourable weather conditions.

Conceptual solution envisages upgrade of 1 existing berth and construction of 6 new berths.

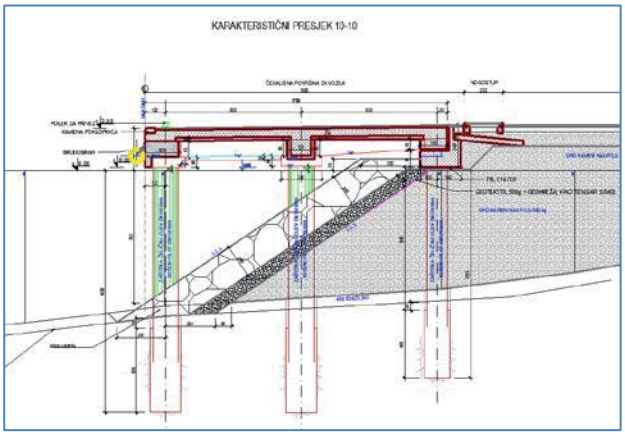
Fig.3. – Conceptual design layout

Total length of the planned coastline is approx. 905 m. Max permissible draft allowed for ships in the future port is 10,7 m.

Other designed structures and facilities of the port are the access road to the port, traffic plateau with internal roads, parking areas, vehicle waiting lanes, pedestrian routes, green belts, ticket booths and sanitary facilities, power station.

Type of the maritime structure and its foundation will depend on the sea bottom topography, geotechnical conditions in the area of the project and its spatial limitations. For the envisaged draft allowed, and taking into account other conditions, foreseen foundation solution is on RC drilled piles.

Fig.4. – Characteristic cross section of the maritime structure – conceptual design



Project will also cover development of the water supply and sewage design, electrical installations, lighting and telecommunications designs.

Rough schedule of the project is: Investigation works, preparation of the Conceptual design – obtaining Location permit, preparation of the Main Design – Review – obtaining Building permit, preparation of the Detailed design - Review.

During construction works proactive Designer's Supervision will be performed.

NEW BREAKWATER FOR THE PORT OF GENOA – SAMPIERDARENA BASIN

Location:	Genova, Italy
Client:	Autorità di Sistema Portuale del Mar Ligure Occidentale
Services:	Feasibility Study, Preliminary Design
Period:	02/2020 – 09/2022
Construction cost:	900,000,000 €

Project Description:

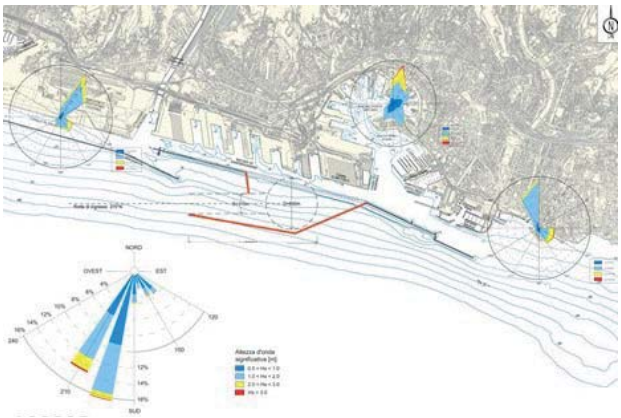
The technical and economic feasibility project of the new breakwater of the Port of Genoa is structured in two phases: a first phase which identifies and examines the possible alternative design solutions and a second phase which, solely for the selected solution, envisages the development of the technical and economic documents of the feasibility project.

Since the construction cost of the work exceeds 50 million, the public works legislation prescribes that the alternative solutions at the end of the first phase are discussed in a Public Consultation involving all the key-stakeholders.

This procedure became mandatory in Italy from 24/8/2018 with the issue of a Regulation which identified the subjects that define and control the Public Debate and the ways in which these subjects must operate have been defined. It is the first time that it has been applied in Italy.

The aim of the intervention is to create the conditions to guarantee safety conditions for port operations and the conditions for the development of the port of Genoa. In the first phase various study and investigation activities are foreseen, including: geophysical field surveys, identification of the project design vessel based on the evolution and the projections of the vessels in a period of time comparable to the technical life of the 'work (100 years), the study of meteorological, geological-geotechnical-seismic conditions, the study of hydrodynamics and sedimentological processes, the study of marine habitats and site archelogy.

In the first phase, once established mandatory project criteria in terms of navigation and operation at the docks, the possible intervention solutions are to be defined, within which the most promising ones are to be selected in relation above all to the costs, which represent a reference element for the economic sustainability of the work.



On such selected solutions, detailed analyses are to be conducted in terms of wave agitation within the port basins, navigation manoeuvres with real time simulator, hydrodynamic and sedimentological, environmental and landscape verification.

The Public Consultation will select the solution to be further analysed in the second phase at the level of the technical and economic feasibility project. In this phase, detailed geotechnical investigations are planned with the use of a DP2 type ship with suitable equipment for conducting surveys in the footprint area of the new breakwater. Physical model tests are also planned in the HR Wallingford hydraulic laboratory to optimize the construction type of the new breakwater.

CONSULTING SERVICES FOR THE EXTENSION OF THE EAST QUAY OF THE GARIBALDI PIER IN THE PORT OF LA SPEZIA

Location:	Port of La Spezia, Liguria, Italy
Client:	LSCT La Spezia Container Terminal
Services:	Final and detailed design
Period:	03/2018 – 03/2020
Construction cost:	€ 72,918,968

Project Description:

Molo Garibaldi is the first pier for commercial purposes within the La Spezia Port area. It was built in late 19th Century and it has been recently extended in South and Western directions up to the today dimensions of 640 m x 160 m.

This project is for expanding the eastern quay to the total width of 258 m. With a design mooring depth of 16 m, the quay will be equipped for the berthing of containers-ships up to TEU 22.000. Quay equipment will comprise 100 ft STS cranes, 200 tons bollards, shore connection supplies. The yard area, with an extension of more than 10 ha, will handle container automatized temporary storage up to the sixth stacking level. The enlargement of the eastern quay will be obtained by construction of new retaining structures and filling of 800.000 cubic metres of stony-granular material.

The local geotechnical scenario represented one of the main issues in the project development, since existing foundation soils consist of 30 m of normally consolidated silt, with poor geotechnical properties. Considerable consolidation times and large settlements are expected to occur and had been taken into account. The filling will be preloaded and consolidated by temporary dewatering.

The overall stability of the new quay will be guaranteed by means of a double combined wall system. The two combined walls, mutually anchored, are made of 40 m long high diameter piles, coupled with sheetpiles. The two walls are placed at a mutual distance of 100 ft which corresponds to the span of the Ship-To-Shore crane in order to act also as the deep foundations of the crane lines.

The layout of the whole pier has been redesigned to host new wide container stacking areas, served by ASC cranes, train railways and truck roads.

DESIGN OF A NEW CRUISE TERMINAL IN BARI PORT

Location:	Italy
Client:	Bari Port Authority
Services:	Final and Detailed Design
Period:	05/2020 – 09/2022
Construction cost:	€ 9,390,000

Project Description:

The new terminal is a large multi-functional building for port and passenger services.

The building is distributed on two levels plus a roof sheltered terrace, with a total height of 11m. The functional macro-areas are divided in: passenger areas, boarding and disembarking areas, service areas, multipurpose areas.

The whole terminal is distributed on a rectangular building 33 m wide and 68 m long, which extends with the external terraces up to a length of 106 m. The structure is made of a reinforced concrete and it is founded on piles.

The use of the design solution for the exploitation of hydrothermal energy from marine sources in a sea city like Bari, arises from the availability of a quenchless resource immediately close to the intervention area and from the opportunity to implement renewable sources.

This design solution also complies with the guidelines of the national energy policy and community, which aims to rationalize the energy system, focusing on the thermal sector and on reducing heating and cooling consumption and emissions drastically.

DESIGN FOR THE CONSTRUCTION OF A NEW SHIPYARD INSIDE THE GENOA SESTRI PONENTE OIL PORT (“PORTO PETROLI”) AND HYDRAULIC WORKS ON THE MOLINASSI STREAM

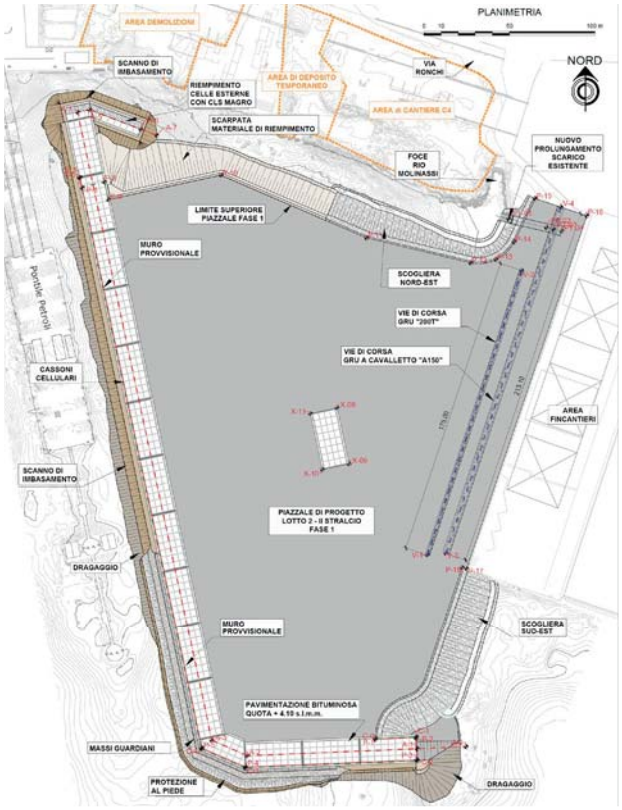
Location:	Italy
Client:	Municipality of Genoa
Services:	Detailed design
Period:	04/2021 – 02/2022
Construction cost:	€ 72,578,780

Project Description:

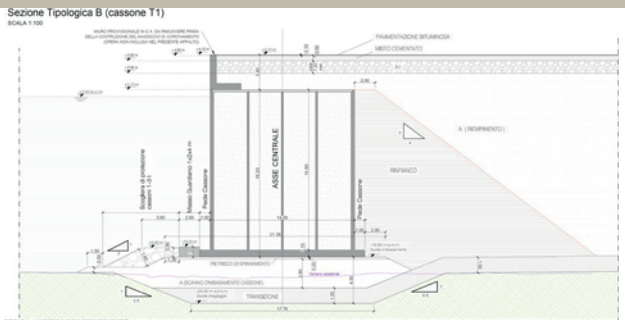
This project relates to the package of interventions called "New reclamation for shipyard utilization within the Porto Petroli of Genoa Sestri Ponente and hydraulic arrangement of the Rio Molinassi".

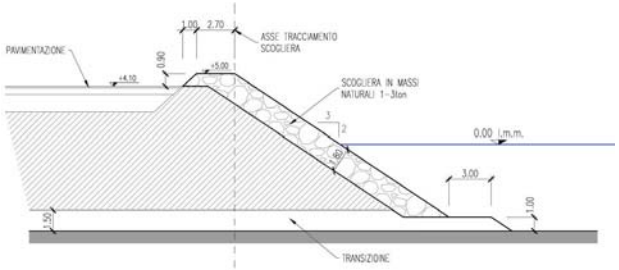
The aim of this design-build consists in the creation of a new industrial platform area (round 64.000 square meters), located between the “Delta” jetty of Porto Petroli and the Fincantieri area in Sestri Ponente, for the transfer of the industrial activities of Fincantieri currently located north of the railway. The intervention makes it possible to improve the logistics of shipyard areas which, in this way, would all be concentrated along the sea side of the railway line. The reclamation area, consisting of approximately 1.000.000 cubic meters of granular material, is bounded by round 500 m long berth wall made with concrete caissons.

The area is affected by the mouth of a river, called Rio Molinassi, which currently presents a highly dangerous situation due to insufficient sections and which, as part of the interventions not included in this contract, will be diverted to the final stretch, at the same time adapting the hydraulic section.



The project also includes the design of a 210 m long beam on piles (1500mm diameter) for the future installation of a 140 t/m crane railways.





During the design some changes to the Final Design were necessary, due to some interferences. Among these problems, the following issues deserve attention:

- unregistered sewer draining within the design reclamation backfilling; the solution involved the design of a temporary box culvert to allow the pipelines drainage.
- modification of the demaining reclamation project
- modification of the demolition design referred to the existing concrete jetty interfering with the reclamation and railway beams;
- Crane load increasing from 110 t/m up to 140 t/m with consequent lengthening of the foundation piles;
- South-east quay extension and modification of the protection revetment of the reclamation fill to ensure safety clearance for ships manouvres from the existing dry dock.

The main engineering consultancies services requested by the Employer concerned:

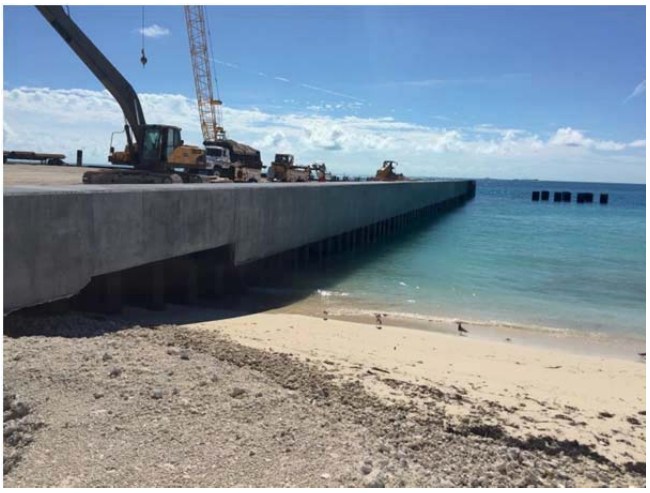
- Preparation of the investigation plan;
- Adjustment of the EMP;
- Resolution of the above described interferences;
- Detailed design of the Works (reclamation, concrete caissons, revetment, rc beams and piles) including reports, drawings, specifications and bill of quantities;
- Works construction phases;
- Design of the Variation Order instructed by Employer with respect to the Final Design.

The project was conducted in the Design and Build mode as an exception to the currently in force Italian Procurement Code (Codice degli Appalti).

ENGINEERING CONSULTANCY SERVICES RELATED TO THE CONSTRUCTION OF THE CRUISE SHIP DOCKING FACILITIES AT THE OCEAN CAY MSC MARINE RESERVE

Location:	Ocean Cay, Bahamas
Client:	GLF Construction Corporation
Services:	Detailed Design, Site Supervision, Technical Assistance during the Construction.
Period:	07/2016 – 10/2019
Construction cost:	€ 25,000,000 approx.

Project Description:



The scope of work is the development of the Detailed Design (Engineer of Record) of all civil structures and the design of provision of plants works necessary for the construction and functionality of the Marine Structures at Ocean Cay Island (Bahamas) and in particular:

- The bulkhead structures design to accommodate Cruise Ship Berthing and Mooring;
- Design of the lateral bulkhead structures and backfill which will connect the island to the berthing line;
- Detailed design of the steel and concrete structures of the bulkhead;
- Additional mooring dolphins and any ancillary structure related to the Design Ship Berthing and Mooring;
- Design of the marine equipment.

The main scope of the design job, will consist of matching budget constraints with the Employer's Requirements, Soil Conditions and Meteomarine Design Criteria which are given by the Employer. In detail, the engineering consultancy services include:

- Development of the technical specifications for the site investigations (geotechnical) to be carried out under Client expenditures and interpretation of the site investigation findings;
- Analysis of the construction methods and selection of the preferred ones in coordination with the Client's representatives;
- Berthing layout arrangement definition and Fendering system definition;
- Mooring layout arrangement to be defined by means of a specific mooring analysis;
- Development of specific geotechnical and structural models to verify the operational ultimate limit states behaviour of the ground soil and of the structures;

- Design of the bulkhead backfill with settlement analysis and completed with concrete paving;
- Detailed Drawings of the construction stages to be prepared in coordination with the Client's representatives;
- Technical Specification preparation for the construction of the structures;
- Client's Shop Drawings review;
- Technical assistance during the construction stage (mostly performed from Italy).
- Pile driving criteria and recommendations.
- Design for accommodation of utilities in the structures as required for the only bulkhead wall area (design of the utilities to be performed by others).
- Technical assistance after Irma hurricane and post storm reconstruction design review.

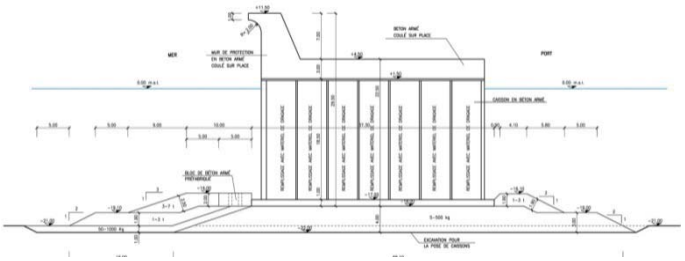
LNG JETTY AND MARITIME AND HARBOUR INFRASTRUCTURES OF THE HYDROCARBONS TERMINAL IN THE PORT OF SKIKDA

Location:	Skikda, Algeria
Client:	ORASCOM and BESIX
Services:	Feasibility Study and Preliminary Design
Period:	06/2018 – 09/2018
Construction cost:	€ 595,039,372

Project Description:

The design of the of Expansion of the Port of Skikda for new hydrocarbon terminals (oil and LNG) includes port infrastructures, dredging, land reclamation and related civil works, and in particular:

- Reinforcement of 1385 m of the existing main North breakwater, with the construction of a berm of 20-25 m width on BCR of 16 m^3 and with the reinforcement of the crest with Tetrapods of 16 m^3.
- Extension of existing main north breakwater with a caisson breakwater of 960 m length; the precast caissons of 34 m width and 58 m length and 18 m height will be installed on a foundation berm of 4 m height, placed on depths ranging from -18.0 m to -23 m
- A new east breakwater on rock material and Accropode of 5 and 8 m^3 of approximately 1000 m long, to protect the new M3 jetty for LNG loading
- A new quay of 1100 m (560 m for container ships, up to 4000 TEU), a container terminal and storage areas (for futures demands of CP3K and sulphur) for a total area of approximately 188,000 m^2 (created with dredged material and reclamation works). The quay level is to be at +3.00m msl and the dredged sea bottom at -15.00m msl. The quay walls are made of combined walls, composed of steel piles and sheet piling.
- dredging of the approach and entrance channel, turning basin and port areas, respectively to -25.00m m.s.l. and -23.50 m.s.l., -23.50 m.s.l and -15.00m m.s.l. in sand soil, with a minimal percentage of silt, totalling an approximate volume of 9.3 million m^3.



In the Feasibility Study and Preliminary Design the following activities have been particularly carried out:

- Definition of several layouts for the development of the port and choice of the optimal layout;
- Evaluation of existing main breakwater and design of the reinforcement of this breakwater;
- Design of new breakwater (on rock material and concrete blocks) and breakwater on caissons;
- Design of quay walls on combined walls, composed of steel piles and sheet piling;
- Dredging works design;
- Land reclamation and vibro-compactation methologies

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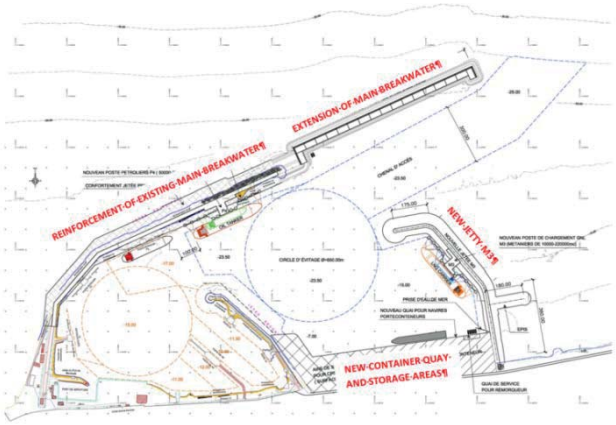
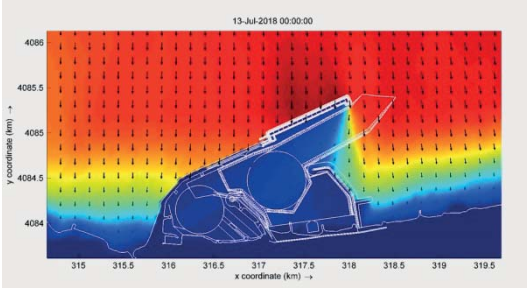


The Engineering consultancy services for the the Feasibility Study and Preliminary Design of the development of the hydrocasrbons port are the following:

- Meteomarine Study with numerical model (SWAN - Simulating WAves Nearshore)
- Agitation study with numerical model (VEGA)
- Navigation Study with fast time numerical model SHIPMA
- Static and dynamic mooring analysis with numerical model (OPTIMOOR)
- Downtime study with numerical model (VEGA)
- Hydrodynamic Study with numerical model (Delft-3D-FLOW)
- Sedimentation study with the morphological module of Delft-3D numerical models package
- Design of dredging (9,3 million m^3)
- Geotechnical studies (filling works, settlements and overall stability analyses, liquefaction analysis and seismic analysis); Land reclamation and vibro-compactation methologies;
- Geotechnical Report
- Bill of quantities



Preliminary design activities comprised preliminary engineering design of the breakwaters on rock material and concrete blocks), breakwaters on caissons; quay and yard infrastructures, including specific definition of the new works layout and cross sections, design of dredging and filling works, settlements and overall stability analyses).

CONSULTANCY SERVICES FOR THE DEVELOPMENT OF MARITIME TRANSPORT INFRASTRUCTURE ON LAKES BANGWEULU AND MWERU IN LUAPULA PROVINCE

Location:	Samfya, Muchinshi, Mbabala, Mbulu, Nchelenge, Kilwa, Chisenga – Luapula Province – Zambia
Client:	Ministry of Transport, Works, Supply and Communications
Services:	Feasibility Study, Detailed Design, Tender Documents.
Period:	06/2015 – 03/2018
Construction cost:	€ 5,000,000

Project Description:

The purpose of the Consultancy is to draw up a report that will provide detailed information on the required marine infrastructure that will support the provision of sustainable and profitable transportation services on the two lakes since the two lakes are host to a significant percentage of people living on the islands but lack safe and reliable water transport services. They depend on unsafe canoes to conduct inter-island and mainland commerce and human interaction. The report will assist to make decisions on the type of infrastructure and also to estimate the total investment required to either construct, rehabilitate or maintain the infrastructure.

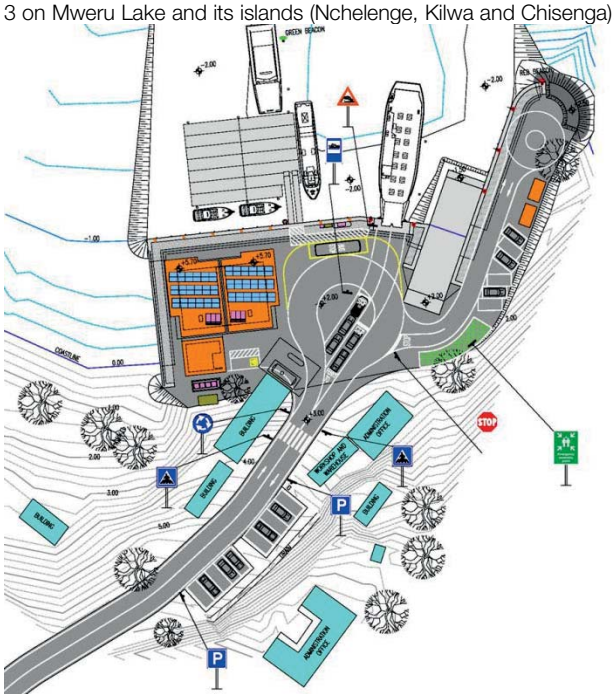
Luapula Province, named after the Luapula River, is one of Zambia's ten provinces, and it is located in the north of the Country. The provincial capital is Mansa. The province is bordered along the Luapula River, through Lake Mweru and to its north by DR Congo which at times has led to disputes and conflict.

The Province has a lot of potential for tourism development and mining. Among the many challenges in this province, transportation is one of the major ones. Lack of transport in outlying areas results in unnecessary deaths and wastage of agricultural productions.

Bicycles and small boats are the main intermediate means of transport in Luapula besides walking and very little motorized traffic. There is a need to improve rural transport services.

The rehabilitation and development of marine infrastructure on the lakes Mweru and Bangweulu will enhance the transportation system of goods and services and people. This will also favour the establishment of supportive infrastructure which will in turn fuel the development of the district, the province and consequently, the Country.

7 locations have been identified, 4 along the coast of Bangweulu Lake and its islands (Samfya, Muchinshi, Mbabala and Mbulu) and 3 on Mweru Lake and its islands (Nchelenge, Kilwa and Chisenga).



At present there are no structures for mooring along 5 places (and at Chilubi Island it is very compromised) and the canoes and little vessels land directly on the beach. This is very dangerous for the boats and for the people, given the presence of crocodiles and parasites in the water.

Three main ports have been designed to become reference points for the lakes, both in commercial as touristic and social reference points; four smaller ports have been designed for the island and their little community. Anyway, for all ports services building and waiting room are foreseen. Some more services as refuelling point and slipway, etc. are built only in the bigger ports.

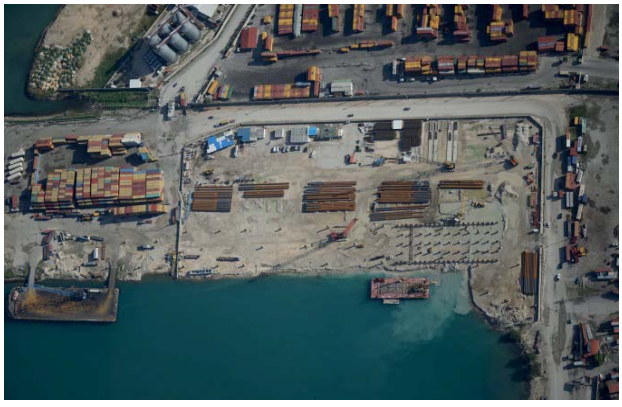
For all locations, the maritime structures are built on piles and floating pontoons in order to assure the operability of the structures in any meteomarine conditions. The project also includes dredging studies.

ENGINEERING CONSULTANCY SERVICES RELATED TO THE RECONSTRUCTION OF THE NORTH QUAY OF THE INTERNATIONAL PORT OF PORT-AU-PRINCE

Location:	Haiti
Client:	GLF Construction Corporation
Services:	Preliminary design and Detailed design (Engineer in Responsible Charge); Specification for Bathymetric and Meteo-marine Surveys, and Geotechnical Investigations; Site Supervision during Geotechnical Investigation; Preparation of Technical Specifications)
Period:	07/2013 – 11/2017
Construction cost:	€ 66,000,000

Project Description:

After the Haiti earthquake of 12 January 2010 the Port-au-Prince Port was severely damaged. Soil liquefaction together with the bad conditions of the structures prior to the earthquake causes the complete collapse of the north wharf and RO-RO ramp during the 2010 seismic event. The reconstruction of the North Quay was a primary issue for the required necessity to increase port service supply and timing represent therefore a major issue for the project.



The location of the new quay was identified by APN (Haitian Port Authority) on the on-shore area, behind the old collapsed wharf.

GLF Construction Corporation was appointed by APN to design and rebuild the collapsed structures of the North Quay and of the RO-RO berth which constituted the main facilities of the port. TECHNITAL has been appointed to develop the whole design of all the works included in the contract. The main facilities included in the works are the following:

- The new quay 410 m long provided with all the interfaces for the future Ship to Shore and plant equipment to give fully operability to the Container Terminal Wharf once technical installations and rail will be supplied;
- the RO-RO platform in concrete (30 x 33 m2) set at the east side of the quay;
- the stockyard area of about 0.9 hectares behind the new quay;
- the dredging works up to -11.50 m depth in the area between the new and the existing quay;
- the revetment protection under the new quay decks.

APN requested a water depth in front of the quay of -11.50 m on MLLW. The new quay is a pile supported wharf. Piles consist of driven piles with tubular steel pipes, with a concrete infill which will ensure the connection with the above concrete deck. Piles are driven on-shore; the dredging activities shape the slope 1:2 and are performed after pile driving and before final deck concrete pouring.

Concrete deck is about 34 m large, in order to ensure an adequate support to the 100 feet spacing rails, the typical STS Crane gauge for Terminal Container quays. In the first phase of the study gathering and interpretation of field data were carried out in order to define the situation at the beginning of the works. TECHNITAL prepared specifications, gave field support and supervision during activities and then processed all data collected to give complete interpretation about the geotechnical soil characterization and the bathymetric and meteo-marine conditions of the area. Seaside surveys were in particular not only focused on off-shore future dredging area but also to detect the correct locations of the ancient concrete decks of the wharf collapsed during the tragic seismic event: a multi-beam survey was therefore supported with additional scan-sonar survey. On the other hand an extensive Geotechnical campaign was also undertaken in order to detect all precise condition of a soil which was extensively affected by liquefaction phenomena.

Investigations results were not favourable for the design: The soil behind the quay has to be stabilized against liquefaction; Vibro-compaction has been designed in order to obtain the soil densification in the area of the quay. Detailed design of the quay walls and piles entailed both static and seismic condition analyses and piles have to sustain both the static and seismic load also given by the containers stacked in the area. Vibro-compaction, piles drivability, geotechnical/structural design of the piles, numerical modelling of the soil-pile interaction and soil-structure and dynamic analysis of the whole quay structure are among the most challenging aspects of the project. The design was strongly influenced by the complexity of supplies on site: tailor made concrete specification for marine structures, stacking yard pavement and slope/scour protection of dredging have been prepared in order to match the rough material availability in Haiti. Work stages, working technologies implemented for the construction, corrosion countermeasures for the structures were developed taking into account both Contractor and APN particular needs. Decks have been completed with tie-down facilities for cranes (as Port-au-Prince area is exposed to Hurricanes) and all the provisions for the future plants (mechanical, firefighting, electrical and potable water supply) and for STS functionality (Electrical Supply, Turnover anchor pits, data communication). Stacking yard pavement design requested also traffic analysis for the port assuming different hypotheses for future port logistic organization. Fendering and Mooring facilities were defined after a specific evaluation of the environmental conditions. Detail design for Dredging, Backfilling works, Quay wharves structures, Plant provisions, Provisional internal traffic roads and slope/scour protection are designed considering the future possible port expansion.

RED SEA GATEWAY TERMINAL – PHASE 1A EXPANSION WORKS

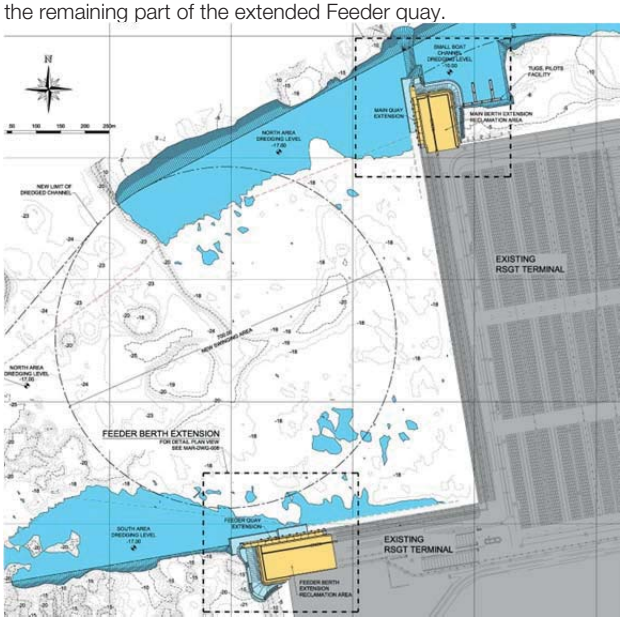
Location:	Jeddah – Kingdom of Saudi Arabia
Client:	Saudi Archirodon Limited
Services:	Detailed Design
Period:	06/2015 – 04/2017
Construction cost:	€ 50,000,000

Project Description:

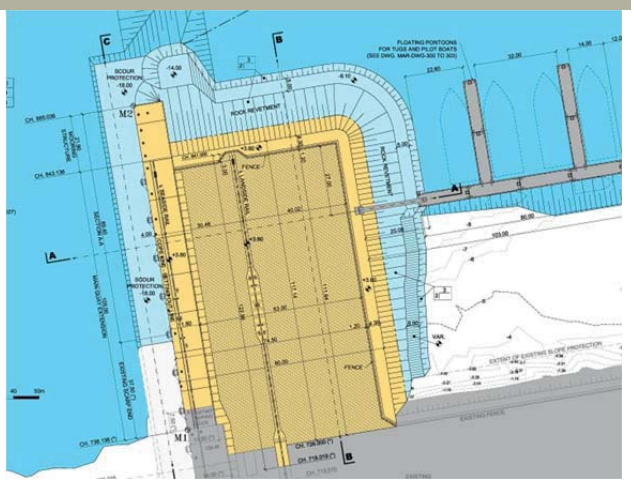
The Project consists of the design and the building of Phase 1A Expansion of the Red Sea Gateway Terminal (RSGT), which is an import/export Container Terminal located at the Jeddah Islamic Port in Saudi Arabia, along the Red Sea coast. The existing terminal comprises a Main Berth, 735m long, that was designed to accommodate Suezmax type containerships up to 15,000 TEU and a Feeder Berth, 320m long, for Panamax type containerships up to 5,000 TEU. The Terminal also includes an approximately 750m by 340m stacking yard for containers behind the Main Quay and a smaller stacking yard, about 180m by 60m, behind the Feeder Quay.

The Phase 1A Expansion Works encompass a 105mx80m extension of the Main berth and a 142.5mx83m extension of the Feeder berth.

The extensions of the berths have been designed to accommodate vessels up to 19,000 TEU along the Main quay and the westernmost 45m of the Feeder Quay, and up to 9,400 TEU in the remaining part of the extended Feeder quay.



The Main and Feeder quay walls are precast concrete blockwork structures with cast in situ capping beams, having a cope level at +3.60 m CD and the toe level (top of scour protection) at -18.00m CD along the Main quay wall extension and from -15.90 m CD to -18.00 m CD along the Feeder quay extension. The quay walls foundation soil consists of coral deposits, with a superficial layer of soft material to be completely removed prior to placing the precast blocks. The precast blocks, which are placed one upon the other in a way to form adjacent vertical columns, are hollow and the central voids of the lower block courses are partially filled with granular ballast material to provide the quay wall with the necessary weight for stability against sliding and overturning. All the blocks belonging to an individual column are connected vertically by dowels to be installed into dowel holes executed on the rear of each precast block



The quay walls extensions are furnished with 150t bollards and Super Cone type fenders at 15m c/c and are designed to carry twin 40ft container handling quay cranes.

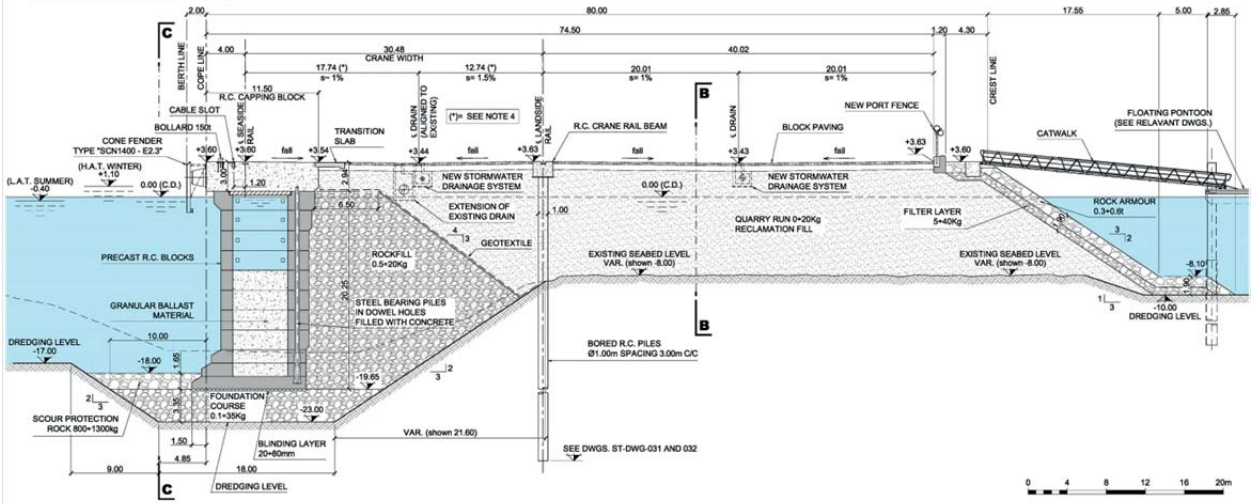
The project also includes:

- the dredging works to deepen to -17.0 m CD and enlarge from 650m to 700m the existing swinging area, in order to enable the design vessels to access the extended berths;
- the approx. 80m wide reclamation of the areas behind the quay walls extensions and the paving works of the new containers stacking areas. The reclamation works comprise a preloading activity to meet the settlement requirements of the Employer.
- the rock revetments of the reclamation slopes;
- The construction of the reinforced concrete rear crane beams, to be founded on r.c. bored piles so as to minimize settlement issues;
- the civil works for the extension of the existing firefighting system and of the drainage network along with the provision of new oil/water separators treating the runoff from the expansion areas;
- the provision No. 3 new 40m high masts and related civil and electrical works to ensure the required lighting level on the extended areas.
- a new berthing facility for the tugs and pilot boats operating in the Terminal, consisting of a 80m long floating pontoon with 40m long finger jetties, to be connected to the Main berth by means of a 25m long steel catwalk. The Works associated with the berthing facility include the dredging to -10m CD of a new access channel beside the Main Quay to grant the access to the floating pontoon.

The company's scope of work has covered the collection and review of existing data and surveys, the geotechnical characterization and interpretation of the foundation soil and the detailed design of marine, structural, civil and electrical expansion works.

The Works have been designed for a 50 year service life and in accordance with internationally recognized codes and standards (British standards, Eurocodes, etc.).

MAIN BERTH EXTENSION
TYPICAL CROSS SECTION A-A



NEW MULTIPURPOSE PLATFORM (DRY BULK, OIL, CONTAINER TERMINAL) IN VADO LIGURE

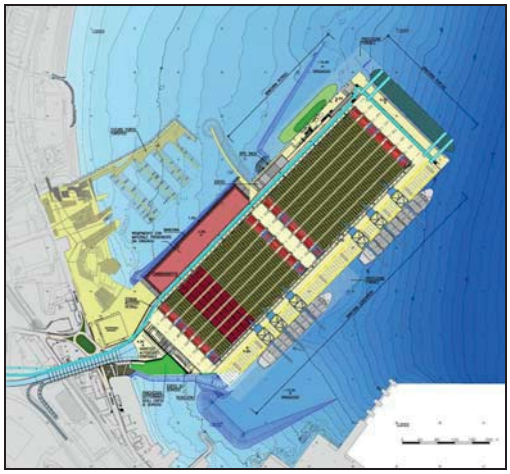
Location:	Italy
Client:	Port Authority of Savona
Services:	Front End and Detailed design for construction and operation of a new multipurpose platform (Dry bulk, Oil, and Container Terminal)
Period:	02/2006 – 08/2017
Construction cost:	€ 334,500,000

Project Description:

The Savona Port Authority published a tender regarding the activities of designing, constructing and operating a new Multipurpose Platform in Vado Ligure, Italy. The Multipurpose Platform is required to provide the following principal facilities:

- a container terminal, including quays, storage areas, gate complex and buildings, and ancillary facilities;
- the basic infrastructure for dry bulk and oil terminals, including quays and access roads, to replace the existing bulk and oil quays, to be demolished being located on the site of the new Multipurpose Platform.

The Joint Venture (JV) of Maersk (Operator), Grandi Lavori Fincosit (Constructor), and TECHNITAL (Designer) submitted a bid to the Savona Port Authority to develop the Multipurpose Platform and to operate the container terminal. The bid process was ruled according to Italian law (L. 109/1994 - Art. 37 bis); after presentation of the preliminary design prepared by TECHNITAL and related financial offer, the tender was won by the JV on 30th June 2006; after awarding the tender, with features of a project financing (part of the money given by the Public Entity through Savona Port Authority, and part by the successful bidder), the JV was transformed into a Company, responsible for final and detailed design, construction and operation of the terminal, named APM Terminals Vado Ligure S.p.A.; within the group, TECHNITAL is responsible for the design.



Designed works are as follows:

1) platform 700 m long and 300 m wide, including container, oil and bulk cargo quays, to be placed on a mainly open structure with a filled area located at the landward end;
2) organization, for operational purpose, of the container area, 700 m long and 250 m wide, with containers stacked in 6 levels of height, with optimization of the layout; the following items are considered in the design:
   - container stacks reefer plug-in points;
   - administration, operations and gate building;
   - fuelling facilities;
   - equipment cleaning area;
   - lighting;
   - paving, surface water drainage, rails for RMGs (rail mounted cranes; and STSs (ship to shore cranes);
   - fire-fighting facilities;
   - telecom., RF data links, security & CCTV systems;
   - security fencing and gates;
   - open storage areas, roads, equipment parking area and car park;
   - main control building and workshop including amenities, stores and canteen;
   - substations, electrical power distribution & standby power generation for buildings, operational plant and facilities;
   - water supply and distribution system including storage tanks;
   - sewerage network;
   - approach roads to the terminals.

The overall width of the platform is 300 m; the quay lengths are as follows:

a) Container quay: 700 m;
b) Dry bulk quay: 340 m;
c) Oil quay: 280 m.

The new platform is to be built on the site where today two oil jetties and a dry bulk jetty are operational, and are to be maintained till the new facilities are operational themselves. The structural solution for the open part of the platform consists of reinforced concrete caissons, precast and flooded, founded on a rock layer based on a transition granular layer; the existing soil under the transition layer must be properly consolidated with a preloading treatment; for the upper deck, a system of beams, precast self-bearing dales and cast “in situ” slabs were considered. The beams are precast and pre-stressed. The landward reclamation volume is used to dispose the dredged material, about 500,000 m3, to be placed within a reinforced concrete caisson perimeter. The detailed design was developed in stages, which fit with the financial availability of the client; phase 1 (32% of the total) was delivered and approved in august 2012; phase 2A (3% of the total) was completed and approved in October 2014; phase 2 (remaining 65%) was delivered and approved in April 2015.

POST CONTRACT CONSULTANCY SERVICES FOR CONSTRUCTION SUPERVISION OF REDEVELOPMENT FOR DOHA SHIOKH PROJECT

Location:	Qatar
Client:	Private Engineering Office (Doha)
Services:	Works Supervision
Period:	02/2011 – 04/2012
Construction cost:	€ 24,236,000

Project Description:

The project works consist of the re-development and refurbishment of the entire perimeter of Doha Shiokh Port.

Layout of the project superimposed to the existing

Shiokh Port is located on the southern side of Doha Corniche, in front of Souq Waqif, and provides berthing for about two hundred fishing and pleasure dhows plus more than one hundred small boats.

Quay walls construction: laying precast box culvert.

Peculiarity of this project is that all the works must be carried out enabling the existing facility to continue in its function and providing berthing for fishing and pleasure dhows.

- Demolition and removal of the existing concrete quay wall structure, suspended reinforced concrete deck, piles and breakwaters all around the perimeter of the port including the ancillary structures;
- Construction of new concrete blockwork quay walls with ground improvement works to provide suitable foundations, new rock armour and crest walls, a new slipway, new piled finger piers;
- Dredging;
- Supply and installation of new pontoons, guide piles, walkways and quay wall furniture.

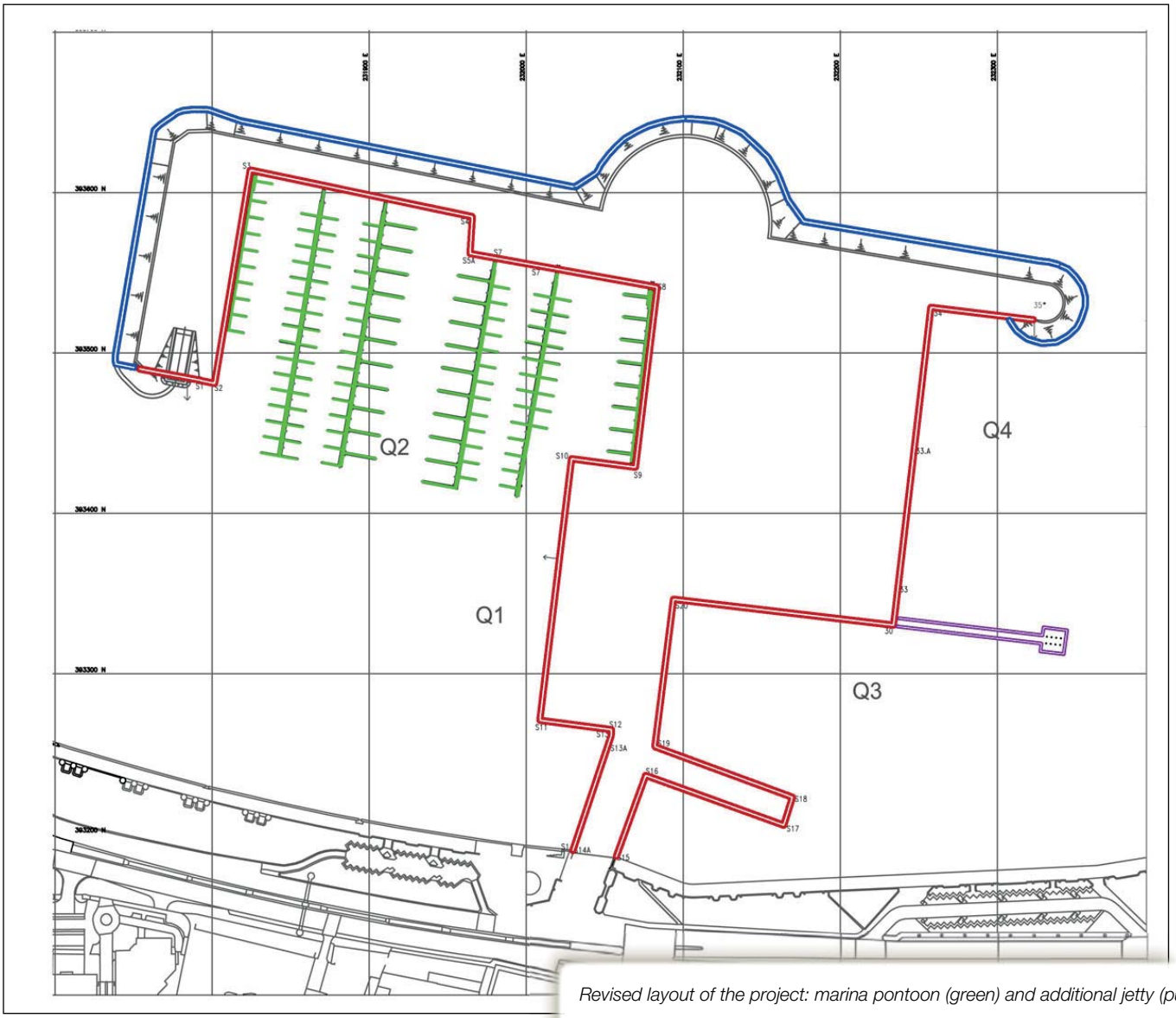
Stone columns soil improvement: driving the casing and drilling.

The General Supervision is carried out by the Supervision Team of the Qatar Branch Office (the Engineer), headed by the Head of Supervision Division, while the Site Supervision is carried out by a team of 7 staff specifically appointed to the Project, under the direction and coordination of the Senior Resident Engineer who assumed the role of the Engineer's Representative (FIDIC).

Breakwaters: laying precast crest wall block.

The general layout has been subject to some changes during the execution of the works. The marina pontoon, previously designed to accommodate sixty small boats has been relocated and revised in order to increase its capacity to two hundred fifty berths.

The Contractor has been also requested to design and build an additional 110 m long jetty which will increase the berthing capacity for fishing dhows.



Revised layout of the project: marina pontoon (green) and additional jetty (purple).

DETAILED DESIGN FOR THE NEW COMMERCIAL SHIPYARD RO-RO AND CONTAINERS WITHIN THE PORT OF CATANIA

Location:	Catania – Italy
Client:	Catania Port Authority
Services:	Detailed Design
Period:	03/2010 – 12/2010
Construction cost:	€ 62,488,548

Project Description:

The project is for the construction of a new operational area that will give enhance the Port of Catania both in terms of space and commercial capacity, with the aim in particular to improve the existing environmental condition through:

- the elimination of the current conditions of degradation;
- the improvement of road conditions;
- the improvement of the conditions of use of the area;
- the increase of services for the Administration and users.

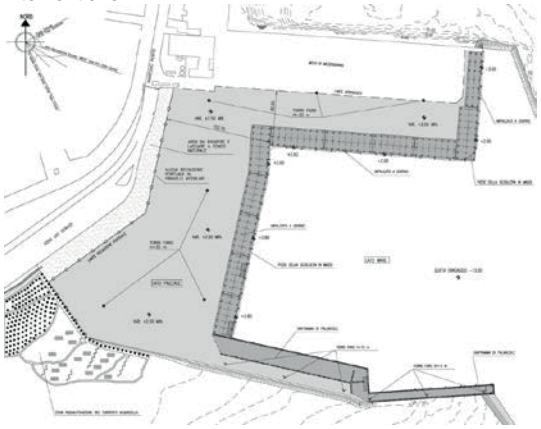
The realization of the planned works requires the execution of some preliminary interventions concerning the existing structures, the water space and the shore, as listed below:

- the demolition of buildings and infrastructures such as the current downdrift pier, Mezzogiorno pier and the crown walls;
- cleaning and remediation of the areas affected by the works;
- removal of submerged wrecks and residual works from other contracts.

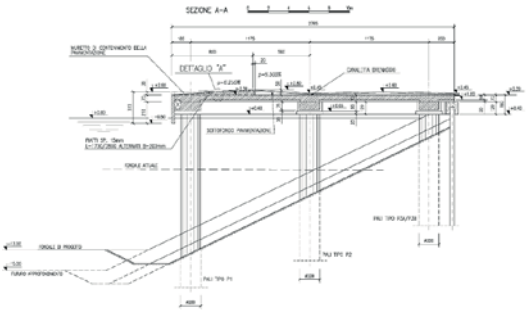
Once the preparatory works have been completed, the following works has been carried out:

- extension of the current Mezzogiorno pier (and construction of the related service apron);
- construction of the quayside;
- first section of the quay of the new downdrift pier made of tie anchored sheet piles;
- second quay section of the new downdrift pier consisting of a cofferdam made of metal sheet piles;
- coastal protection with rocks from the wave motion of said first section of the pier of downdrift;
- construction of the operational yards, electrical, water, fire-fighting system and first water collection plant;
- dredging of the dock bottom up to a project height of -13 m;
- submerged nourishment in Agnone littoral with part of the dredged material inside the dock.

The above works are preparatory works for the following interventions:



- expansion of the current Molo Mezzogiorno with open decks in reinforced concrete for approximately 310 m on the eastern front, 270 m on the northern front and 160 m at its head. The structures, cast or prefabricated, are made of concrete class 35/45 (Rck≥45MPa) with exposure class XS3 and steel for reinforced concrete B450C (FeB44k). On the back of the open decks, sheet piles are to be inserted to contain the embankment. All the sheet piles made with "H" type sheet piles coupled with "Z" type sheet piles or with "Z" type sheet piles alone, as envisaged in the project, are made of S355GP steel, standardized according to EN 10248, with a yield strength fy≥355 MPa and a breaking strength fu≥480 MPa.



- downdrift pier composed of a series of docks, for a total development of 417.13 m, to be realized with cofferdam with tie anchored sheet piles. The height of the quay is +2.60 m a.s.l. and the cofferdam is designed to withstand overloads of up to 40 kN/m2. On the sea side, the structure is to be protected by rocks.

- dredging of shipyard seabed up to the design limit of -13 m and reuse of the dredged material for the construction of the submerged bar, along Agnone, with a length of about 1800 m, a width of about 200 m at the top (tending to be horizontal), a height of about -2.50 m at the top and a section of 190 m2, will take place thanks to the detailed programming of an unloading plan that provides for a dynamic positioning system (transverse bow thruster and transverse stern thruster) thanks to which at each unloading the dredger is able to precisely reposition itself in a position adjacent to the previous unloading. The discharge plan will be monitored with bathymetric surveys that will allow operating with maximum reliability.

EXPANSION OF THE EXISTING PORT FOR FERRIES - RO-RO AT TREMESTIERI (MESSINA)

cation:	Sicily, Italy
Client:	Messina Municipality (Sicily)
Services:	Final Design, EIA
Period:	12/2009 - 06/2010
Construction cost:	€ 53,500,000

Project Description:

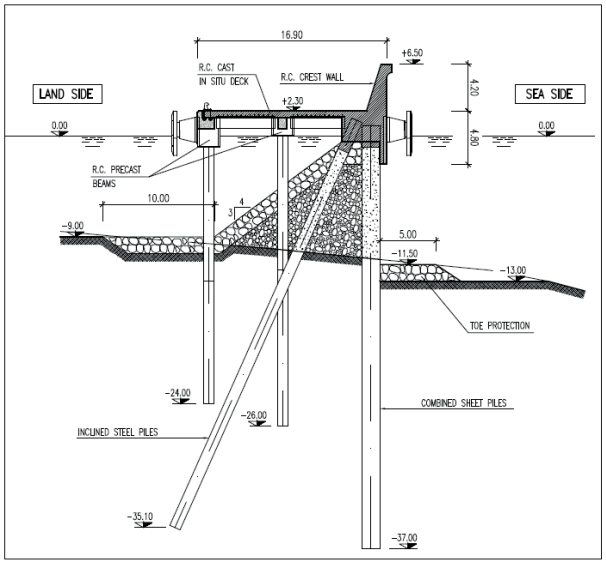
In 2006 the construction of Tremestieri ferry terminal (near Messina) was completed and port operations began, bringing a notable improvement to the connection of Sicily to Calabria. The new infrastructures however are insufficient to cater for the high demand for ferry connections between Sicily and Calabria and for Ro-Ro connections from Sicily to other ports of southern Italy. The Municipality of Messina therefore planned the expansion of the terminal completed in 2006, in compliance with the functional issues and recommendations indicated in the general master plan of the terminal.

The new terminal of Tremestieri envisages 5 berths for ferries (2 berths in the existing terminal, 3 berths in the new port basin) and 1 berth for Ro-Ro ships. A second Ro-Ro berth is envisaged on the sea side of the protective breakwater for use in calm meteo-marine conditions.

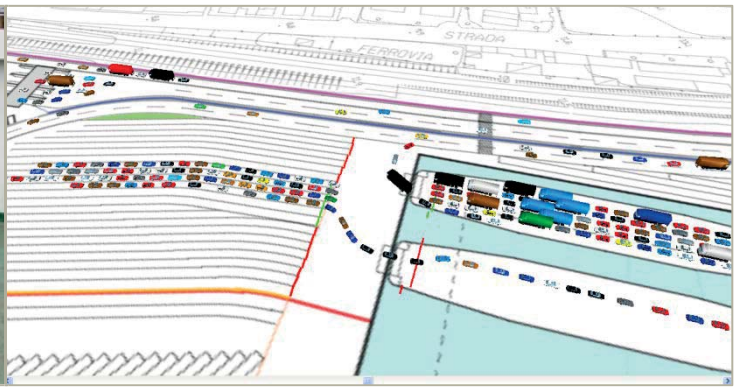
Different alternative configuration concepts for port expansion (the layout of land and marine infrastructures) were identified on the basis of the port requirements and a comparative analysis of the proposed solutions was performed to select the most promising development option in terms of technical-economic feasibility.

The land facilities were studied, in consideration firstly of the plan to separate the two logistic systems: ferries and Ro-Ro, and also to manage critical points in terms of traffic in the port areas, to allow flexibility of use of the parking areas, and to optimise the time for land operations such as loading/unloading vehicles to/from the ships, etc (see the figure above on right concerning simulations carried out by mathematical model VISSIM).

Regarding the marine works, the final solution, developed in the Detailed Design, envisages a breakwater protecting the internal basin to be built in very complex conditions due to the steep sea beds and a high magnitude design earthquake. The structure features a wall made by combined steel sheet piles anchored by inclined steel piles to counteract horizontal loads due to earthquakes and waves. The platform is made of reinforced concrete pre-cast beams and concrete cast in-situ deck (see the figure below).



The internal quays are 'open' structures to reduce the internal wave agitation and feature r.c. piles supporting an r.c. platform. The protection of the new land parking areas consists in a rubble mound structure with the armour layer in acropodes. The internal basin has to be dredged to -9 m and the dredged volume of 850,000 m^3 is used for beach nourishment at the down-drift part of the port to compensate the erosion process due to the construction of the new marine works.



QUAY OF THE NORTH ABUTMENT FOR THE MOBILE SURGE BARRIER AT LIDO SAN NICOLÒ INLET, VENICE LAGOON

Location:	Venice lagoon, Italy
Client:	*Consorzio Venezia Nuova* – Ministry of Public Works
Services:	Detailed design
Period:	01/2006 – 12/2008
Construction cost:	€ 52,345.300

Project Description:

The context of the works

The construction sites of the works to protect Venice and its lagoon from tidal floods are situated at the port inlets, the natural passages through the coastal strip that connect the sea and the lagoon, and permit the ebb and flow of the tides. The three port inlets are, from north to south: Lido inlet, Malamocco inlet and Chioggia inlet.

The figure below shows the works planned at Lido inlet.

General layout of works underway and works finished at the Lido inlet

The works underway in progress are:

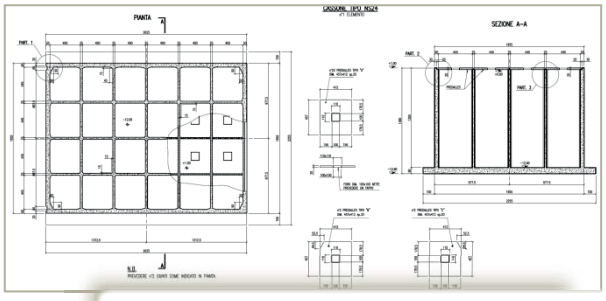
1. refuge harbour – lagoon side,
2. refuge harbour and dry basin,
3. new island – central core,
4. new island – lagoon side channel,
5. new island – Treporti side shore,
6. bottom protection of the San Nicolò channel,
7. production area – south shore yard,
8. reinforcement of the south breakwater.

The flood protection barrier at Lido inlet is built in two sections separated by an artificial island in the middle.

The North abutment quay

All infrastructures and plants serving both the San Nicolò barrier and the Treporti barrier, as well as several centralized monitoring and control services for coordinating the operation of the entire barrier, are installed on the artificial island at Lido San Nicolò Nord, in a restricted plant area accessible only to operators.

Construction of the central core of Lido island



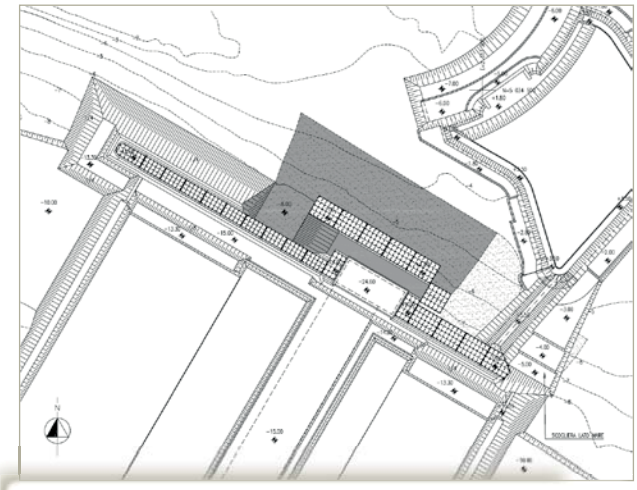
Pre-cast reinforced concrete cellular caisson.

The buildings housing the electrical plant and instruments powering the systems serving the flood-gates and controlling their operation, together with all ventilation and cooling systems for the rooms, are situated on top of the abutment caissons.

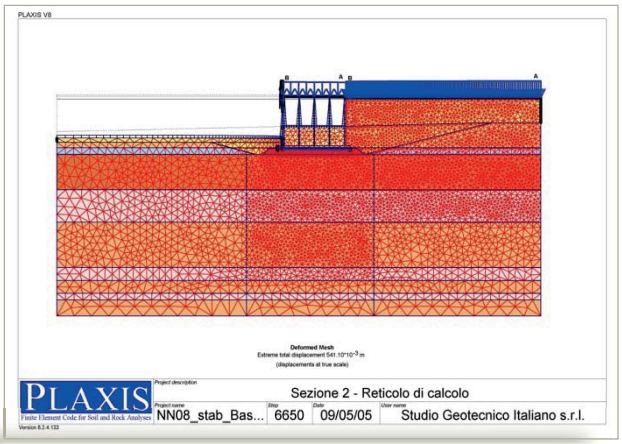
The main function of the bulkhead caissons and the rock protection on the sea side is to connect the barrier to the artificial island and support the embankment behind.

The bulkhead caissons of the quay also serve to house general service buildings (guardhouse, changing rooms, mess hall, offices and centralized control room that receives main control data from all three inlets).

The first phase of the project envisages the construction of pre-cast reinforced concrete cellular caissons to be built in special floating construction plant for pre-casting from where they are towed to the installation area, permitting construction of the shores adjacent to the barrier and the lagoon side breakwater.



Detailed plan of the North abutment at Lido San Nicolò inlet.



Finite element modelling of a section of quay made of cellular caissons

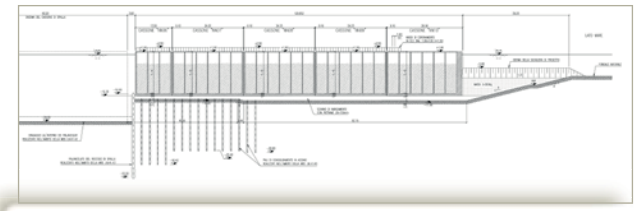
Typical construction, assembly and transportation phases for pre-cast reinforced concrete caisson

Before they are conveyed to site the caissons are covered with pre-cast reinforced concrete slabs to create a cover decking at a level of +1.00 m above mean sea level.

Also located at the North abutment is a service quay for access by small lagoon vessels and lighters (which carry all that is necessary for normal operation of the systems, personnel, machinery, consumables, fuels, etc. to the Lido island). At the end of this quay is a closing caisson that houses the fire-fighting and industrial water storage systems for the island facilities.

The pre-cast cellular caissons, with average size of 19x25x16m, are composed of 50 cm thick outer walls, 25 cm thick inner partitions, an 80 cm thick bottom slab that extends out in two 150 cm wide cantilevers on the long sides.

All caissons are set at a level of – 15.20 m below sea level.

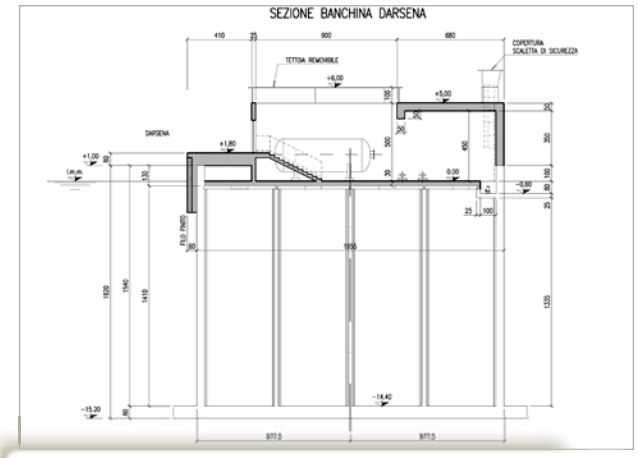


Cross-section of the North abutment caissons on the sea side at Lido San Nicolò inlet.

After laying the rock base bank, which acts to distribute the weight of the caissons on the dredged sea bed, the caissons are sunken into the positions stipulated in the project and subsequently ballasted.

The dock and barrier caissons create a structural assembly that protects the barrier from earth thrusts. At the same time the dock offers a well-furnished series of accesses to the technological and logistics buildings composing the complex (unloading quay, access ramps to plant buildings, etc.).

A pre-cast reinforced concrete wall panel, of a type widely used in sheet piling projects for mobile structures, is attached to the caisson with clearance, with respect to the finished line, sufficient for correlating with the fixed lines of the abutments.



Section of a quay caisson and the systems set on top

Summary of project requirements

Design life of the works:	100 years
Key environmental conditions:	Seismic zone, XS3 exposure
Reference standards for structural design:	Eurocodes, Seismic regulations and DM05
International standards and recommendations:	PIANC, EAU, BSI, USACE, EPA
Project and verification methods:	Limit states (service, damage, ultimate)
Analysis methods:	Non linear.

QUAY OF THE SOUTH ABUTMENT FOR THE MOBILE SURGE BARRIER AT LIDO SAN NICOLÒ INLET, VENICE LAGOON

Location:	Venice lagoon, Italy
Client:	*Consorzio Venezia Nuova* – Ministry of Public Works
Services:	Detailed design
Period:	01/2005 – 12/2008
Construction cost:	€ 53,805,600

Project Description:

The context of the works

The construction sites of the works to protect Venice and its lagoon from tidal floods are situated at the port inlets, the natural passages through the coastal strip that connect the sea and the lagoon, and permit the ebb and flow of the tides. The three port inlets are, from north to south: Lido inlet, Malamocco inlet and Chioggia inlet.

The figure below shows the works planned at Lido inlet.

General layout of works in progress or finished at Lido inlet

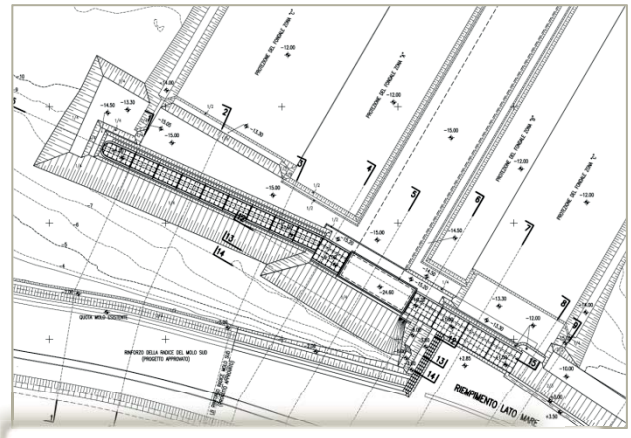
The works underway in progress are:

1. refuge harbour – lagoon side,
2. refuge harbour and dry basin,
3. new island – central core,
4. new island – lagoon side channel,
5. new island – Treporti side shore,
6. bottom protection of the San Nicolò channel,
7. production area – south shore yard,
8. reinforcement of the south breakwater.

The South abutment quay

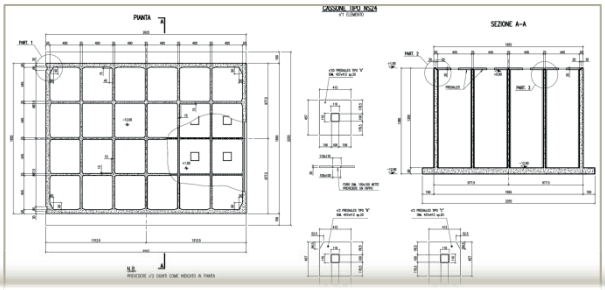
The main function of the bulkhead caissons and abutment works consists in joining the barrier (and in particular the abutment caisson) to the existing breakwaters, ensuring the extension of the vertical wall for an adequate length both upstream and downstream of the mobile barrier, and in supporting the embankment behind. The bulkhead caissons on the lagoon side also serve to guide the current flow towards the barriers.

The first phase of the project envisages the construction of pre-



Detailed plan of the South abutment at Lido San Nicolò inlet.

cast reinforced concrete cellular caissons to be built in special floating construction plant for pre-casting from where they are towed to the installation area, permitting construction of the shores adjacent to the barrier and the lagoon side breakwater. Before they are conveyed to site the caissons are covered with pre-cast reinforced concrete slabs to create a cover decking at a level of +1.00 m above mean sea level.



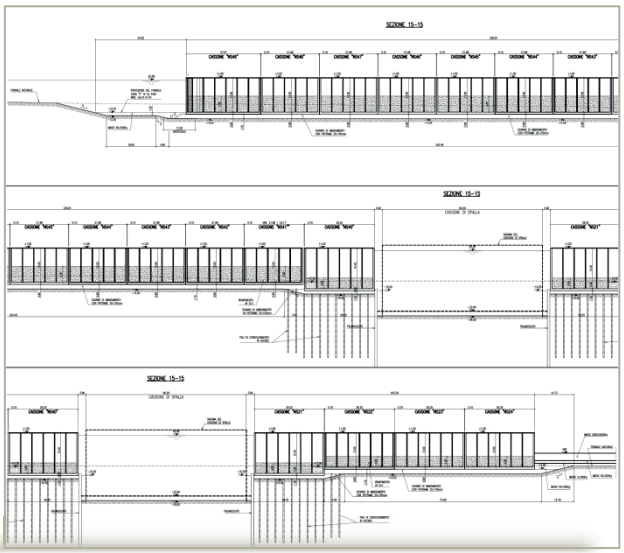
Layout and cross-section of a pre-cast reinforced concrete cellular caisson.

Typical construction, assembly and transportation phases for pre-cast reinforced concrete caisson

All caissons are rectangular, generally 19x25m, and approximately 14/16m in height.

The cellular caissons have 50 cm thick outer walls, 25/22 cm thick inner partitions, an 80 cm thick bottom slab that extends out in two 150 cm wide cantilevers on the long sides.

The caissons are set at a level of – 12.80 m below sea level except for the two caissons adjacent to the barrier abutment caisson which are installed at a lower level, at a depth of –15.20 m below mean sea level.



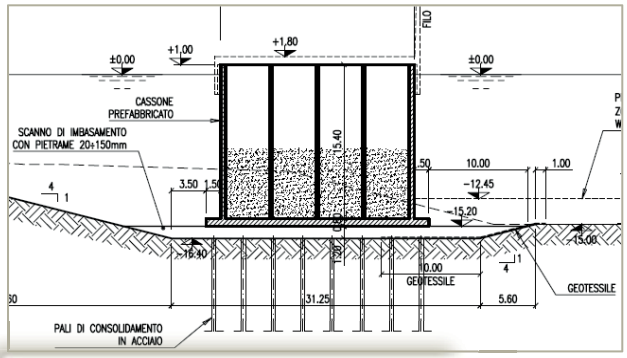
Cross-section of the South abutment caissons at Lido San Nicolò inlet.

There are also 20 small caissons necessary to make the quay and the mooring place behind the barrier. Their dimensions are much smaller and they are laid at a depth of –3.00 m.

After laying the rock base layer, which serves to distribute the weight of the caissons on the dredged sea bed, the caissons are sunk into the position stipulated in the project and subsequently ballasted.

The design for the South abutment foresees the construction of the following caissons:

- two caissons adjacent to the abutment caisson, one on the sea side (NS21 plant caisson) and one on the lagoon side (NS40);
- three bulkhead caissons on the sea side (NS22, NS23 and NS24);
- nine caissons on the lagoon side to build the breakwater(NS41÷NS49);
- twenty small caissons to make the quay and the mooring place (NS01÷NS20).

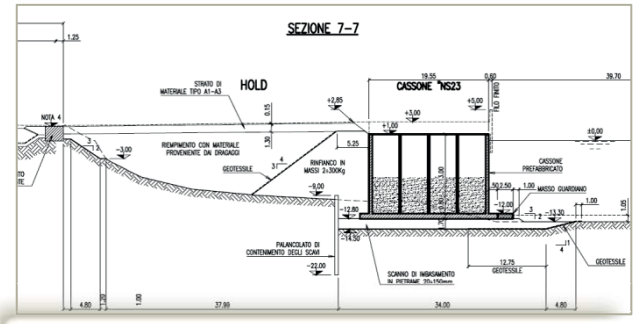


Cross-section of a South abutment caisson

Durability of the works

Design process focused on the theme of the durability of the works. The goal of ensuring a useful (or service) life of 100 years was achieved as follows:

- systematically analyzing service conditions and assessing the action of all correlated loading situations, both regarding performance required by its function and by calculating the necessary ultimate reserve of resource of the structures;
- giving the works a geometric shape to make them easy to inspect and, where it is more complicated to repair or replace them, to equip them with all the characteristics and resources necessary to keep them efficient during their entire service life, including scheduling adequate maintenance procedures;
- designing materials in order to contrast aggressive environmental agents or furnishing them with the most adequate and enduring protection system;
- designing an integrated monitoring system that permits routine and extraordinary maintenance procedures to be scheduled and calibrated.



Cross-section of South abutment caissons at Lido San Nicolò inlet.

Summary of project requirements

Design life of the works:	100 years
Key environmental conditions:	Seismic zone, XS3 exposure
Reference standards for structural design:	Eurocodes, Seismic regulations and DM05
International standards and recommendations:	PIANC, EAU, BSI, USACE, EPA
Project and verification methods:	Limit states (service, damage, ultimate)
Analysis methods:	Non linear.

MULTIPURPOSE QUAY IN PORT OF TARANTO: UPGRADING AND RE-QUALIFICATION OF MOORING QUAY

Location:	Taranto, Italy
Client:	Taranto Container Terminal S.p.A.
Services:	Preliminary and Final Design
Period:	01/2004 – 12/2008
Construction cost:	€ 69,188,000

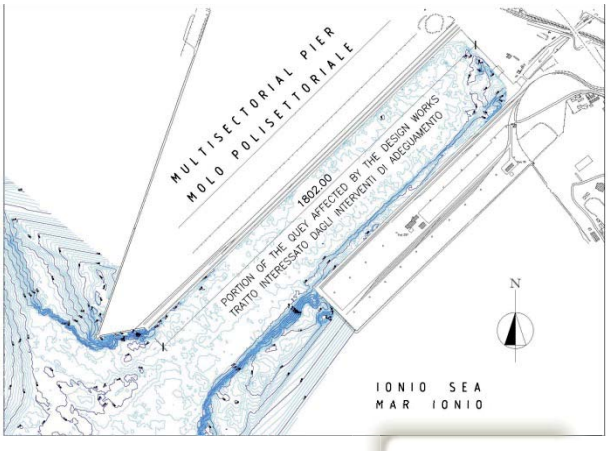
Project Description:

The work envisages the modernization of the existing quay along its entire length of 1800 m, to allow the mooring of container ships up to a future capacity of 12,500 TEU with a maximum draught of 15.00 m. This will necessitate increasing the bottom depth by 2.50 m, from the present -14.00 m below m.s.l., and also the consolidation and stabilization of the existing structure by strengthening it at the base and connecting tie beams at the top. These latter will counter the increased thrusts and impede possible variations in the gauge between the existing crane rails, owing to the deforming condition created by the works.

Aerial view

For the structural consolidation and the stabilization of the existing quay structure, in relation to the increased bottom depth, the following works are planned:

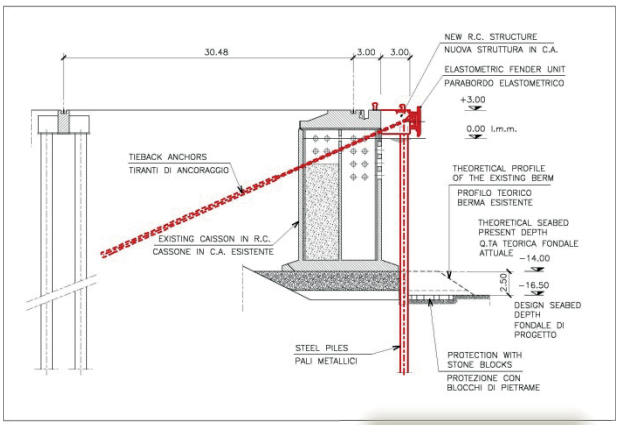
- Installation of a row of steel piles filled with concrete, t in front of the quay, to reinforce the base of the caissons and to effectively confine the part of the berm placed under the foundations of the caissons themselves;
- The treatment for cementing the material comprising the berm, located below the sole of the foundations of the caissons, with suitable valved metal pipes placed in the spaces between the piles, by means of which injections can be made, so as to reduce the horizontal thrusts on the piles and seal the spaces between them, thereby impeding the possible future leakage of material once the dredging has been carried out;
- Pre-loading of the tie beams so as to contain the possible variations in the gauge between the rails, which would otherwise derive from the rotations of the quay structure, with associated horizontal displacement of the top, as a result of the increase in uneven pressures on at the base of the foundations, produced by the future removal of the underlying material;
- Increasing the capacity of the bollards and improvement of the elastic berthing fenders.



Plan of the works

Activities performed:

- Identification and study of the possible alternative solutions for the works in question
- Preparation of a preliminary design of the works limited to a 750 m long sea side section of the quay
- Preparation of the design documents necessary for the geognostic survey of this section of quay.



Typical cross section

DESIGN OF REHABILITATION/RECONSTRUCTION OF QUAYS 7 & 8 IN THE PORT OF DURRES

Location:	Durres, Albania
Client:	Albanian Ministry of Public Works, Transport & Telecommunication
Services:	Feasibility study, preliminary and detailed design; tender documents
Period:	05/2007 – 12/2007
Construction cost:	€ 14,000,000

Project Description:

Given that the Port of Durres is the main port of Albania and due to the rapid development of the country, the Port of Durres Authority decided to upgrade – by rehabilitating or reconstructing – the existing Quays 7 and 8 in order to provide access and berthing for bigger vessels and reliable and efficient loading/unloading facilities for steel scrap, grain, cement and other heavy general cargo.

The project consisted of three main activities:

- **Evaluation of the structural adequacy of the two existing quays** to satisfy the imposed operating requirements and identification of the most suitable solution between rehabilitation or full reconstruction options.
- **Detailed Design of the rehabilitation/ reconstruction of the quays** for a total length of 406 m.
- **Tender Documents** for the execution of the works in accordance with European Investment Bank formats.

This Project presented a particular complexity due to the strict and demanding operating requirements imposed by the Port Authorities and the dredging that had to be executed right in front of the quays.

Following a full geotechnical investigation campaign, a series of simulations were carried out to evaluate the effect of the imposed loads on the soil and on the quay structures. The evaluation of various design options recommended the complete reconstruction of the two Quays, with a structural solution combining deep steel sheet piles anchored to ground tie rods.

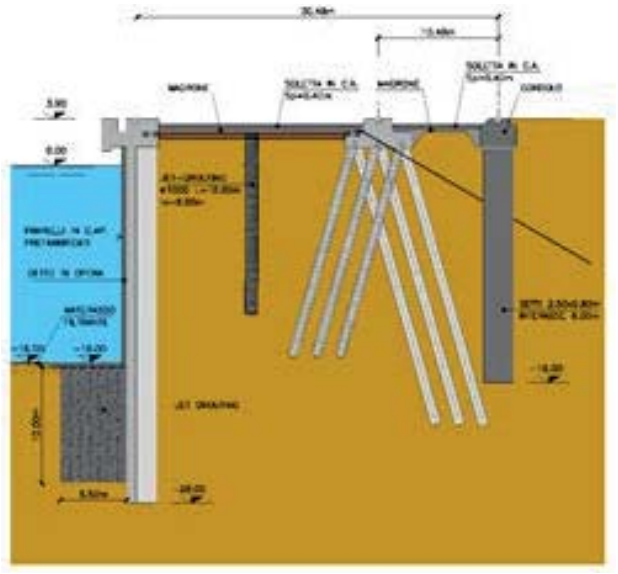
REHABILITATION OF CONTAINER QUAYS IN THE PORT OF GIOIA TAURO

Location:	Gioia Tauro, Italy
Client:	Port Authority of Gioia Tauro
Services:	Detailed design
Period:	09/2006 – 06/2007
Construction cost:	€ 31,800,000

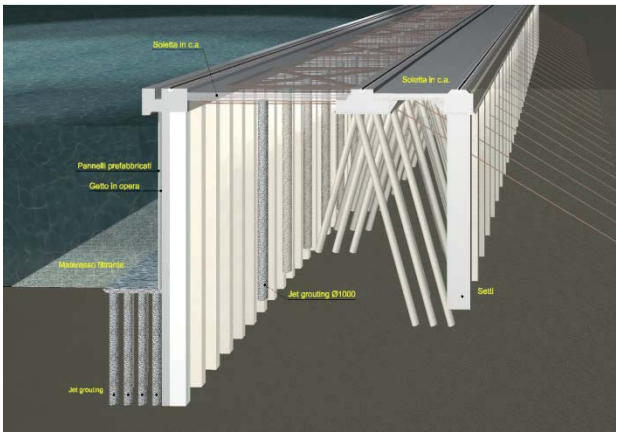
Project Description:

The tender published by Gioia Tauro Port Authority regards the activities of designing and refurbishing three existing container quays, with an overall length of approximately 1,900 m, and for designing and performing dredging works for approximately 900,000 m^3.

The new quays, originally designed to undergo an excavation at the quay toe varying between -13..5m and -15.0m are now required to undergo the planned dredging to -16.00m, in order to allow the new container vessels, Post Panamax type, to berth.
The engineering services involved the following activities:



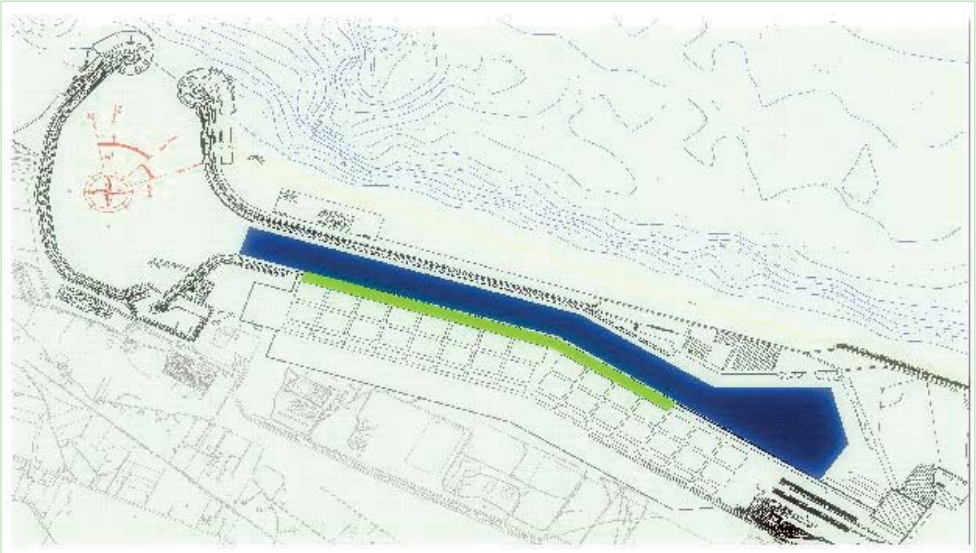
- providing the berth new anchors and structural improvement in order to allow the foreseen dredging and new berth and yard loads;



- providing a new rear quay rail in order to allow the installation of new cranes, with a 30.48m space between rails;
- designing the existing structures (r.c. diaphragms) coating, with a r.c. structure, for corrosion protection
- designing the dredging and following disposal of dredged material along 10 beaches in Calabria.

The Temporary Association formed by the contractors Grandi Lavori Fincosit, Cidonio, Società Italiana Dragaggi, Vipp Lavori, submitted a bid to the Gioia Tauro Port Authority to perform the works.

The bid was made, on the basis of a preliminary design, developed by Technital S.p.A., closely interacting with the construction group. Following the presentation of the preliminary design and relative offer, the tender was awarded to the group in June 2006



CONVERSION OF QUAYS INTO A NEW CONTAINER TERMINAL FOR SHIPS IN THE PORT OF NAPLES

Location:	Naples, Italy
Client:	Port Authority of Naples
Services:	Concept, preliminary design connections
Period:	01/2004 – 04/2005
Construction cost:	€ 280,000,000

Project Description:

The new quay for container ships is to be built by converting an existing quay with the following features:

650 m length, 14 m depth which could be increased to 16 m for future needs;

capacity to berth two 6,000 TEU ships at the same time, or one ship of 11,000 TEU

storage and handling area for containers including backup area of 230,000 m^2;

availability of areas for road and rail connections, port services and workshops for dockers.

The structure is equipped with cranes for handling the containers, and electrical, water supply, fire-fighting and drainage installations. Since the modification of the former wet dock is related to the re-cycling of contaminated material from an area to be reclaimed, the structural solution adopted will therefore guarantee the total insulation of the contaminated fill material of the new quay.

The new quay structure is as follows:

- quay structure sea side consisting of a double wall of steel piles connected with Larssen type joints, with polyurethane waterproof sheathing up to the impermeable tufa layer.
- quay structure land side consisting of a plastic diaphragm (cement-bentonite mixture) likewise placed up to the impermeable tufa layer.

The new quay will also house a cooling water system of the of the TIRRENO POWER station, designed for a maximum volume of 14 m^3/s.

The services carried out by TECHNITAL include:

- general design of works for the conversion of the wet dock into a new quay for container ships of up to 11,000 TEU (on maximum design depth of 16 m) ;
- planning of the geotechnical investigations;
- planning of the investigation to define the quality of the contaminated material;
- preliminary design of the new road and rail connections serving the quay.

The contract was carried out by TECHNITAL (40%) in association with ACQUATECNO - DAM - SERVIZI INTEGRATI.

DESIGN OF REHABILITATION/RECONSTRUCTION OF QUAYS 10 & 11 IN THE PORT OF DURRES

Location:	Durres, Albania
Client:	Albanian Ministry of Transport & Telecommunications
Services:	Feasibility study, preliminary and detailed design, tender documents
Period:	05/2004 – 12/2004
Construction cost:	€ 23,400,000

Project Description:

Given that the Port of Durres is the main port of Albania and due to the rapid development of the country, the Port of Durres Authority decided to upgrade – by rehabilitating or reconstructing – existing Quays 10 and 11 in order to provide access and berthing for bigger vessels and reliable and efficient loading/ unloading facilities for steel scraps, grain, cement and other heavy general cargo.

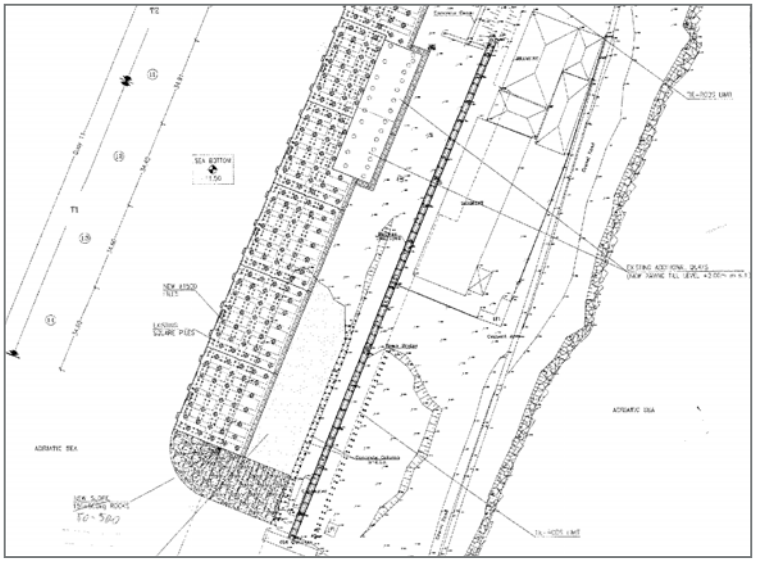
The project consisted of three main activities:

- **Evaluation of the structural adequacy of the two existing quays** to satisfy the imposed operational requirements and identification of the most suitable solution between rehabilitation or full reconstruction options.
- **Detailed Design of the rehabilitation/ reconstruction of the quays** for a total length of 437 m and construction of a new Back-up Area of some 18 Ha including utilities, access roads and railway links.
- **Tender Documents** for the execution of the works in accordance with World Bank formats.

This Project presented a particular complexity due to the strict and demanding operating requirements imposed by the Port Authorities, aggravated by the very unusual geotechnical conditions of the area which has a layer more than 30 m thick of soft, normally consolidated clay, with a very low permeability and shear strength

Following a full geotechnical investigation campaign, a series of simulations were carried out to evaluate the effect of the imposed loads on the soil and on the quay structures. The evaluation of various design options recommended the complete reconstruction of the two Quays, with a structural solution combining deep concrete piles with a concrete cast-in-situ diaphragm. The access channel and quay area will be dredged down to – 10.5 m.

The Backup Area behind the quays included: road and rail accesses, service networks (oil pipeline channel, electric lighting, HV, MV and LV distribution, telephone and IT systems), repair and reconstruction of the deteriorated existing structures, storage area pavements (including drainage, sewerage, fire fighting system) and utility systems.

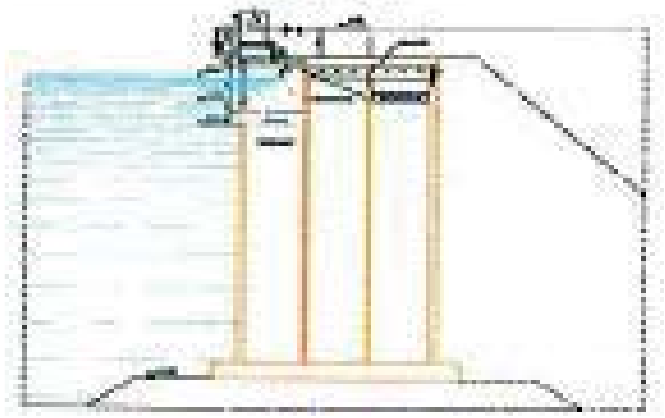


NEW CONTAINER TERMINAL IN THE PORT OF CIVITAVECCHIA

Location:	Civitavecchia, Italy
Client:	Grandi Lavori Fincosit
Services:	Detailed design
Period:	02/2003-08/2003
Construction cost:	€ 31,408,000

Project Description:

Present port of Civitavecchia & Typical cross section



The Project concerned the design of quays for various cargo traffic – bulk dry goods and containers – with a total of some 757 m of lee breakwater to protect the basin of approximately 108 m long, to be built entirely in cellular reinforced concrete caissons. The area behind the quay is to be filled with rocks.

Each caisson consists of a base slab 0.80 m high measuring 23.00 x 29.86 m, whilst the body has a horizontal plan of 20.00 x 29.86 and reaches the level of + 0.50 m.

The superstructure of the caisson lies between +0.50 m and +2.50 m. The level of the crown of the seawall is +8.50 m asl. On top of this is a 1 m high spray protection wall. The caisson is filled with inert matter ranging in size from 1 to 7 cm.

The base, which lies at the level of -15 m, was built following the preparation of the sea floor with an appropriate bed of stones and consists of 1st category rocks with the following properties: width of 56 m (var.) at -18.50 m and reaching the bottom with a toe of 2/1 on the inside and 3/1 on the outside.

This rubble-mound is protected on the outside, starting from the external perimeter of he caisson, by a cladding of 3rd category rocks some 3.00 m thick.

The project envisaged the following special works:

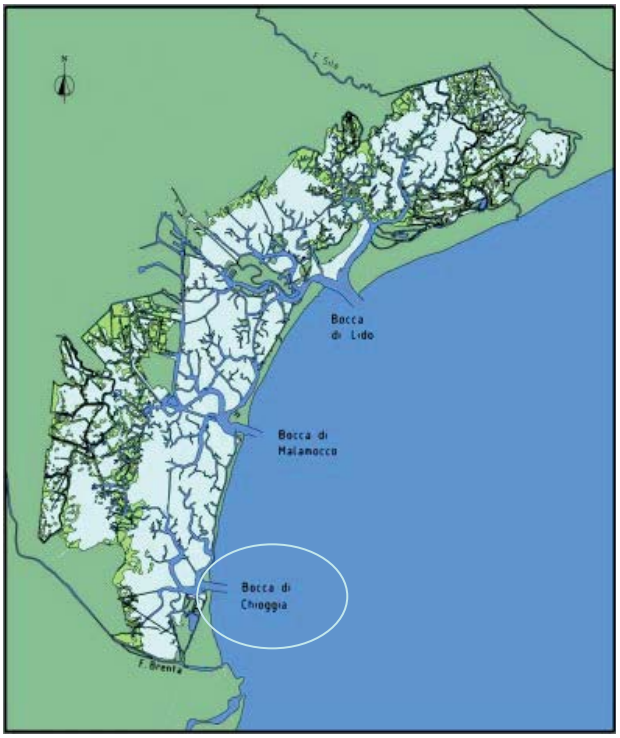
- Dredging of the substrata down to -25.00 m for approx. 70,000 m3
- Caissons: n° 38 caissons 27 x 12 x 16 m (built on a dolphin floating plant)
- Concrete for quay superstructure: approx.17,000 m^3
- Rocks 5-50 kg for lateral cladding / base: 134,000 m^3/37,815 m^3
- Tout-venant for the base of the caissons: 36,000 m^3

OUTER BREAKWATER AT CHIOGGIA INLET

Location:	Venice lagoon, Italy
Client:	*Consorzio Venezia Nuova* – for Ministry of Public Works
Services:	Detailed design
Period:	03/2003 - 08/2003
Construction cost:	€ 28,700,000

Project Description:

The outer breakwater at Chioggia inlet was designed and built to reduce the wave impact at the inlet where one of the storm surge barriers will be located to regulate the tidal flow, in the context of the scheme to protect Venice and its lagoon from flooding due to the high tides.

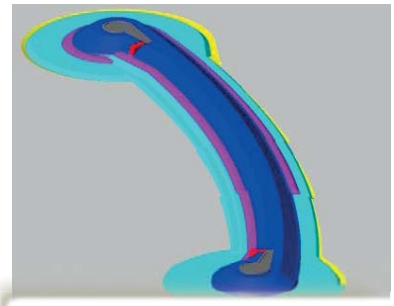


The breakwater has the following characteristics:

- length approx. 520 m on depths ranging between -7 and -12 m,
- the breakwater ends have a diameter at the base of roughly 140 m and shore end some 67 m, a crown made of blocks, of 24 m diameter at a height of +2.50 m; both ends are equipped for mooring
- the breakwater cladding consists of acropods of 6.3 m^3, with base level of -7.4 m, crest height of 2.50 m, and a 3:2 gradient, with a width at the crest of some 13 m
- underlying stone layer of 1-3 t pieces;
- the core and the berms of the breakwater are in quarry *tout venant*.

The breakwater is completed with cable ducts to supply power to the signalling lights placed at the ends of the breakwater.

During the construction some structural adjustments were made, to reinforce the foundation soil, by means of placing a layer of granular material under the berm which made possible a better compaction of the bottom soil and the distribution of the loads so as to disperse settlements in the lower layers of the breakwater.



Mathematical model of outer breakwater

The contract included the provision of the following services :

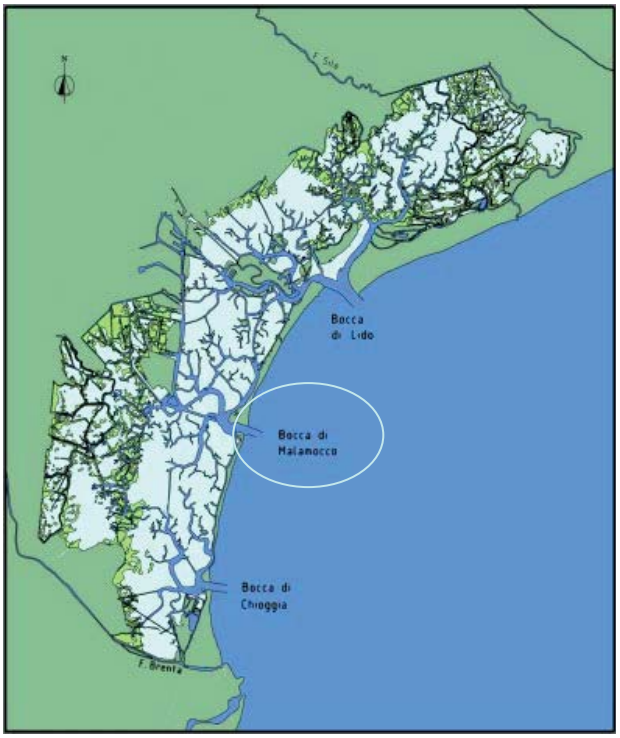
- detailed design of a structure to protect the port inlet against wave action:
- mathematical and physical model study to define the optimal layout;
- geological-geotechnical investigations to support the design;
- activity of safety coordination for the design.

OUTER BREAKWATER AT MALAMOCCO INLET

Location:	Venice lagoon, Italy
Client:	*Consorzio Venezia Nuova* – for Ministry of Public Works
Services:	Detailed design
Period:	06/2002-11/2002
Construction cost:	€ 58,430,000

Project Description:

The outer breakwater at Malamocco inlet was designed and built to reduce the wave impact at the inlet where one of the storm surge barriers will be located to regulate the tidal flow, in the context of the scheme to protect Venice and its lagoon from flooding due to the high tides.



The breakwater has the following characteristics:

- length approx. 1280 m on depths ranging between -6 and -14 m,
- diameter of the base of the breakwater head at the sea end roughly 100 m and shore end some 67 m,
- the breakwater ends have a crown made of blocks, of 24 m diameter at a height of +4.00 m,
- the slopes of the breakwater at the sea end consist of acropods of 6.3 m^3, with crest height of 4.30 m and 3:2 gradient, placed on a double stone layer of 1-3 t pieces;
- the slopes of the breakwater at the shore end are made of natural stone pieces of 2-5 t, placed directly on the core; the core and the berms of the breakwater are in quarry *tout venant*,
- the typical cross section consists of acropods of 4.30 m^3 covering the entire section from the height of +4.00 to -3.90/-7.80 m, with a width at the crest of some 9.50 m,
- where necessary a trench was created to house the berms at the design level,
- possibility of mooring at either end is foreseen,
- the breakwater is completed with cable ducts to supply power to the signalling lights placed at the ends of the breakwater.

The contract included the provision of the following services :

- detailed design of a structure to protect the port inlet against wave action:
- mathematical and physical model study to define the optimal layout;
- geological-geotechnical investigations to support the design;
- safety coordination for the design.

DESIGN REVIEW OF NEW QUAYS IN THE PORT OF DURRES

Location:	Durres, Albania
Client:	Albanian Ministry of Transport & Telecommunications
Services:	Design review
Period:	11/2000 - 12/2002
Construction cost:	€ 12,538,400

Project Description:

At the time of the original design for the detailed design of the rehabilitation works carried out by TECHNITAL and SOGREAH Ingénierie (France) in 1997-98, there was limited knowledge of certain design parameters, such as the detailed soil parameters in the specific area of reconstruction. The contractor responsible for the construction of these works was therefore obliged by contract to perform soil investigations to determine the required design soil parameters and to verify the structural design.

Subsequent to the award of the Contract the Contractor, Mohammed Abdulmohsin Al-Kharafy & Sons WLL (Kuwait), performed detailed subsoil investigations and reported that the soils are significantly different from those considered in the original design. As a result, a complete Design Review became necessary in order to adapt the original design to the new information obtained by the bathymetric surveys and the geotechnical investigations.

TECHNITAL was awarded a new contract, for the Design Review of quays 1, 5 and 6, to be coordinated with Danport, the company responsible for the works supervision and Al Karrafy, the Contractor.

Furthermore, due to the loss of archival material and 'ad hoc' development in the past, there were no existing plans showing elevations, drainage patterns and systems, or ducting and/or electrical conduit layouts, water systems, etc. within the port area.

The Port of Durres Authority (PDA) and the Project Implementation Unit recognized, in view of all the rehabilitation and development works being carried out, the need to have accurate and up-to-date surveys locating all existing port facilities including building, and designs for drainage, utilities and services systems. They also determined the need to carry our detailed design and tender documentation for the implementation of drainage structures, paved areas, internal road network and site illumination.

The scope of works of this new contract therefore consisted of two parts:

Phase A: Review of Design for Civil Works:

- to review and update the design of quays n°. 1, 5 and 6 performed by Technital in 1997-98 taking into account updated design parameters that have become available and assure the Employer that the structural engineering design and drawings is "fit for purpose" intended.

Phase B: Surveys and Infrastructure Design:

- to carry out surveys within the Western Port, from quay n°. 1 through quay n°. 8, showing, as a minimum the locations of buildings , roads and other above ground features, ground elevations; drainage systems including existing manholes and pipe routes; electrical systems including existing light towers, crane power outlets and power supply circuits; water systems including existing water outlets and pipe routes; telephone system layout; IT ducting layout, etc.,
- to design the pavement of the storage area and internal roads for the Western Port area;
- to design an integrated drainage systems, as well as services and utilities systems and IT ducting layout for the Western Port area.

NEW FERRY TERMINAL AT TREMESTIERI (MESSINA)

Location:	Sicily, Italy
Client:	Amadeus S.p.A.
Services:	Detailed design; EIA
Period:	11/1998 - 04/2000
Construction cost:	€ 41,316,500

Project Description:

At present the road and rail connections between Sicily and the Italian mainland are achieved by a complex multimodal ferry system connecting the Sicilian port of Messina with Villa San Giovanni and Reggio Calabria on the Calabrian (mainland) side, with considerable negative impacts on both sides of the strait.

In particular, the city of Messina is heavily penalised by the traffic to and from the existing terminal. The project entrusted to Technital therefore envisages the relocation of the vehicle ferry terminal outside the city of Messina, at Tremestieri, 6 km to the south, while guaranteeing the functionality of the sea and land traffic systems.

The design criteria for the new terminal therefore included:

- guaranteeing safe and efficient connections between the terminal and the existing road system
- creation of adequate parking and storage areas for the vehicles waiting to embark
- provision of easily accessible and well protected ferry berths.

The works therefore included

- road link to the Messina-Catania motorway and state highway S.S. 114
- parking areas and yards
- breakwaters to protect the inner basins from the waves
- berths to accommodate 4 two-way ferries with easy approach channels.

The study of the port layout, conducted with the aid of a physical model, led to the adoption of the solution with two mooring basins for the car-ferries and two parking areas for the vehicles waiting to embark.

The breakwaters protecting the inner basins consisting of sheet-piling anchored with backfill from dredged material. The berths have a r.c. deck resting on piers and on sheet-piles behind with rubble-mound cladding. On the sea side, the terminal yards are protected by an artificial rubble-mound structure topped by a sea wall.

Several alternatives were studied for the connections to the road network. In the design solution the last section of the Larderia stream is confined to a channel so that part of the stream bed can be used to create the connection to the existing road network. This new stretch of road is joined to the motorway and the S.S.114 by means of access ramps which do not interfere with the urban traffic and also allow the continued operation of the existing service station.

The project also includes an environmental impact study with regards both the marine and land infrastructures with particular regard to the existing urban constraints and the problems of sea pollution and coastal erosion. It includes an artificial by-pass system for sediments, to overcome the interruption of the littoral drift and the risk of coastal erosion, and a water treatment and storage tanks for surface runoff from the yards and roads.

Chosen new site at Tremestieri

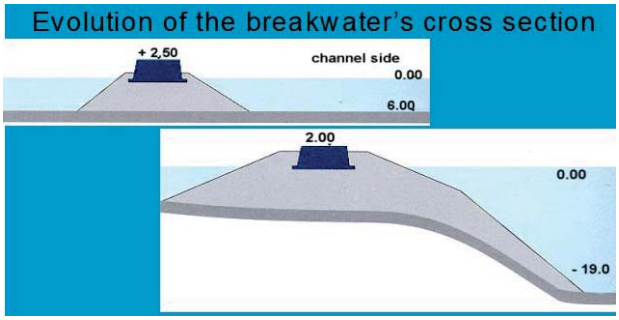
Rendering with the new works

BREAKWATERS AT THE ENTRANCES OF THE PORTS OF THE VENICE LAGOON

Location:	Venice lagoon, Italy
Client:	*Venezia Nuova* Consortium - Ministry of Public Works
Services:	Hydrodynamic studies, physical modelling, preliminary and detailed design, landscaping design
Period:	04/1991 - 12/1997
Construction cost:	€ 71,787,500

Project Description:

The construction of the six breakwaters at the entrances of the three ports of the Venice lagoon, Chioggia, Malamocco and Lido, which was carried out in the period between the mid-nineteenth century to the early twentieth century, was motivated by the need to protect the lagoon's navigable access channels against filling with sediment. These works did in fact cause an increase in the depth of the access channels, but at the expense of the stability of the breakwaters which increased proportionally with the depth.



Technital was commissioned to:

- examine the reasons for the continuous maintenance requirements;
- evaluate the feasibility of definitively rehabilitating the breakwaters, in relation to their present and future function;
- suggest the best type of intervention;
- perform the preliminary and detailed design of the proposed interventions.

The Preliminary Design, completed in 1991, included the examination and development of the kind of works needed to make the breakwaters compatible with their present use and, above all, with their future function, when the flood control works (the fixed works for the mobile barriers) have been constructed.

These interventions comprise:

- the creation of a filter in the lower part of each breakwater which prevents the loss of fine materials, without removing all or part of the existing claddings and thus without creating hazardous conditions for the overall stability;
- the creation of a protection against erosion at the base of the breakwaters to combat further subsidence of the foundations;
- the renovation of the claddings exposed to current and wave action, using similar materials to the existing ones
- the restoration of the crown wall.

During 1992-1997 Technital developed the Detailed Design for all six breakwaters at the port entrances. The work defined by the design comprises:

- the installation of filters by the laying of 20-150 mm. crushed stone and foundation berms for the cladding by laying 50-1000 kg and 1-3 t. rubble for a total of 1,500,000 t.
- the restructuring of the protective cladding by installing 6.3 m3 tetrapods, with a total of 40,000 m3 of concrete, and of 2-5 t. rubble for a total of some 300,000 t.

This Project includes the reconstruction of 6 breakwaters at the 3 lagoon port entrances on depths varying from 9 to 19 m, for a significant wave height of 5,5 m, and for a total length of approx. 6,200 m.

QUAY WALLS FOR FISHING AND COASTAL VESSELS, BARGES, FERRIES AND GENERAL CARGO, VENICE LAGOON

Location:	Venice, Italy
Client:	*Venezia Nuova* Consortium - Ministry of Public Works
Services:	Feasibility study, basic, preliminary and detailed designs
Period:	05/1990 – 12/1997
Construction cost:	€ 113,620,500

Project Description:

The shores of the islands of Venice lagoon were in a very badly degraded and in particular the quay walls for the mooring of local commercial crafts were seriously undermined and in a state of disrepair.

The project involved the construction of approx. 13,000 m of quay walls inside the Venice Lagoon, on very weak and low bearing capacity soils.

Typical quay structures considered in this Project are concrete sheet piling and anchored steel sheet piling.

The quay walls also include utility culverts to accommodate 1m dia. sewage pipes, interconnecting valves and electrical cables.

TECHNITAL was awarded a contract by *Venezia Nuova* Consortium, the Concessionaire of the Italian Government, for the following engineering services:

- quays planning;
- preliminary and detailed design of the structures;
- preliminary and detailed design of the piping and electrical works;
- preliminary and detailed design of paved areas;
- general supervision.

NEW QUAY “MOLO ITALIA” FOR THE PORT OF LIVORNO

Location:	Tuscany, Italy
Client:	Port Authority of Livorno
Services:	Preliminary and Detailed Design
Period:	07/1997 - 11/1997
Construction cost:	€ 12,395,000

Project Description:

The port of Livorno (Leghorn) is a multipurpose port on the west coast of Italy (Tuscany region) handling all kinds of ships and cargo.

TECHNITAL was entrusted with the preliminary and final design of a new multipurpose port structure approximately 500 m long and 135 m wide to be built on a depth of 14 m.

The design includes all installations and fittings for the operation of the quay:

- ladders, bollards, fenders;
- water and telephone lines;
- 2 parallel runways for cranes along the sides of the quay.

The quay is suitable to accommodate four ships at a time. The maximum design ship is the 60,000 D.W.T. dry bulk carrier.

From the three design alternatives examined for the quay structure, the cellular caisson type structure was selected.

QUAY WALLS FOR THE NEW INDUSTRIAL PORT OF RAS LAFFAN

Location:	Ras Laffan, Qatar
Client:	Condotte & Partners, for Qatar General Petroleum Corporation
Services:	Detailed design of 600 m of quay walls on 13.5 m depth
Period:	01/1993 - 12/1994
Construction cost:	€ 22,992,600

Project Description:

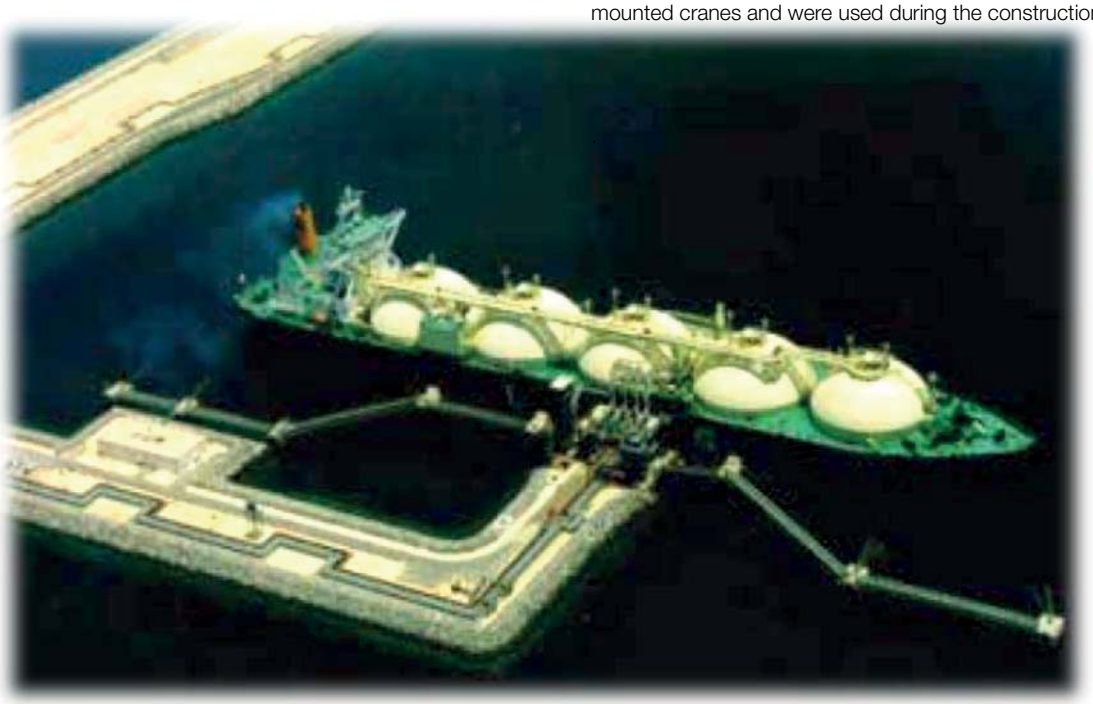
The construction of the port of Ras Laffan was started in 1992 and completed in 1995.

The new port, whose total construction cost amounted to US $ 800 million, included 4 berths for LNG vessels, 3 for container ships and 6 for tankers carrying refined and semi-refined petroleum products.

The huge harbour is protected by two breakwaters, which extend for over 6 km. and for 4.5 km. respectively.

In 1993 Technital was awarded a contract by Grandi Lavori Fincosit, one of the 3 partners of Condotte Qatar JV, for the detailed design of 600 mt. quay walls in gravity concrete blocks and r.c. capping beams.

These quays, for containers, Ro-Ro tugs and heavy loads, were located on depths of 13.5 m and dimensioned to accept rail mounted cranes and were used during the construction phase.



Small Harbours and Marinas

TECHNITAL

DESIGN OF RESTORATION AND REINFORCEMENT WORKS OF THE MAIN BREAKWATER OF TOURISTIC PORT CARLO RIVA IN RAPALLO

Location:	Rapallo, Italy
Client:	Porto Turistico Internazionale di Rapallo S.p.A.
Services:	Preliminary Design, Final Design, Detailed Design, EIA
Period:	01/2019 – 04/2020
Construction cost:	€ 23,200,000

Project Description:

On 29 October 2018 Northern Italy was battered by a severe storm with strong winds generating large waves and exceptional storm surge along the Ligurian coasts. The structures of Port Carlo Riva in Rapallo were severely damaged, with the nearly total collapse of crown wall on top of the main breakwater and the partial failure of internal structures. Immediately following this event, a plan was drawn up which envisaged 3 different phases of intervention for the rehabilitation and the reinforcement of marine infrastructures.

The services are related to the design of works of Phase 3, consisting of the reinforcement works of the main breakwater (South breakwater), the reconstruction of the two quays along its internal side and of the small warehouses ("cave a bateau") adjacent to the new crown wall. The company was also commissioned to draw up the technical specifications for physical modelling study in supporting of the design and to supervise the execution of the laboratory tests.

Meteomarine conditions for the design of marine infrastructure were defined on the basis of the meteomarine study carried out by Laboratory of Maritime Engineering of Florence University (LABIMA). The reinforcement works of the South breakwater were designed for a significant wave height of 5.4 m in a water depth of 11 m.

Two different configurations of reinforcement works were tested on 2D physical model carried out at LABIMA. The first one was found not to meet the project requirements in terms of stability and overtopping discharge. Therefore, an alternative solution was conceived and tested on physical model, featuring an armor consisting of a double layer of 11-15 t rocks in the emerged slope and of 8 m3 tetrapod in the submerged part, placed upon a filter layer made of 1-3 t rocks, constituting also the toe berm. A geotextile separator has been foreseen between 1-3 t rocks and natural soil. The armor crest level was set to +5.50 m MSL and the crest level of the new crown to +7.00 m MSL. The crest berm featured an overall width of 12 m.

This second configuration was found to satisfy project requirements and was therefore developed within the final design, which was subjected to the Environmental Impact Assessment procedure.

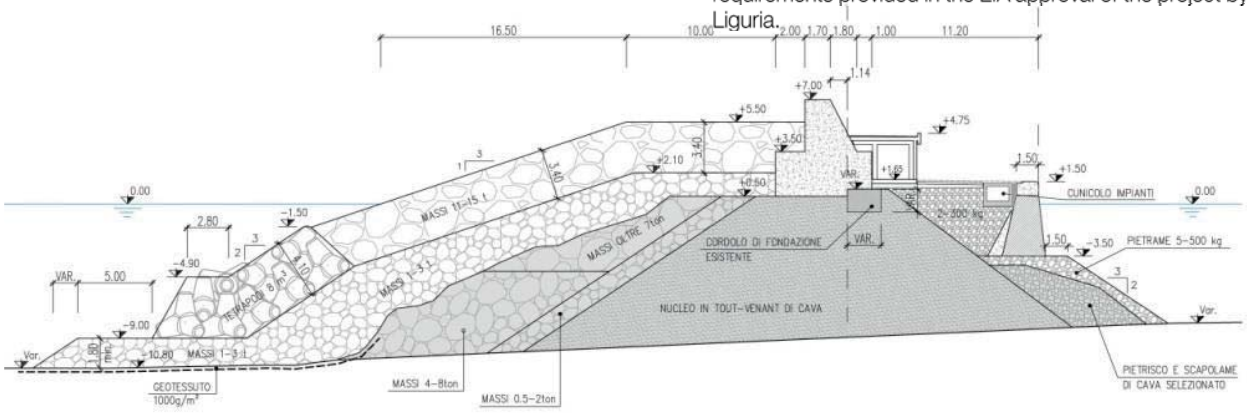
The seaward end of the South breakwater, from which the East breakwater stretches, was conceived as a roundhead and the seaward slope of the rock armor layer was reduced from 1:3 of trunk section to 1:4, while maintaining a slope 2:3 for tetrapod.

A different reinforcement solution was designed for the shore arm of South breakwater, with a reduced seaward extension in order to limit the impact of new works on Posidonia oceanica lies on the seabed of this area. This first stretch of South breakwater will feature an armor consisting entirely of a double layer of 11-15 t rocks with a seaward slope 1:2, placed upon the existing rock armor. The crest berm will have an overall width of 8.25 m. A submerged berm made of 3-7 t rocks, 10 m wide, will be constructed at structure toe, aiming to reduce wave impact on the armor layer.

In order to mitigate the environmental impact of design works, the project has foreseen the transplanting of the plants of Posidonia oceanica lying over or in proximity of the footprint area of new works at breakwater root, in nearby coastal areas where prairies of Posidonia oceanica already exist.

The reconstruction of the quays along the internal side of South breakwater was foreseen by reusing the existing precast concrete blocks. After the lifting of the existing blocks and prior to their reuse, a reinforced-concrete element will be cast on the rear side of precast blocks, aimed at improving their stability. The top level of quays will be +1,50 m MSL, about 30 cm higher than the pre-existing ones, to take account of the increase in sea level caused by climate change.

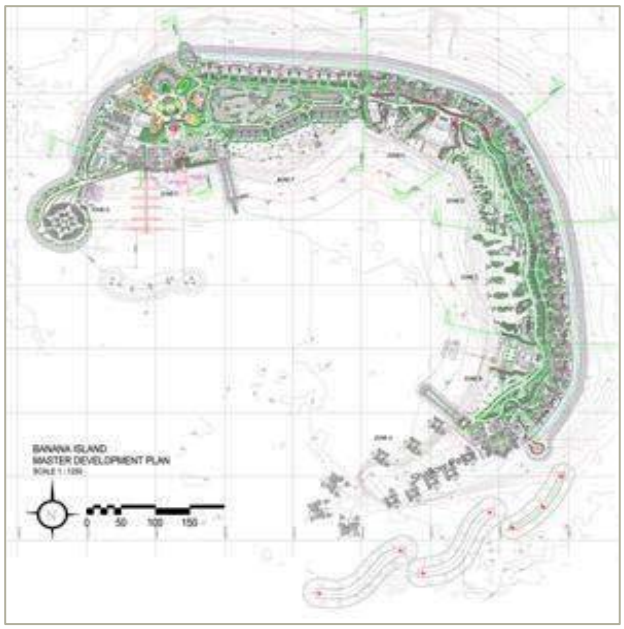
Detailed design was completed in April 2020 and complied to the requirements provided in the EIA approval of the project by Regione Liguria.



DESIGN REVIEW AND POST-CONTRACT CONSULTANCY SERVICES FOR BANANA ISLAND

Location:	Doha, Qatar
Client:	Private Engineering Office
Services:	Design Review and Works Supervision
Period:	09/2012 – 09/2014
Construction cost:	€ 266,391,000

Project Description:



The Anantara Doha Island Resort project is located off the Qatari eastern coastline close to Doha Bay and 3.5 KM to the east of the New Doha International Airport.

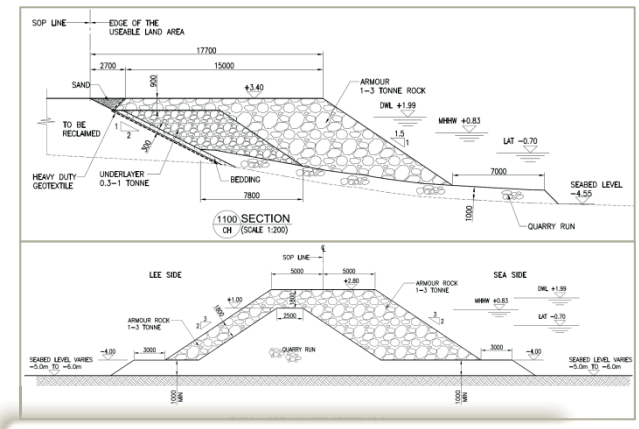
The main objective of the project is to place Qatar on the world's stage as a leading world-class tourism and hospitality destination.

In the following table and figures the earthworks main characteristics are shown.

STRUCTURES	Length	Top elevation	Seabed level
Northern shore protection	1.400 m	+ 3,40 m	-2,5÷-4,5 m
Southern detached breakwaters	Tot. 750 m	+ 2,80 m	-5,0÷-6,0 m
Marina detached breakwater	200 m	+ 3,00 m	-6,0 m
New beach	790 m	+ 2,00 m	-4,0÷-5,0 m

The scope of the marine works is outlined below:

- Rehabilitation of the existing revetments;
- Construction of new revetments including revetment for the marina;
- Construction of detached breakwaters for the Marina and Overwater Villas (OWV);
- Construction of the beach and groynes;
- Construction of the helipad (western breakwater);
- Marina pontoons;
- Floating pontoons for the restaurant;
- Service jetty;
- Miscellaneous small floating jetties (arrivals jetties, diving pontoon, overwater villas pontoon);
- Dredging operation close to the overwater villas;
- Miscellaneous dredging works at various locations and;



Northern shore protection & Southern detached breakwaters - Typical sections

DESIGN REVIEW AND POST-CONTRACT CONSULTANCY SERVICES FOR NAVIGATION CHANNEL, COAST GUARD BASE AND SECONDARY NAVIGATION CHANNEL

Location:	Qatar
Client:	Private Engineering Office
Services:	Design Review and Works Supervision (General Supervision, Site Supervision & Quantity Surveying Consultancy Services)
Period:	10/2012 – 01/2014
Construction cost:	€ 135,765,541

Project Description:

Project Layout

The project is located in the Qatari Eastern Coastline North of Doha between Simaysmah and Lusail and the work is basically consisting of three major parts:

1. Excavation of the base harbor up to a depth of -6.88 QND level and -8.88 QND level in the quay wall portion. This area is approximately 320,000 m2. Further a land area adjoining the base of roughly 250,000 m2 is to be reclaimed and backfilled with approved material up to a level of +3.50 QND.
2. Excavation of Secondary Navigation Channel connecting the base harbor to the main Navigation channel. The Secondary Channel is 80 mt wide with a depth of -6.88 QND and a total length of about 1.17 km.
3. Dredging of Main Navigational channel: 80 mt wide with a depth of -6.88 QND and a total length of about 9.48 km.

Disposal of excavated material at approved location on land is also involved in the scope of works.

Site map

MARINA ON GARDA LAKE AT BRENZONE

Location:	Brenzone, Lombardy Region, Italy
Client:	Brenzone Municipality
Services:	Feasibility study, preliminary design
Period:	11/2011- 02/2013
Construction cost:	€ 8,622,000

Project Description:

The design of lakeside port works prepared by Technital includes that particularly worthy of note of the new tourist port in Acquafresca, in the municipality of Brenzone, on the Verona shore of Lake Garda.

The preliminary project for the new tourist port was prepared as part of the Project Financing Proposal for the development of "Interventions to optimise and develop tourism in Brenzone" presented by Technital to the local administration.

The intervention designed aims to meet the ever increasing demand for boat moorings in the upper lake and to rationally reorganise the entire nautical activity of the municipality, also guaranteeing suitable availability of dedicated parking spaces, which currently do not suffice.

As part of the design, various alternative solutions were examined for the port layout, in order to identify and optimise the project solution to be developed. All solutions showed the need to adopt floating structures to protect the port basin from wave motion, given the great depth of the bed even near the coast.

The new port structure, which will develop in the area currently occupied by the buoy field, will be able to house 200 sailing or motorboats and guarantee all the services and structures required by modern boating enthusiasts.

In addition to the main dock, there will be a transit port basin opposite the existing embankment, which will allow 40 boats to moor during sports events.

The two port basins are protected from wave motion by a dam stretching 385 m long, consisting of floating breakwaters arranged approximately in a north-south direction. The main basin is further protected from waves from the north by a floating 20 m long damn fixed to the pier envisaged at the port entrance. The use of floating breakwaters solves the problems connected with the significant depth of the bed and limits the impact on the surrounding environment.

The perimeter of the port docks will be outlined by vertical wall quays built from overlaying prefabricated concrete blocks. In order to reduce reflection, and thereby limit residual internal agitation, the quays will be fitted with an absorbent chamber at the top. Boat mooring will be parallel to the breakwater damn, on the inside of the floating breakwaters.

Inside the main dock, mooring is also along floating piers arranged orthogonally to the quay, parallel to Strada Gardesana.

In the southern part of the port basin, there will be a service quay equipped with a crane for launching and the slipway of boats; at the adjacent embankment, there will be an area measuring approximately 1600 m^2 used for sheltering the boats outdoors.

At the level of the lake, there will be a port service building which will also host areas assigned to the sailing school and structures intended to provide food and refreshment. In addition to the covered surface areas, there will be a large yard of approximately 4,700 m2 to be used according to the season and needs of the nautical circle activities.

An underground car park will be built in the existing embankment to park 255 cars and 16 motorcycles; this will be for use by the port and the sports/commercial activities that will be organised in the area of the intervention.

On the road level, a small restaurant will be built, lodgings for the nautical circle and a kiosk serving refreshments. The uncovered surface area will allow for 7 short-term car parking spaces, 5 bus shelters and 30 bicycle posts.

EXPANSION OF MARINA/FISHING PORT AT AL WAKRAH

Location:	Al Wakrah, Qatar
Client:	Private Engineering Office (QATAR)
Services:	Concept, Preliminary and Detailed design; tender documents
Period:	10/2011 - 09/2012
Construction cost:	€ 150,000,000

Project Description:

The main purpose of the pre-contract design activities was to investigate and design the expansion of the existing fishing port and facilities at Al Wakrah (on the west coast of Qatar) to accommodate n° 380 fishing dhows, n° 700 small boats, MoE/Coast Guard vessels, PEO wooden dhows and traditional dhows, and in a manner that will resolve the current inadequacies and problems concerning coastal water quality and sedimentation all around the existing port. The existing port facilities can accommodate only 150 fishing dhows.

Three design stages were performed: a Concept Stage, Preliminary Stage and Detailed Stage including the preparation of tender documents for the construction of the marine works.

In the Concept Design Stage the following activities were carried out for the comprehension of present situation:

- a topographic and bathymetric survey;
- an environmental study based on site investigations;
- a preliminary geotechnical site assessment;
- a jetty structural assessment study based on several site inspections;
- a meteomarine study for the assessment of winds, waves, sea levels and currents at the site;
- a coastal morphological study
- an hydrodynamic and water quality study.

Different alternative configuration concepts for port expansion were identified on basis of port requirements The design of lakeside port works prepared by Technital includes that particularly worthy of and a comparative analysis of the proposed solutions was performed in order to support the Client in selecting the most promising development option in terms of technical-economic feasibility.

The final solution, developed in the Detailed Design, envisages the demolition of the existing jetty and the construction of a new main port characterised by 2 different basin at a depth of -4 m MSL (fishing dhows basin) and -3m MSL (small boats basin).

The traditional dhows are to be accommodated in a mini port located close to the coast and along the north edge a public beach has been located. The final configuration of the port includes:

- concrete blocks quay walls for an extension of 5,900 m in the Main Fishing Port and 500 m in the miniport
- 1,700,000 m3 of total dredging, including Northern (L=2,300 m) and Southern (L=2700 m) Channels
- rubblemound breakwaters for an extension of 2,400 m in the Main Fishing Port and 530 m in the Miniport
- 700 m long and 70 m wide beach
- 84,600 m3 of beach sand fill
- 175m long access causeway made of box culverts.

CRUISE PORT FOR THE LARGEST CARNIVAL AND ROYAL CARIBBEAN SHIPS

Location:	George Town, Grand Cayman
Client:	GLF Construction Corporation (USA)
Services:	Feasibility Study and Preliminary design of land and port facilities for the largest cruise ships in the world (the Oasis Class)
Period:	10/2010 - 04/2011
Construction cost:	€ 128,008,125

Project Description:

The Cayman Islands Governor and the Port Authority of the Cayman Islands ("PACI") have committed to developing new facilities to enhance the management and development of cruise tourism, passenger and cargo handling in the Cayman Islands.

With the advent of larger vessels ("Oasis Class") and the resultant increase of passengers per vessel, the Government/PACI has recognized the need to develop four berths and reclaim land in order to accommodate the direct shore side docking of cruise ship. Included in the development will be the generation of reclaimed land at the port which will allow the cruise operations to be separated from cargo operations.

This separation will increase operational flexibility and growth potential.

The reclaimed land will be developed from material generated by dredging operations necessary to allow cruise ships access to the berths.

The existing Port Facility at George Town is currently utilized both for tourism and cargo. It is composed of three terminals: two are used for tender berthing, the other one for Roll On/Roll Off and cargo.

Currently the cruise ships anchor at the edge of the shallow shelf in front of the port.

The cargo port provides for the handling of break bulk cargo, bulk aggregate and cement.

The primary technical purpose of the George Town Port Expansion Project is to provide two cruise ship piers with the capability to simultaneously berth four cruise ships permitting direct debark and embark of passengers from ship to pier versus the present practice of tendering to transport cruise passengers to the shore and back to the ships.

The main new marine works are the following:

- Cruise Piers and relocated Tender Berths;
- Revetment and breakwater;
- Dredging and reclamation.

The upland area will consist of the following major components:

1. Cruise terminal including sterile areas;
2. Non-sterile cruise related and retail area;
3. Transportation areas.

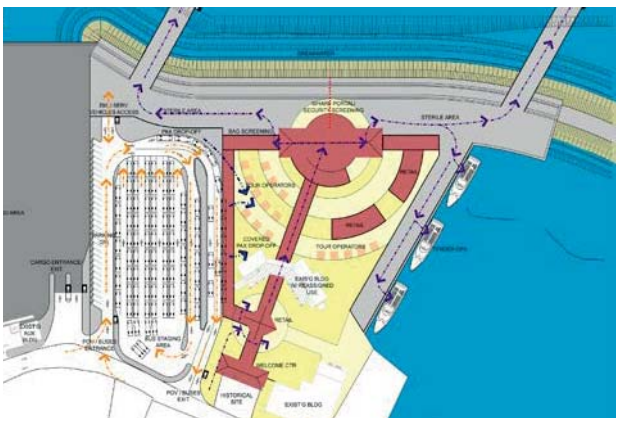
The below figure provide the layout of the proposal upland areas devoted to cruise related activities.

The *Cruise terminal including sterile areas* will allow passengers to be debarked and embarked from cruise ships and tenders to the new "Wharf Portal". From the Portal, passengers can walk to the tour operators for island experiences and to visit George Town.

The *Transportation Area* will be configured as a "spiral" allowing busses direct access to the drop on/off area or to the staging area. This configuration will allow a better traffic handling and improve the safety of passengers/tourists. The south side of the parking area will be available for cars and on the south-east an emergency/services vehicles entrance will be allowed for direct access to the cruise piers.A guard house will be reinstalled at the entrance to the cargo area.

The *Non-sterile cruise related* and *Retail area* will consist of: existing cruise terminal building, canopies, retails and prefabricated booths. The existing cruise terminal building will be renewed for other uses.The canopies will be open covered walkways or gazebos and will allow access to the city or to parking area. The retail area will consist of enclosed retail spaces.

Finally the prefabricated booths will accommodate the tour operators.



FISHING HARBOUR AND MARINA AT AL RUWAIS

Location:	Al Ruwais, Qatar
Client:	Building Affairs department of Public Works Authority
Services:	Preliminary and detailed design, tender documents
Period:	09/2007 – 04/2010
Construction cost:	€ 7,500,000

Project Description:

Al Ruwais Port is located at the extreme point in the north of Qatar and the aerial photo showing the existing facilities. In 2006 the company Halcrow submitted to the Building Affairs department the design of marine and land facilities for the Development of Al Ruwais Port.

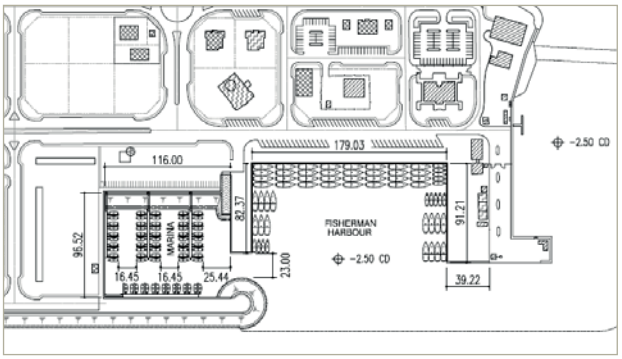
In the Halcrow design, a fishing harbour and a marina are located in the southern part of general port layout. Technital was appointed by Building Affairs of Public Works Authority to undertake the consultancy services related the review of marine works design in order to achieve the following objectives:

- increase the capacity of the fishing harbour by introducing a quay wall and demolishing existing structures;
- move and expand the marina from the Halcrow design location (close to the existing fishing boat harbour) towards the south;
- introduce a boat lift dock located in the basin for coast guard boats.

In the concept design different port layouts have been examined in order to achieve the following functional requirements:

-
- the fishing harbour must have a quay wall 350 m long in order to accommodate about 60 dhows for the present situation, with the possibility for the future to accommodate up to 100 dhows;
- the new marina will be to accommodate up to 50-60 fibreglass boats.

These different layouts were compared and the best was chosen examining the hydrodynamic and water circulation, the downtime due to the waves for the boats at the berths, the sedimentation rate in the port basin.



The concept design involves the selection of the marine work typologies:

- for the quay wall pre-cast concrete blocks, following a technology widely utilized for its characteristics of stoutness and safety during construction, were adopted;
- rock armour revetments were proposed for the breakwater delimiting the marina, consisting of 60-300 kg quarry stones for the armour, placed upon a substratum made of 75-200 mm crushed rocks laying on a geotextile;
- the berthing of fibreglass boats inside the marina will be obtained by floating dock system organized in a series of walkway pontoons anchored to steel piles and accessible via gangways and a series of cantilever fingers arranged for double slips.

The detailed design includes the stability calculations for the quay wall in pre-cast concrete blocks, for the floating pontoons and for the rock revetments.

In order to have a water depth of -2.5 m CD and to form the foundation trench for the block quay wall, dredging activity for a volume some 150,000 m^3 is foreseen, to perform part in soft material and part in soft rock. Laboratory test results on dredging material samples indicate that marine sand fully complies with specification to be used as fill while the marine silt does not. Therefore a part of dredged material could be used for filling.

Finally, tender documents will be prepared to permit to the Client to tender the construction of the new work facilities for the development of Al Ruwais Port.

NEW MARINA AND REQUALIFICATION OF THE WATER FRONT AT VADO LIGURE

Location:	Vado Ligure (SV), Italy
Client:	Port Authority of Savona
Services:	Concept and preliminary design
Period:	10/2008 - 02/2010
Construction cost:	€ 63,349,249

Project Description:

This intervention has been designed as part of a Project Financing proposal in response to the intention of the Port Authority of Savona and Municipality of Vado Ligure to upgrade the coastal area of Vado Ligure by the construction of a new marina and facilities for public use.

Technital, as proponent, undertook to design and build the works without any financial investment from the Port Authority of Savona and proposed to manage the structures for a 50-year term in order to amortise the financial commitment required to realise the works.

Moreover, this intervention comes as part of the compensation works envisaged for the adjacent construction of the multi-purpose platform (for containers, bulk, oils), for which Technital also acts as promoter under the scope of a project financing initiative.

The preliminary project for the tourist port and the reorganisation of the Vado Ligure seafront has been developed by Technital on the basis of the contents of the Town Planning Structural Scheme (SAU) prepared by the municipality of Vado Ligure that identified the area of interest as segment D.

The SAU also establishes a general reorganisation of the area, namely the requalification of the coastal strip from the port of Vado through to the mouth of the River Segno, the connection of the new port systems (the new platform) with the motorway system overpass of the Aurelia and the hydraulic works of the River Segno.

Segment D, which acts as a sort of "hinge" between the city and the port area and faces the sea, has been internally divided up into segments D1, D2 and D2, each of which has its own specific intended purposes.

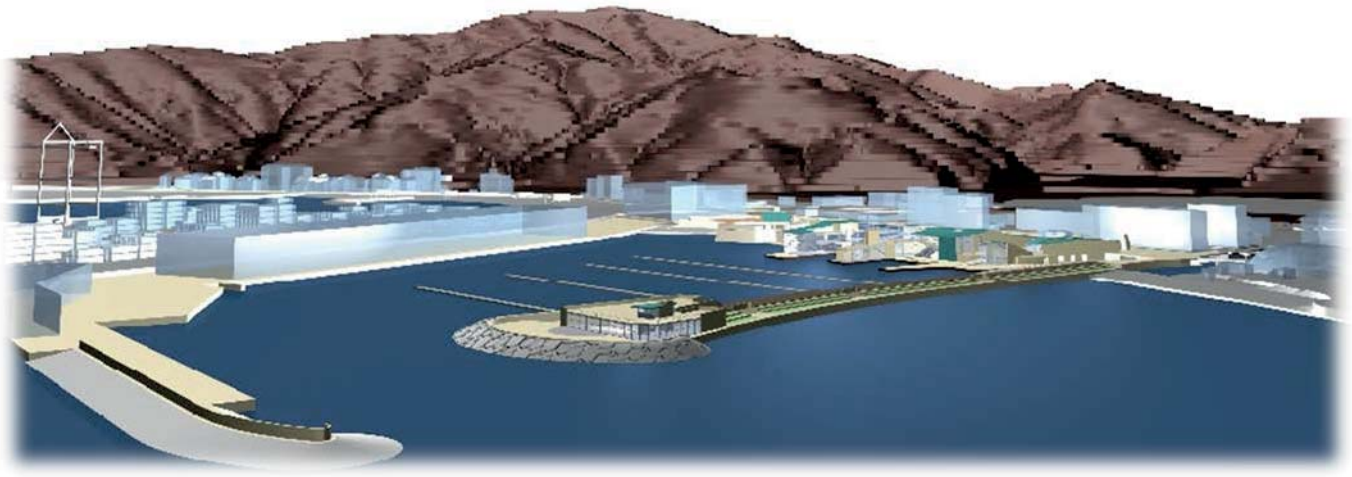
Segment D1 includes the whole of the inner breakwater complete with building complex (housing sports structures and public shops/businesses) and the port basin with floating piers providing moorings.

Segment D2 takes on the role of "high quality new urban area", with new underground car parks to minimise use of the soil "resource", a cultural centre complete with auditorium, music school and training centre, a commercial structure with bar-restaurant, a youth centre, port services with the authorities and the sports installation.

Segment D3 represents the "site area", where the various elements of the vessels arriving from the production sites are assembled.

Restaurant and Bar

The works designed to protect the port basin from wave motion consist of an outer breakwater in cellular caissons. The inner breakwater consists of a reef head and a current vertical wall section built from large concrete masses. The quays within the site and on the water front are built from large concrete masses topped with a chamber designed to absorb the wave motion, thereby limiting the residual internal wave.



MARINA AND WATERFRONT DEVELOPMENT AT ZUWARAH

Location:	Zuwarah, Libya
Client:	ODAC (Organization for Development of Administrative Canters), Tripoli
Services:	Feasibility study
Period:	5/2009 - 10/2009
Construction cost:	€ 155,435,084

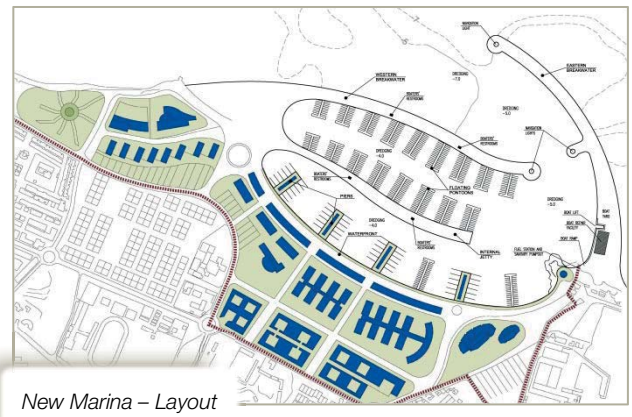
Project Description:

In the framework of a comprehensive development plan of the waterfront of the Mediterranean town of Zuwarah and the adjacent coastal area, TECHNITAL carried out the Feasibility Study of a new marina with a berthing capacity of 580 boats up to 35 m in length. The harbour, surrounded by a pleasant complex of leisure and tourist facilities, was conceived as one of the major features fostering the evolution of the town's traditional inland vocation towards a sustainable urban concept open to the sea.

New Marina – Artist's Impressio

The Feasibility Study of the new marina encompassed the following main topics:

- Analysis of physical site conditions (coastal morphology and bathymetry, meteomarine conditions - winds, waves, water levels, etc.);
- Assessment of port layout and optimum berthing capacity;
- Spatial and functional planning of port infrastructures and service facilities;
- Definition of marine structures' typologies and relevant pre-dimensioning;
- Preliminary estimate of quantities and construction costs.



New Marina – Layout

The main features and figures of the new marina are briefly summarized hereunder:

- The port basin covers an area of approx. 535,000 m2, to be dredged partly down to -5 m and partly to -4 m MSL;
- The basin is bordered landward by a blockwork quay wall over 1,200 m long extending along the contour of the existing shoreline, while it is sheltered against wave action by two rubble mound breakwaters with lengths of approximately 900 m (eastern breakwater) and 1,100 m (western breakwater);
- Most of the 580 berths are located along a series of floating pontoons connected to the western breakwater's inner slope, to the outer side of a fixed internal jetty approximately 700 m long, and also to the landward quay wall;
- The largest berths (40 Nos.) are located along fixed blockwork piers, approx. 100 m long, projecting normal to the landward quay;
- All the quay walls, piers and jetties are suitable for vehicles and their dimensions allow for adequate spaces for restroom facilities and parking;
- Boat service facilities are located on the inner trunk of the eastern breakwater and include a boat yard, workshop, boat lift dock, slipway, fuel station, etc;
- The main quantities estimated for the construction of the new marina include approx. 1,200,000 m3 of dredged material, 1,500,000 ton of rock material, 180,000 m3 of concrete, 200,000 m2 of paving.

NEW MARINA ON GARDA LAKE AT TORRI DEL BENACO

Location:	Torri del Benaco, Italy
Client:	Municipality of Torri del Benaco
Services:	Feasibility study and Preliminary Design
Period:	07/2008 -12/2008
Construction cost:	€ 15,328,000

Project Description:

Technital has a consolidated experience in marina engineering, for both sea and freshwater structures (lake and port). The new marina located at Torri del Benaco, on the Verona coast of Lake Garda, is an example of design of a marina structure in a lake environment. This marina has been designed as part of a Project Financing proposal in response to the intention of the municipality of Torri del Benaco to upgrade the shoreline facing the area of the Scaligero Castle of Torri and the parking area in front of it.

Technital, as proponent, undertook to design and build the works without any financial investment from the municipality of Torri del Benaco and proposed to manage the structures for a 30-year term in order to amortise the financial commitment required to realise the works. The proposal also envisaged that a part of the parking and boat mooring spaces would be transferred to the municipality without compensation for being destined for institutional purposes or for being then allocated to private parties.

The common denominator behind the design choices was to ensure that the new structures were as compatible as possible with the environment and landscape and in harmony with the urban economic and building fabric.

The new port structure has been currently designed at a preliminary level to accommodate about 300 sailboats or motorboats and to provide all the facilities and services required by modern leisure boating (slipway, boat storage yard, refuelling station, service posts for the supply of water and electricity, waste water collection unit…). In order to protect the internal basin of the port, a breakwater was designed, the inshore part made of cyclopean concrete blocks and the offshore part consisting in a floating structure made of reinforced concrete lightened by a core of polystyrene foam. This typology of structure for the offshore part of breakwater was identified because of the significant depths of the seabeds and in order to limit the impact on the surrounding environment.

In the light of the preliminary topographic-bathymetric and geognostic investigations results, and with the aim of reducing the impact of the works on the historical centre of Torri del Benaco, the site chosen for the location of the port was in the natural loop to the South of the town.

Boat moorings inside the port were envisaged using floating pontoons anchored by piles and able to move up and down to adapt to lake level variations.

In addition to the realisation of a new marina, the preliminary design has also concerned:

- a public parking area in front of the Scaligero Castle to suit 372 vehicles (cars/buses) in an underground structure and 85 vehicles in an open space;
- the renovation and/or the upgrading of the city buildings and the public zones located in proximity of the marina;
- the adiacent ‘Lido area’ will be recovered by the construction of a new beach equipped by swimming pools and facilities for tourists. A new jetty is envisaged to allow the berthing and mooring of small boats.

In the framework of a comprehensive development plan of the waterfront of the Mediterranean town of Zuwarah and the adjacent coastal area, TECHNITAL carried out the Feasibility Study of a new marina with a berthing capacity of 580 boats up to 35 m in length. The harbour, surrounded by a pleasant complex of leisure and tourist facilities, was conceived as one of the major features fostering the evolution of the town’s traditional inland vocation

NOLI-SPOTORNO TOURIST HARBOUR: CHIARIVENTI MARINA, LIGURIA

Location:	Chiariventi, Italy
Client:	Grandi Lavori Fincosit S.p.A.
Services:	Preliminary and detailed design
Period:	11/1999 – 12/2004
Construction cost:	€ 24,445,000

Project Description:

For more than ten years, the municipalities of Noli and Spotorno, in the province of Savona in western Liguria, have been considering the construction of a new marina on the mutual border between the two municipal areas, to boost a section of coastline, in any case of significant historical and environmental interest, which to date is poorly endowed with pleasure boat facilities.

The high demand for boat spaces, particularly for the users of the Lombard-Piedmontese basin, often forced to use the facilities of the distant French Riviera, led to the birth in 1991 of the private Cooperative of Chiariventi whose objective was the realization of a new harbour at Chiariventi for pleasure craft.

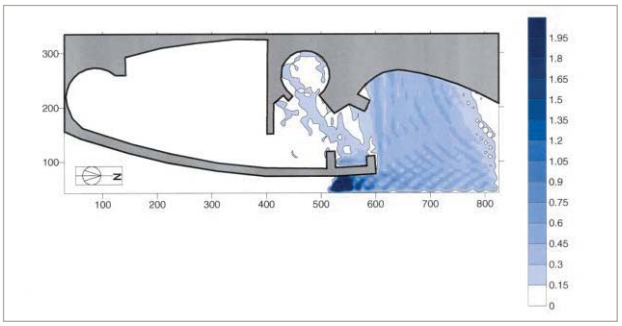
The Cooperative has entrusted the contractors Grandi Lavori Fincosit S.p.A. with the construction of the works, and they in turn have engaged Technital for the design of all the infrastructures.

The preliminary design of the new harbour took into consideration the following general criteria:

- guarantee at least 600 mooring points and protect the harbour basin from the waves which vary according to the different levels of operation of the berths,
- guarantee the connections of the existing road network with the port area;
- provide for – in the context of realising the harbour utility structures – town planning of the area facing onto the harbour to enhance its tourist appeal;

- respect the environmental and landscaping requirements typical of an area of public interest.

Specialist studies were carried out to support the design works, including mathematical model studies to analyse the wave propagation both outside and inside the harbour area and the littoral drift phenomenon.



Study of the wave propagation in the harbour

Careful attention was paid in the design to the choice of the type of protection works for the harbour basin. In the end the choice fell on a vertical-sided breakwater (of caissons) rather than a rubble-mound breakwater, for the following main reasons:

- building a rubble-mound breakwater would have required large quantities of stone which could not be obtained locally, there being no quarries in Liguria;
- a rubble-mound breakwater, because of its broader base, would have occupied a considerably larger area of the sea floor, thereby causing an unacceptable impact on the environment owing to an excessive interference with the valued eel-grass meadow.

Besides the effect on the eel-grass, the environmental impact study paid particular attention to the landscaping of the works to ensure that the new harbour harmonizes with the surrounding coastal environment. For this reason it is planned to have a large area of vegetation around the harbour, as well as a an attractive stone cladding to mitigate the visual effect of the breakwater wall. The study also demonstrated the negligible effects of the new structure on the littoral drift.

To date, both the preliminary design and the environmental impact study have been completed and await approval by the competent authorities before proceeding with the detailed design

Navigation Locks and Refuge Harbours

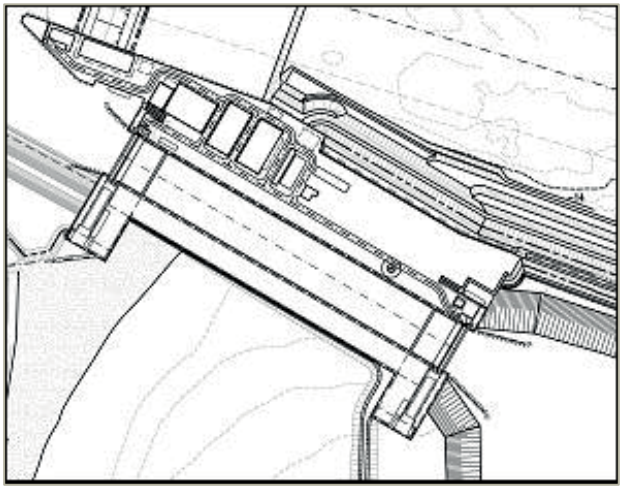
TECHNITAL

NAVIGATION LOCK FOR 150,000 DWT SHIPS AT THE PORT ENTRANCE OF MALAMOCCO

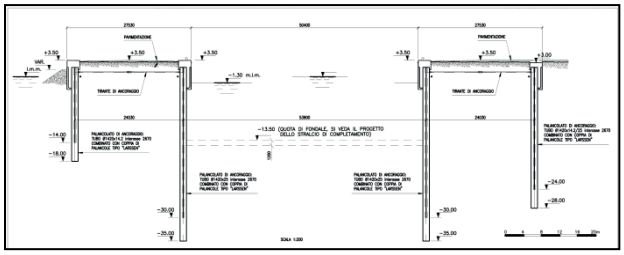
Location:	Venice Lagoon, Italy
Client:	*Venezia Nuova* Consortium - Ministry of Public Works
Services:	Detailed Design, Tender Documents, Mathematical Modelling
Period:	01/2004 – 05/2012
Construction cost:	€ 266,060,000

Project Description:

The navigation lock is 371 metres long and 50 metres wide and 13,5 metres deep at mean water level and is equipped with two sliding doors lightened by a special water jet system and manoeuvred by cables. No steel rails have been used since sliding of the lighten doors (no more than 50 t) can be done by Teflon strip.

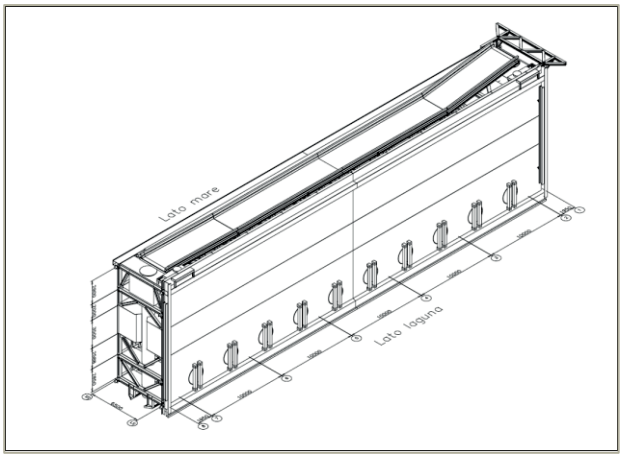


Each lateral wall of the lock chamber is built with two alignment of a combined wall steel structures: a sequence of 1.4 metres diameter steel piles and two element of sheet piles. The two alignment are connected by tension rods at a distance of 2.67 metres located at +1.0 metres. Piles are 37 metres long and are driven in the soil.



A detailed analysis has been carried out to demonstrate that a concrete bottom slab is not needed and that the lock bottom can be built only by a sequence of granular material with different grain size.

No pumps are needed to modify the water level in the lock since the water level sea side is always higher than the water level land size. Water level variation in the lock is obtained by manoeuvring ten stop log located directly on the doors. The operation is carried on in less than 30 minutes.



The lock is equipped with two guiding walls. The entrance areas where ships can use their propeller to change speed and direction is protected by 1.3 tons layer of stones.

The contract included the provision of the following services :

- Detailed Design of the structures and of the equipment
- Bill of Quantities and Cost Estimate
- Tender Documents
- mathematical model study of the hydrogeology around the lock to define the bottom characteristics
- geological - geotechnical investigation and analysis to support the design;
- Maintenance and Operation Manual

REFUGE HARBOUR AND NAVIGATION LOCK AT THE PORT ENTRANCE OF CHIOGGIA

Location:	Venice Lagoon, Italy
Client:	*Venezia Nuova* Consortium - Ministry of Public Works
Services:	Preliminary and Detailed Design, Tender Documents (specifications for geological - geotechnical and bathymetric surveys, mathematical model studies)
Period:	07/2003 – 12/2006
Construction cost:	€ 125,458,500

Project Description:

To improve the safety of the Chioggia port entrance a new refuge harbour has been planned equipped with two locks for the transit of tugs, pilot boats and fishing vessels.

View of the refuge harbour

The new refuge harbour is composed by two basins: the one sea side has a 3.6 ha surface; the one lagoon side has a 4.8 ha surface. The water depth is – 5 m in the basins and-7 m at the entrance.

The two locks are located between the two basins. Each lock is 125 m long and 15 m wide. Sector type doors have been used to manage the water level difference and the vessel traffic, being that more suitable in the actual conditions.

The sea side basin has been designed to offer the possibility to use it as prefabrication yard for the dry construction of eight huge concrete cellular caissons 60x40x10 m. The basin is therefore excavated up to -11 m and the boundary structure designed accordingly. Different structural typology have been used to satisfy the different needs in the different life period of the basin, such as: single sheet pile wall; similar structure combined with a natural slope protected by stones of different size; and double alignment of combined wall connected by tie rods. The sheet piles and the combined wall are driven to a depth of approximately - 27 m were an impermeable soil layer has been found.

Construction phases of the navigation locks: filling of the cofferdam

Navigation locks

The prefabrication yard excavated at – 11 m is maintained dried by wells located along the basin perimeter approximately every 100 m. They are used to dewater the basin and to reduce the water pressure in the soil layers under the basin

The contract included the provision of the following services:

- Detailed design of the structures described
- Bill of quantities and cost estimate
- Tender documents
- definition of the activities and assistance with the geological-geotechnical and bathymetric surveys related to the project;
- definition of the activities and assistance with the physical model studies to define the wave action inside the refuge harbours;
- execution of mathematical model studies to assess the wave action inside the refuge harbours and to analyse the manoeuvring conditions for the boats.

Construction phases of the navigation locks: sheet pile driving

FEASIBILITY STUDY FOR NEW LOCK FOR CARGO VESSELS AT CHIOGGIA INLET

Location:	Venice Lagoon, Italy
Client:	*Venezia Nuova* Consortium - Ministry of Public Works
Services:	Navigation study and Feasibility study
Period:	09/2004-09/2005
Construction cost:	N.A.

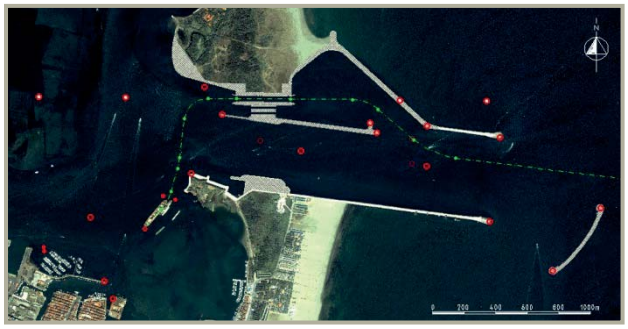
Project Description:

Chioggia Municipality officially asked the Venice Water Board to appraise the suitability of construction of a lock dedicated to cargo vessels, similar in dimensions to that - already approved - at Malamocco inlet. The Venice Water Board in turn requested the *Consorzio Venezia Nuova* to investigate the matter. The layout of the inlet with the new lock for cargo vessels (adjacent to the twin smaller locks for fishing boats) is presented below. The aim of this facility is to guarantee the navigation even when the mobile barriers are closed to prevent flooding caused by high tides.

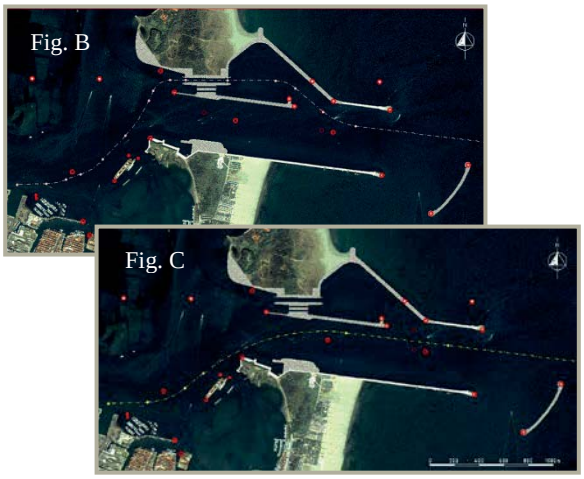
The technical feasibility had already been evaluated within previous studies. The suitability of the lock was then assessed from the nautical and economic points of view.

Safe navigation conditions were assessed by means of fast time simulator (SHIPMA) using two different ships, of 70,000 and 5,000 DWT. For each ship, different manoeuvring routes were considered: the bigger one passing through the lock and stopping within the buoys field (see Fig. A); the smaller one passing either through the inlet (see Fig. B) or through the lock with final destination in the inner port of Val da Rio (see Fig. C).

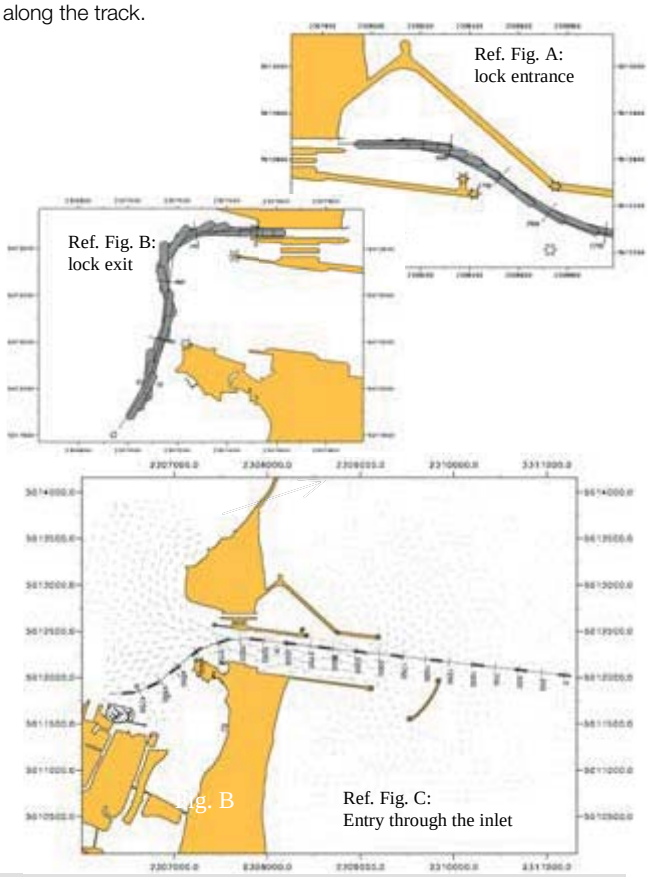
In the preliminary stage (pre-model phase) nautical assessment was carried out to define width, bends, alignments, weather conditions for simulations and depths of navigational channels, in accordance with International Recommendations (PIANC, BS, etc.).



An extensive simulation program was successively conducted with SHIPMA model that is capable of performing (by means of an autopilot) typical harbour manoeuvres like turning, reverse sailing, berthing, tug assistance and use of thrusters.



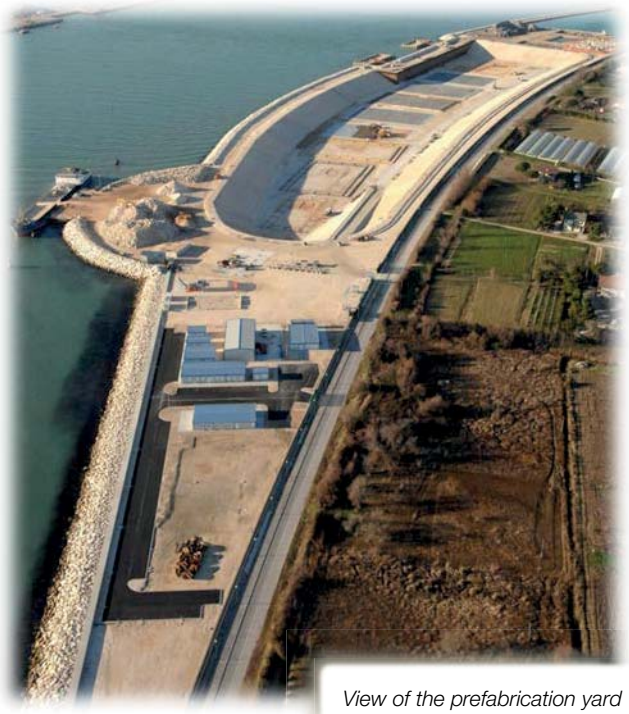
The results of the simulation was produced in form of track plots showing the evolution of the position, course and heading of the ship and data plots containing time history of steering parameters (rudder angle, number of propeller revs, ship speed, course deviation and distance to the desired track along the track including environmental parameters such as speed and wave height and relate forces on the ship, flow velocity, water depth etc.) along the track.



REFUGE HARBOUR AND NAVIGATION LOCK AT THE PORT ENTRANCE OF LIDO TREPORTI

Location:	Venice Lagoon, Italy
Client:	*Venezia Nuova* Consortium - Ministry of Public Works
Services:	Preliminary and detailed design; tender documents
Period:	07/2003 – 01/2004
Construction cost:	€ 108,459,500

Project Description:



View of the prefabrication yard

To improve the safety of the Lido port, a refuge basin has been planned in the north side of the port entrance, including a navigation lock to allow hydrofoil and passenger vessels to enter the lagoon during the closure of the barrier. The basin, before satisfying the final objective, is planned to be the dry construction area of 7 concrete cellular caissons 60x35x9 metres. All structures of the basin are therefore designed to satisfy both objectives.

The detailed design includes:

- The reinforcement of the shore between the landward end of the north breakwater and the seaward side of the refuge harbour, modifying the profile of the breakwater to limit overtopping
- The reclamation (about 7 ha.) at the end of the refuge harbour bound by the link dyke between the main breakwater and the lock area. The backfill has been achieved using sediment from the undersea excavations, whilst the material unsuited to this purpose has been used for morphological works inside the lagoon.
- The prefabrication yard for the dry construction of the concrete caissons, delimited by a temporary sheet pile cofferdam and by a plastic diaphragm wall 28m high, executed with the Cutter Soil Mixing (CSM) method. The dimensions of the refuge harbour on its south side are compatible with the possibility of obtaining an area some 100 m wide and about 500 m long, with a depth of –8.70 m, to allow the prefabrication of the caissons for the Lido Treporti barrier.
- The first phase of the works for the refuge harbour on the north side of the inlet, destined to harbour small craft wishing to exit the lagoon during the period of closure of the barriers.

Navigation lock

- The area of the navigation lock, involving the driving of sheet-piling to delimit the lock area and the realization of the lateral embankments to act as construction sites.

The contract included the provision of the following services :

- Detailed design of the structures described
- Bill of quantities and cost estimate
- Tender documents
- 2-D and 3-D mathematical model study of system for emptying the cofferdam of water
- in-situ well permeability tests to verify the assumptions made for the filtration analysis

Construction phases of the refugee harbour: cofferdam sheet pile driving and reclamation filling

Detail of the CSM equipment

Port Master Plans and Logistic Studies

UPDATING OF THE MASTER PLAN FOR THE PORT OF TRIESTE

Location:	Trieste, Italy
Client:	Port Authority of Trieste
Services:	Updating of the existing Master Plan
Period:	10/2004 – 01/2006
Construction cost:	€ 980,000,000 (excluding soil decontamination)

Project Description:

The Port Master Plan will formally update the existing one, issued in 1957 and subsequently – even if many of the relevant works have been realized – subjected to many variants and sub-variants. It is also based on updating of the preliminary studies carried out by Technital (also with the collaboration of Marconsult) in the period 1998-2000.

In the Porto Vecchio, the northern and oldest (2nd half of the 19th century) port section, several disused warehouses of high architectonic and monumental value are located, whereas in the Porto Nuovo are the commercial terminals and industrial settlements. The port of Trieste has a historical role as terminal of the Trans Alpine Pipeline (TAL), carrying crude oil to Germany, Czech Republic and Austria (35 million tons yearly), a major role as short range sea shipping terminal – Ro-Ro lines to/from Turkey and ferry to/from Greece, as well as the advantage of high natural water depth, up to 18m at the container terminal, fully in compliance with the characteristics of the last generation cellular ships, whereas for general cargo traffic it is in competition with other North Adriatic sea ports, namely the very near Monfalcone (Italy, 30 km west) and Koper (Slovenia, 10 km east).

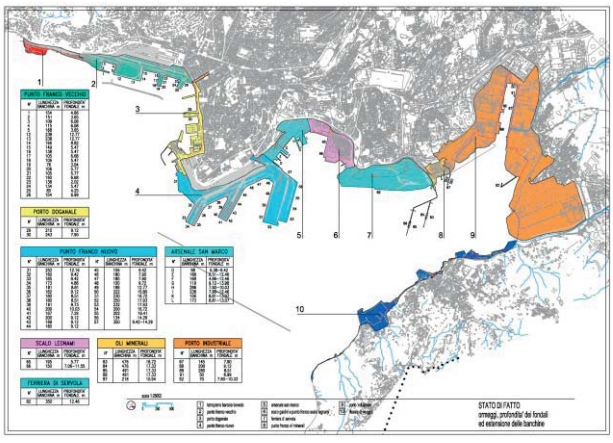
The Master Plan indicates the future configuration and port development in terms of land use and related infrastructures with respect to two basic aspects: (1) the operational port for cargo and passenger traffic (2) the integration between the port and the town along the so-called waterfront, the border area where the specific port and urban functions meet and overlap.

The main infrastructural works of the Master Plan (long term configuration, about 9.5 km of quay length and up to 130 ha of seaside expansion areas) are:

- Extension of the container terminal, by prolonging the existing pier
- Remodelling of the existing Ro-Ro facilities (new pier), as well as a completely new Ro-Ro terminal mainly on reclaimed area
- New multifunctional pier, extension of the already designed so called Logistic Platform, for general cargo, bulk cargo and Ro-Ro cargo terminals, provided by a new section of navigation channel
- Completion of the quay around the so-called Industrial Channel, an industrial historical district under partial conversion to a logistics district
- Underground road by-passing the urban centre waterfront, and the improvement of cruise ships facilities, as well as a new road improving the internal link among port areas.

The following tasks were carried out:

- Port present status appraisal and SWOT analysis (Strengths, Weaknesses, Opportunities, Threats)
- Port operational requirements and future lay-out alternatives, with special attention to the commercial cargo traffic (container, Ro-Ro/ ferry and general cargo), in accordance with a “Plan reference traffic scenario” by cargo handling category agreed with Port Authority and Port Committee (Port Authority and other appointed local entities)
- Zoning (into commercial and industrial, recreational navigation and urban use, etc.) of existing and new port expansion areas
- Location, lay-out, sizing and cost estimate for the “main infrastructural works”
- Definition of general and detailed implementation rules, including main edification standard (covered surface ratio, building alignments, etc.), at various levels of port territory size, respectively port sector (6 sectors), homogeneous area (15 areas) and intervention unit (30 units).



FEASIBILITY STUDY OF THE NEW BASRAH GRAND PORT AND REHABILITATION OF THE EXISTING IRAQI PORTS

Location:	Iraq
Client:	CIITI - Consorzio Italiano Infrastrutture e Trasporti per l'Iraq
Services:	Technical and economic feasibility study; geotechnical, hydrodynamic studies, EIA
Period:	09/2007 - 03/2008
Construction cost:	€ 4,393,000,000

Project Description:

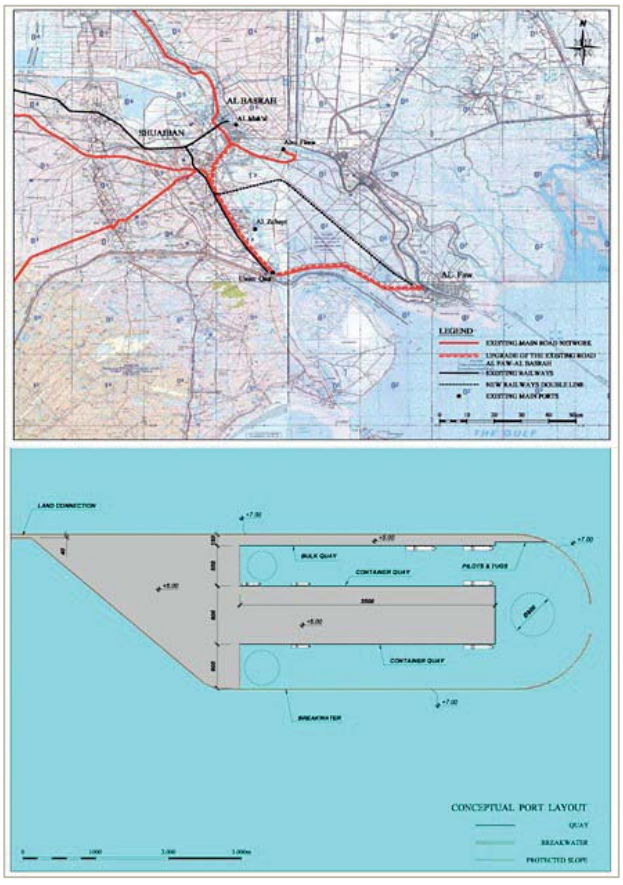
The new Basrah Grand Port will be located along the Kawr Abdallah Channel, near the Tigris River mouth, in Iraq.

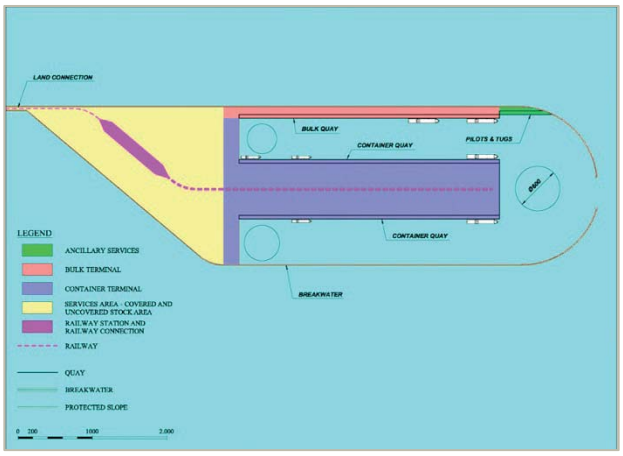
The new port has been designed in order to move about 100 million tons of freight, 5.5 million of TEU i.e. 70 million tons of containerized freight, about 30 million tons of dry bulk. The port has been designed to become the fifth port in the world.

The depth of the quays (-15.5 m) will allow the operation of the new generation of container ships. The special quays for the operation of container ships will be 7,000 m long (about 22 berths). The quays specialized in moving dry bulk will be 3,500 m long (about n berths).

A dredged channel 400 m wide will connect the new port to the deep water.

A road bridge (double lane) and a railway (double track) will connect the new port to the land.





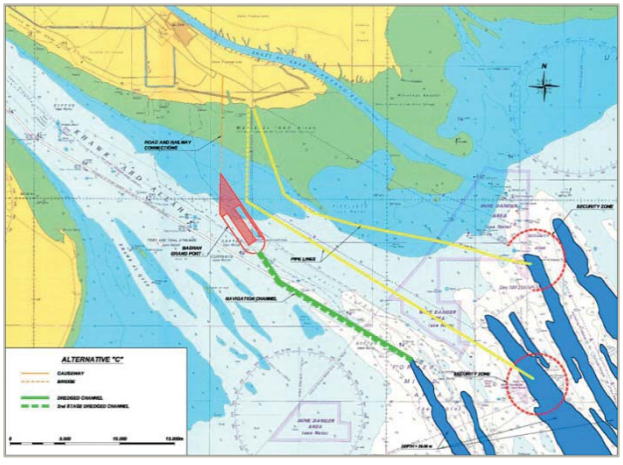
Description of the activities:

On the basis of a pre-feasibility study (also performed by Technital) 8 alternative solutions were identified along the Kawr Abdallah channel. The selection of the best alternative was performed by means of a multi-criteria analysis, involving several Technital experts (maritime, transportation, and structural engineers, economists and an environmental expert) and a commission of Iraqi officials.

In coordination with the Transportation Master Plan of Iraq, several demand scenarios were forecast (horizon time: 2018 – 2028 - 2038)

Once the technical requirements (quays and yard extension, quay and channel depth, equipment etc.) had been defined, a general layout was designed, taking into account also the results of specialist technical studies, geotechnical and hydrodynamic in particular.

Finally, the Technical and Economic Feasibility study, at a bankable stage, was carried out considering, besides the new port, also the reorganization of the existing ports (mainly Um Qasr and Khor Al Zubair)



MASTER PLAN FOR THE HARBOUR AREA OF PORTO LEVANTE ON PO RIVER

Location:	Rovigo, Italy
Client:	Sistemi Territoriali
Services:	Preliminary studies, Master Plan
Period:	11/2007 – 05/2008
Construction cost:	€ 40,000,000

Project Description:

Close to its delta, the Po river ramifies into a number of arms and one of these, the Po di Levante, is navigable for more than 12 km.

At present, the waterway is ploughed by numerous barges and ships (maximum draught 3,20 m) that call at the industries that established along the river during the past decades. The most important is certainly the shipyard *Cantieri Visentini* that builds ro-ro and ferries up 190 m long.

Sistemi Territoriali (Regione Veneto) charged Technital to study a Master Plan of a new commercial harbour to develop the entire area and rationalize the services.

The first phase of Master Plan regards some interventions to make navigation safe along the river:

- maintenance dredging up to the sea to allow the navigation of bigger ships;
- creation of a new turning circle close to *Cantieri Visentini* (this will be used for the launching even of ro-ro up to 210 m);
- creation of anarea where a ship can moor in safety in case of necessity;
- realization of new row of little piers for boats.

The second phase indicates the future configuration and port development in terms of land use and related infrastructure.

The proposal includes 650 m of new docks for the mooring of container ships of up to 130 m, bulk-carriers and general cargo ships of up to 150 m, ferries and ro-ro up to 180 m. The docks will be built on the land side and the available operational area for the harbour is about 15 ha. The stockyards dedicated to bulk-carrier terminal are large enough for some 500.000 t/yr and the container area can hold some 30,000 TEU/yr. The parking area for ro-ro terminal has been designed for a 2,500 m queue of vehicles.

The harbour will be provided with all the necessary services, such as Fire department, Police department, customs, pilot, mooring facilities, and so on.

The costs for the first phase have been estimated at around €9 million, taking into account maintenance dredging works along the river, dredging and excavation works for the turning circle and the realization of new embankment.

The second phase includes all the infrastructures to make the harbour operative, such as the paving, lighting, housing and other buildings, and roads, as well as the docks. The estimated cost for the realization is €40 million.

The harbour will be the new focal point for the development of Polesine area since, through the existing waterway network, goods can reach a number of destinations in in the lower Po Plain area.

NEW MASTER PLAN OF THE PORT OF GIOIA TAURO

Location:	Italy
Client:	Port Authority of Gioia Tauro
Services:	Traffic and market study / Seaside and landside infrastructure planning and layout / Environmental Impact Study
Period:	06/2007 – 03/2010
Construction cost:	Euro 890,000,000

Project Description:

Port Master Plans aim to set out development strategies and projects targeted over the medium-long term, representing a benchmark framework for public administrations, private investors, users and the local communities involved. The port of Gioia has the shape of a canal and occupies a surface area of approximately 500 hectares with approximately 5,000 metres of docks. The main operating area is the container terminal that extends along the East side of the canal 240 m wide and has approximately 3,200 metres of docks on sea beds with up to 17 metres depths and some 180 hectares of yard.

Container traffic is the order of about 3 to 3,5 million TEUs handled, mainly generated overseas in a global market.

Ships calling are of the unit class "S" of MAERSK 347 meters long, 42 meters wide and with a draft of around 15 meters, as well as unit of MSC 366 meters long, 51 meters wide and with a draft of around 16 meters (14.000 TEUs).

The new Port Master Pian drawn up by Technital is a complex planning tool that connects the port area to the constantly changing maritime traffic networks (transhipment, feeder). This entailed the study of engineering aspects of port infrastructures, operational aspects of land and sea transport, aspects of national and international freight exchange in an increasingly global market, serving the following Port Master Pian functions:

- commercial terminal - container and unitised goods (container l new motor vehicles) - already present in the port, and the newly established "Sea Motorways";
- commercial non-terminal - logistics facilities for goods storage and processing, already present in an embryonic form, now designed to diversify the role of the port;
- industrial-energy terminal, for LNG ships feeding a new plant planned just outside the port area border;
- other functions such as shipyards for leisure craft, port services, fishing, leisure boating, etc.

Numerous assumptions of zoning and configuration have been studied, taking into account the physical constraints (natural relief) and anthropogenic (cemetery of Gioia Tauro, wastewater treatment plant) that make it difficult or prevent the expansion of port area. Three alternatives were then assembled and evaluated through comparative analysis multi-criteria, in relation to qualitative and quantitative technical, environmental and economic parameters. The chosen Port Master Plan configuration, combination and development of the alternatives, includes the following new main Infrastructures:

- a dock (''2nd canal") behind the current terminal container, serving unitised goods, containers and new motor vehicles with a length of slightly less than 1 kilometre, a width of 220 metres and a seabed depth of 17 metres, connected to the turning basin by an access canal. The capacity of the new works for container traffic is equal to 2.5 million TEU per year. The total capacity of the East terminal- dock and the new dock is 5.5+ 2.5=8.0 million TEU.
- a dock dedicated to ancillary navigation services with an approximate 200 metres by 150 metres rectangular shape;
- a multipurpose wharf along the Southern side of the turning basin, with a 6-700 metre length;
- remodelling the Western dock, creating an additional stretch of water for ship manoeuvres;
- an intermodal road-rail terminal serving the container terminal;
- a LNG terminal, including a jetty and mooring equipment needed for the unloading of the product.

Significant figures of the proposed lay-out are over 5 km of new quays (1,5 km in a first phase), and 190 hectares of new yards (100 ha in a first phase), including a big reclamation area (60 hectares of which 30 ha already built with dredging materials, 30 ha under construction). Total embankment volume is about 11 million m3, whereas total dredged volume is about 16 million m3, of which a significant part is sandy material, suitable for beach nourishment.

The Environmental Impact Study has been prepared taking into account the national and regional legislation. The impacts to be considered are mainly those related to transformation of the territory and of the uses of the same.

Master Plan zoning

FEASIBILITY STUDY OF THE NEW "EUROPE PLATFORM" OF THE PORT OF LEGHORN

Location:	Leghorn (Livorno) - Italy
Client:	Port Authority of Leghorn
Services:	Feasibility Study
Period:	11/2010 – 09/2011
Construction cost:	€ 1,234,276,500

Project Description:

The job has been carried out in parallel with the drafting of the new Port Master Plan, finished in 2013, with the aim to study more in deep the proposed new infrastructure for port development, as far as possible preliminarily evaluating their "market attraction", looking at a possible public / private partnership (PPP) for both the realisation and the operation.

The Port of Leghorn is a Category II Class I port (classification for ports where Port Authorities reside.

The present port includes the Old Port in the south, the New Port and the industrial channel in the north and consists of 4 basins: port facilities include dry docks, quays for dry bulk / general cargo / container / crude oil and oil products, for both commercial and industrial use, as well as ferry passenger / cargo traffic with Sardinia and Corsica islands, and cruise traffic.

The new Master Plan constitutes an important strategic step for Leghorn, not only for the development of the port, but also for the city and the outlying industrial areas, in relation to both an increasingly global market, and the economies and requirements of local development. As far as the commercial port is concerned, the objective is to modernize a port of call which has numerous short-comings which have held back its development, summed up as follows:

- Limited area of the operative yards, in particular those dealing with container traffic;
- Navigation / berthing difficulties in the inner port;
- Unfavourable location of the berths for petrol products which must be transferred into the storage tanks through pipes affecting the working areas;
- Interference with the Navicelli canal.

The present main container facility – Terminal Darsena Toscana – is 1200m long and 250m wide.

The approach channel at the outer harbour is 15 m deep, whereas the access to the S. Stefano Basin and the relevant turning area (width 500 m), as well as to the turning basin of the New Port (diameter 375 m) and thence to the *Toscana* dock and quay, is through a seaway dredged to a depth of –13.00 m. a.s.l., and through a 100 m wide channel, with a useful dredged width at -13.00 m equal to 70 m. Mooring depths along the eastern part of the *Toscana* dock are -13.00 m a.s.l..

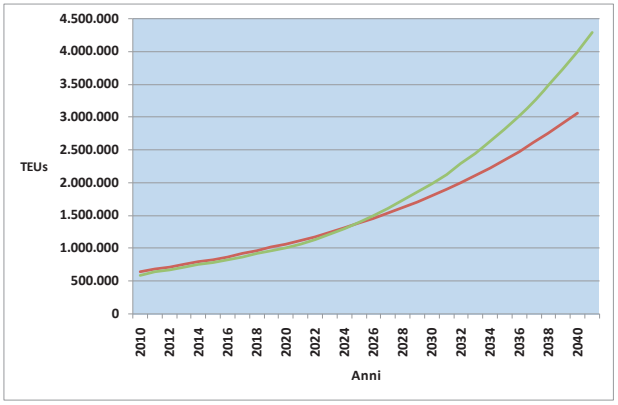
The *Toscana* dock has been realized – as a variant to the present Port Master Plan approved in 1973 – by widening the Navicelli canal to the west and building, where the canal enters the new dock, a Vincian gate to eliminate the backflow of the solid transport from the river Arno into the dock itself, as occurs during peak flows. North of *Marzocco* breakwater and west of *Toscana* dock, a big job started in early 2000s, the impermeabilized basin to be filled with dredged materials, after becoming the environmental impact critical for the inclusion of the port basin inside the perimeter of the "Polluted Site of National Interest" of Leghorn (2001) and the institution of the Cetacean Sanctuary.

The Feasibility Study – in compliance with the official Italian laws and technical guidelines – includes:

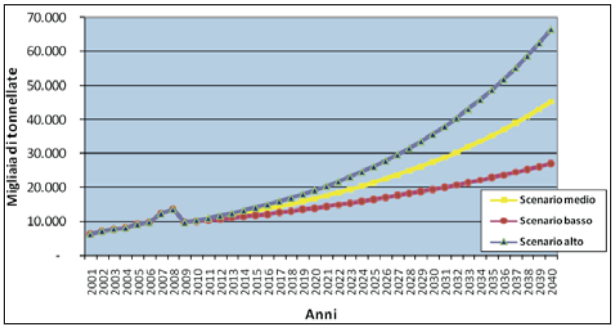
a) territorial socio-economic framework
b) demand analysis
c) offer analysis
d) project description, cost estimate
e) study of the alternatives
f) operation and maintenance cost estimate
g) financial analysis (expenses / incomes)
h) economic analysis (cost / benefit)
i) environmental impact
j) public / private partnership model analysis

k) key design issues.

The seaside demand has been estimated up to 2040, based on international skilled consultants studies as well as on other sources and related to main economic indicators (GDP etc.), according to alternative trends.



Container traffic forecast



Ro-Ro traffic forecast

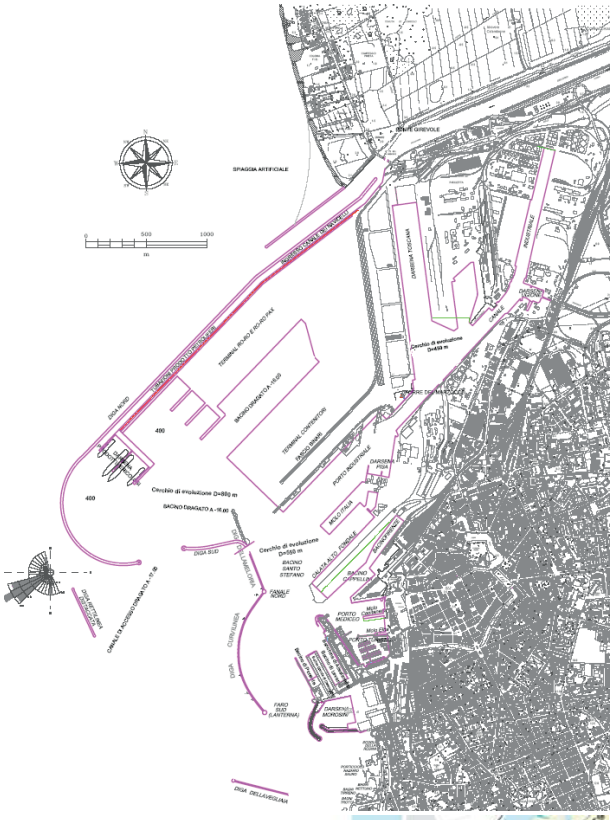
Similarly, the landside demand has been estimated and split into different transport means – road/rail/waterway.

Several alternative layouts have been examined, all of them complying with same basic criteria:

- Compatibility with layout of the dredged materials waterproofed basin (filling tank) under completion.
- New breakwater at port North side, internal ships turning basin, and access to/from Arno floodway and Calambrone river mouth.
- Relocation of oil / oil products / LNG berths and of relevant pipelines to / from the storage facilities, to keep such handling away from urban area.
- Limitation of seabed excavation to allow the maximum balance between dredged and embankment volumes.
- Realization through intermediate phases, to be operational in favour of private interest / partnership.

The selected project solution, the so-called Europe Platform, consists of:

- 2 very large piers, oriented roughly north-east to south-west, as per the dominant local winds, protected by a breakwater approximately 3km long, the South pier intended to container freight, estimated capacity around 3 million TEU (approx. 1200m long by 650m wide, depth suitable for “Post Panamax” last generation container ships), operating on both sides, and the North pier intended for roll-on/roll-off freight – full cargo as well as mixed passenger/cargo (approx. 1000m long by 500m wide), operating on one side, and the head where 3 jetties 250m long are provided. The piers, separated by a dock 300m wide, connected at the root, where a big railway yard is located, are served by a turning basin 800m diameter. New quays will have a total length over 5km, and new yards a total area 190 ha;
- An oil and dangerous cargo terminal, protected by an additional breakwater. An approach navigation channel wide 250m complete the works.
- a new railway yard for train operation and link between external network and port, and separate new terminal railway yards for containers and trailers or semi-trailers wagons charging / discharging,
- a new road bidirectional axis, extension of the present road link to the Darsena Toscana container terminal, serving both new South (container) and North (Ro-Ro) piers.



As far as the cost / benefit analysis, both the financial and the economic analysis show an IRR (internal rate of return) higher than 5% minimum required.

LOGISTIC ASSESSMENT AND EXCEPTIONAL PACKAGE HANDLING AT UMM QASR PORT

Location:	Umm Qasr, Iraq
Client:	Saima Avandero
Services:	Technical studies
Period:	0972011 – 10 /2011
Construction cost:	n.a.

Project Description:

The assessment of the Umm Qasr Port (located in the south of Iraq, along the Khawr Abd Allah Channel western shore) was performed with the aim of verifying the Client's possibility of handling exceptional packages, whether for size or weight.

Each step of the logistic chain - offshore and onshore – was analysed: from the arrival of the vessel to the anchorage point (offshore) to temporary storage of goods (onshore).

The analysis was focused on two main points:

- Navigation along the access channel to Umm Qasr port (50-mile long and about 200 m wide), and consequent limits on type and dimension of vessels and possible dwell time, considering first of all the draught of the channel and the sedimentation problem.
- Handling procedure of oversize packages (21 m long, around 7 m wide and 8 m high), with a weight of over 240 t.

The assessment of the logistic chain considered not only physical, operational and functional characteristics, but included also a proper structural analysis (see figure 1) of the existing quay evaluated as the most appropriate for the oversize package handling activities.

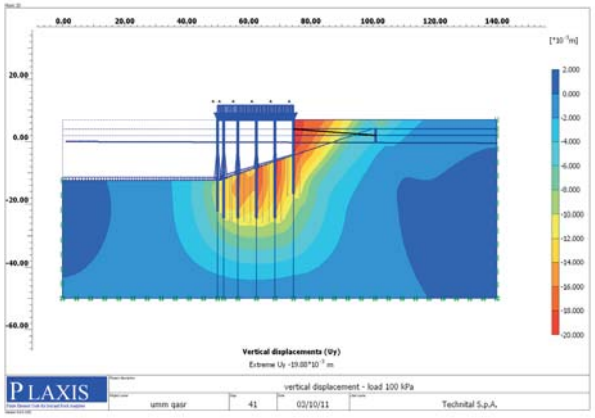
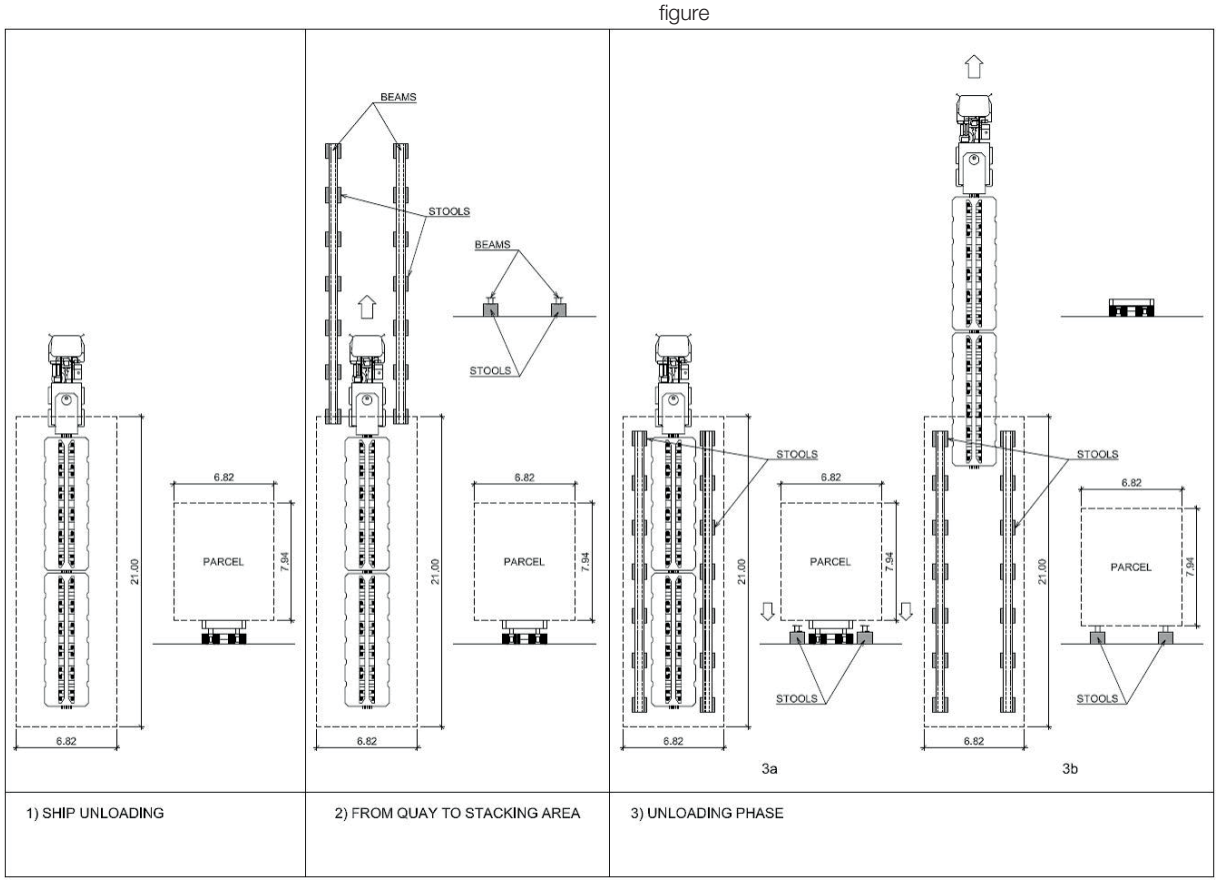


Figure 1: quay structural analysis

The study also determined the handling equipment needed (both quay side and yard side), the most suitable quay to be used, the apron and yard area (already indicated for the oversize break bulk cargo handling and storage), the speed and the procedure to be followed for the unloading, transferring and the temporary stacking phases.

A sketch of the several handling phases is given in the following figure



CONCEPT AND PRELIMINARY DESIGN FOR THE HARBOUR AREA OF PORTO LEVANTE ON PO RIVER - ROVIGO

Location:	Italy
Client:	Sistemi Territoriali – navigation department
Services:	Concept and Preliminary designs
Period:	10/2011 – 12/2011
Construction cost:	€ 43,000,000

Project Description:

Close to its delta, the Po river ramifies into a number of arms and one of these, the Po di Levante, is navigable for more than 12 km. At present, the waterway is ploughed by numerous barges and ships (maximum draught 3,20 m) that call at the industries that established along the river during the past decades. The most important is certainly the shipyard *Cantieri Visentini* that builds ro-ro and ferries up 190 m long.

Technital S.p.A. won the tender for the design of the works already suggested and studied in the Master Plan of a new commercial harbour to develop the entire area and rationalize the services on behalf of Sistemi Territoriali (Regione Veneto).

The design regards, first, some interventions to make navigation safe along the river:

- maintenance dredging up to the sea to allow the navigation of bigger ships;
- creation of a new turning circle close to *Cantieri Visentini* (this will be used for the launching even of ro-ro up to 210 m);
- creation of an area where a ship can moor in safety in case of necessity;
- enlargement of the bottleneck at Porto Levante and realization of new row of little piers for boats.

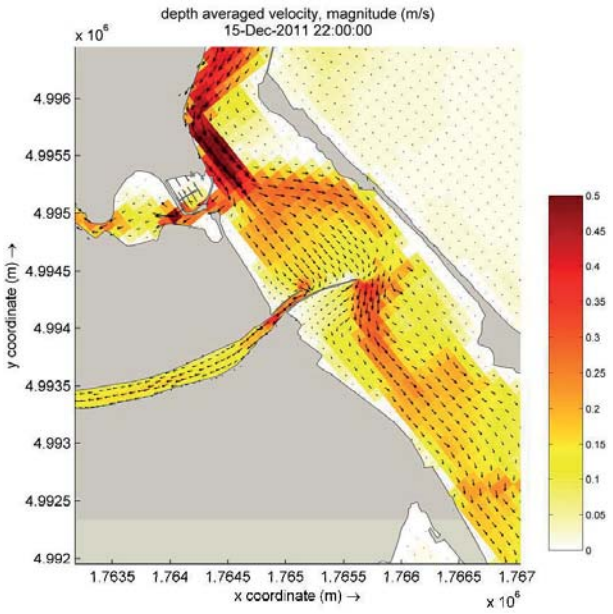
After that, the design indicates the future configuration and port development in terms of land use and related infrastructure.

The proposal includes 650 m of new docks for the mooring of container ships of up to 140 m, bulk-carriers and general cargo ships of up to 150 m, ferries and ro-ro up to 180 m. The docks will be built on the land side and the available operational area for the harbour is about 20 ha. The stockyards dedicated to bulk-carrier terminal (4 ha) are large enough for some 500.000 t/yr and the container area (2 ha) can hold some 30,000 TEU/yr. The parking area for ro-ro terminal has been designed for a 2,500 m queue of vehicles.

The harbour will be provided with all the necessary services, such as Fire department, Police department, customs, pilot, mooring facilities, and so on.

The costs for the 'safe navigation channel' have been estimated at around € 6 million, taking into account maintenance dredging works along the river, dredging and excavation works for the turning circle and the realization of new embankment.

The development harbour area phase includes all the infrastructures to make the harbour operative, such as the paving, lighting, housing and other buildings, and roads, as well as the docks. The estimated cost for the realization is € 36 million



STUDY OF THE ADRIATIC GATEWAY

Location:	Italy - Slovenia
Client:	Ministry of Transport - Italy
Services:	Traffic and Market study; feasibility study; Concept design
Period:	02/2012 – 12/2012
Construction cost:	n.a.

Project Description:

The study is organized in three phases, named A, B and C:

Phase A: traffic and marketing study.

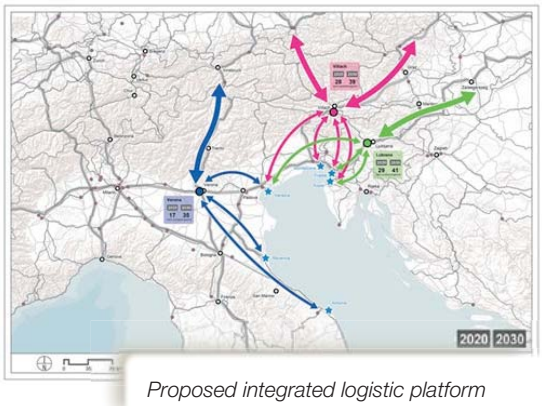
The following aspects are analysed:

- freight traffic analysis performed through a comprehensive scheme of the current and future supply and demand of transports in the Mediterranean and European area;
- identification of existing and planned transport infrastructures in Europe (TEN-T projects, maritime services and Motorways of the Sea);
- analysis of regional and global transport demand, especially that related to trade among countries involved in the development of the "Adriatic Gateway";

  Particular attention is devoted to:

  – hubs (ports all over the world, in the Mediterranean area and in the Black Sea);
  – European existing and planned intermodal / logistics platforms of interest for the Gateway;
  – The network of maritime service providers and its potential evolution

The analysis will be supported by a transport model on European scale, i.e. a simulator of freight traffic developed from the database of the TRANS-TOOLS model.



Proposed integrated logistic platform

Phase B: definition of excellence models - best practices.

This part involves the following activities:

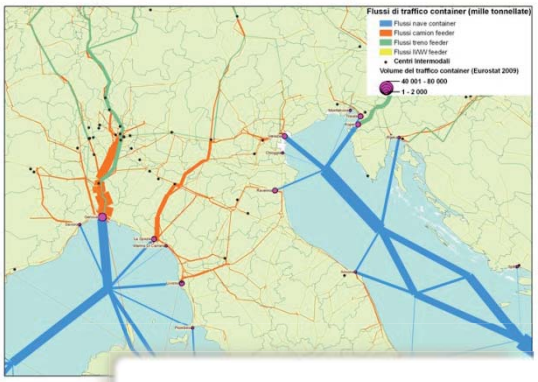
- definition of an exportable multi-functional port model capable of sustaining, as a single port, both passengers and goods flows;
- definition of the "model" as a combination of single - sectorial - best practices in the infrastructures, services, technologies and innovative systems sectors;
- Division of the port system and the connected logistic hubs into several sub-components such as:
  – port infrastructures: breakwaters, access channels, docks, yards and warehouses;
  – road infrastructures: port roads and external links/junctions;
  – rail infrastructures: junctions and rail links with the external rail network;
  – Port superstructures: loading and unloading cranes for the docks and yards.
- Identification of indicators for each sub-component so as to ensure the best operating conditions - or at least the minimum requirements - to achieve excellence.
- Consideration of environmental sustainability as paramount in the definition of best practices.

Phase C: planning of the "Adriatic Gateway".

This final part involves the following activities:

- The creation of a detailed action plan:
  – to implement new infrastructures (or renovation/strengthening of the existing ones) and related priority
  – to expand the offer of logistics services and define new services to meet the traffic forecasts, to drive the customers' preference and create/strengthen a different kind of access, all in an environmentally sustainable way.
- the Concept Design, as result from the integrated analysis of intervention proposals derived from:
  – the diagnostic analysis of ports and their infrastructures;
  – the analysis of existing services and SWOT analysis;
  – a modelling analysis and market assessment (traffic forecast).
  – A preliminary economic-financial analysis

The Gateway planning will allow the resolution of critical issues identified during the system diagnostic phase and also the accommodation of potential critical situations; it will provide the interconnection of the gateway to the surrounding territory, to the port hinterland and to major multimodal corridors, thus verifying its technical – financial feasibility and the exportability of the model to similar context.



Strategic multimodal simulation model

REVISION OF THE MASTER PLAN OF THE PORT OF LIVORNO

Location:	Livorno (Leghorn), Italy
Client:	Port Authority of Leghorn
Services:	Port Master Plan, EIA
Period:	2004-2006 and 2010-2013 (after suspension / contract redefinition)
Construction cost:	€ 1,400,000,000 approx.

Project Description:

The new Master Plan has been firstly developed in the period of the years 2004-2006, coming up to setting detailed planning criteria, after that a job suspension occurred. A contract addendum has been signed in 2010, and the job resumed, leading to the final Master Plan in 2013.

The Port of Livorno includes an Old Port, as well as a New Port: the *Porto Mediceo* (Old Port) is intimately bound up with the urban context, to which it is connected also by water by means of a series of canals, since the 16th century. The approach channel at the outer harbour is 15 m deep, whereas the moorings depth reaches -13.00 m in the eastern part of the *Toscana* dock (maximum allowed ship draught 11.60 m), and generally less than -10.00 m in the rest of the port, as more decreasing as much going into the inner basins. The port of Leghorn has a total of 12 km of quays and 90 berths.

The volume of traffic in the port is about 20 million tons of freight, mainly generated by the surrounding regions, whereas overseas port relations are with a global market. The port of Leghorn has a key role for the ferry and Ro-Ro services connecting Sardinia and Corsica, with exceptionally high tourist traffic peaks in summer. The industrial settlements – oil stocking and refinery, gas stocking, energy production, chemicals – occupy large extents of land, and several areas are used by the car industry logistic services – stocking, pre-sale arrangement, etc. The limited area of the operative yards dealing with container, Ro-Ro and cruise traffic, is a short-coming for the development of the commercial port.

The present Port Master Plan was approved in the year 1955. Several variants have been issued in the meantime (almost completely realized). At present, the necessary dredging works are heavily influenced by the inclusion of the port basin inside the "Polluted Site of National Interest" of Leghorn (2001) and by the institution of the Cetacean Sanctuary.

The new Port Master Plan – looking to the year 2040 as time horizon – is based fundamentally on the extension of the port achieved by creating large new outer port basin(s) to the north of the *Marzocco* breakwater, as far as the mouth of the Calambrone river.

The new infrastructure – to be used mainly for container services – will require a new breakwater and will be accessible through a new port mouth. It will allow the relocation of the present main oil terminal to a better position with respect to the urban area, as well as a modular approach from the point of view of the realisation and relevant expenses. The new container terminal will be able to serve the so called "Post Panamax" last generation container ships. With the new basin(s) proposed in the Master Plan, a rationalisation of the existing port installations use will be possible also for other commercial (Ro-Ro and general cargo) and passenger (ferry and cruise) port sectors.

Significant figures of the proposed lay-out are over 5 km of new quays (1,5 km in a first phase), and 190 hectares of new yards (100 ha in a first phase), including a big reclamation area (60 hectares of which 30 ha already built with dredging materials, 30 ha under construction). Total embankment volume is about 11 million m3, whereas total dredged volume is about 16 million m3, of which a significant part is sandy material, suitable for beach nourishment.

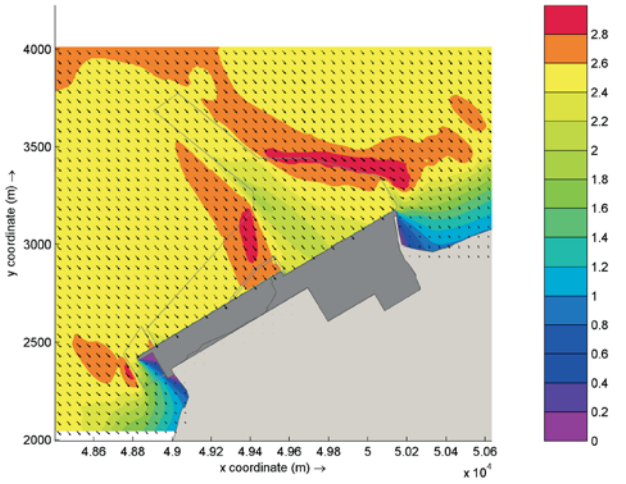
Technital – in coordination with other partners –was in charge of the following tasks:

- Landside cargo and passenger volume and traffic forecast – at the Plan time horizon, by transport mean – estimating freight units as well as road vehicles / trains / barges in the average day / peak hour;
- Support to the partner Sciro for the maritime traffic forecast and to the partner Modimar for the port layout study;
- Assessment of the landside infrastructural network (road / railway) – inside port area and in the hinterland – as well as rough draft of the new port railway yards and the new port road access.

MASTER PLAN AND PRELIMINARY DESIGN FOR BRIGHTON PORT

Location :	TRINIDAD & TOBAGO
Client:	National Energy Corporation of Trinidad and Tobago Ltd
Services:	Master Plan and Preliminary Design
Period:	10/2013 – 07/2014
Construction cost :	€ 72,189,250

Project Description :



Objective of the Project was the preparation of the Master Plan and Preliminary Design for the development of Brighton Port at La Brea, located on the west coast of Trinidad and managed by the National Energy Corporation of Trinidad & Tobago (NE).

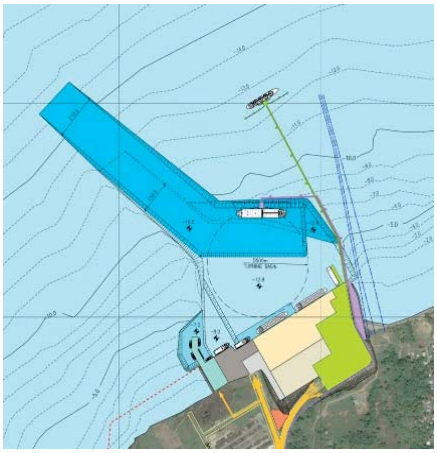
Originally planned as an infrastructure supporting the oil & gas industry, being used as logistic base for offshore wells and rigs and for the prefabrication, assembly and repair of such structures, in the recent past Brighton Port started to be used also as a multipurpose cargo facility.

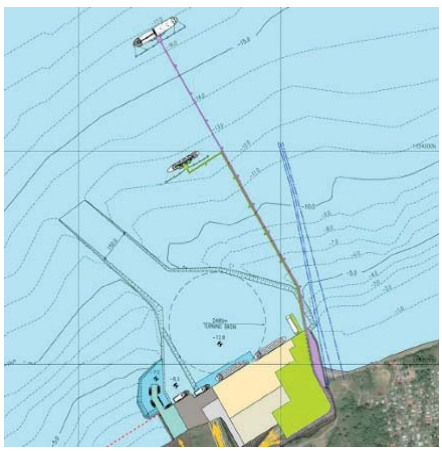
More recently, various other private companies planned to invest in the area and presented to NE official requests for dedicated port areas and berths, with the purpose of handling liquid petrochemical products (Methanol, DME), liquefied natural gas (LNG), as well as bulk, break-bulk and containerized cargoes. Due to the number of additional berths required, the volume of products to be handled and the request to handle also dangerous products, NE decided to rationalize the requests of the interested companies within the framework of an overall Master Plan of the port, with a time horizon of 25 years. Furthermore, in order to avoid the risk of planning decisions not consistent with local site conditions or with technical analysis generally carried out at a later stage, also the Preliminary Design of the port infrastructures was required to be developed in parallel with the Master Plan.

The process for developing the Master Plan was articulated in the following phases:

- Definition of functional and operational requirements for the port development, in particular: type and throughput of products to be handled; dimensions and number of vessels expected to use the port for each type of product and, based on the agreed berth occupancy rate, the number of berths required; main spatial requirements for the different port areas and berthing facilities, to include consideration of safety distances related to the handling of dangerous oil & gas products.
- Analysis of local site conditions, including: metocean and coastal conditions (winds, waves, water levels, currents, sediment transport tendency) – a modelling study of wave propagation in the port area was also performed in support of the master planning, and then of Preliminary Design activities; geological, geotechnical and seismic features of the project area.
- Development of Master Plan alternative layouts: during this planning stage, a number of alternative layouts were studied, following two different development concepts:
  - a more traditional concept, providing for the location of oil & gas berths on separate offshore jetties and also reducing the areas to be dredged;
  - an alternative development concept, allowing for the requests of the companies handling petrochemicals and LNG to moor and operate their ships along inshore berths, thus minimizing the distance between the industries and the berths.
- Preliminary sizing of main marine structures' typical cross sections, so to develop port layouts certainly feasible and for which it is possible to provide a preliminary estimate of construction costs.
- Multi-criteria comparison of the proposed Master Plan alternatives and identification of the most promising option from an overall technical and economic standpoint.

After approval of the Master Plan layout, the dimensioning of the works for Brighton Port expansion – including dredging works, quays, embankments, water drainage and treatment system – was further developed at proper Preliminary Design level, in compliance with the specific project requirements and applicable internationally recognized best practices, design criteria, codes and standards.





Port Studies and Evaluations

LNG JETTY IN GIOIA TAURO

Location:	Italy
Client:	LNG Medgas Terminals S.p.A.
Services:	Mooring Analysis; Manoeuvrability Study, Layout Study.
Period:	07/2009 – 10/2009
Construction cost:	€ 160,000,000

Project Description:

The project is related to the design a new jetty inside the port of Gioia Tauro suitable for operating gas carriers up to 270.000 cu.m in capacity.

Jetty - Position outside the commercial port

The jetty is about 500 m long, in sea depth up to 70 m, subject to high seismic and wave loads.

It includes:

- an unloading platform (50 m x 49 m);
- 6 mooring dolphins (with 4 x 100 t SWL hook assembly);
- 4 breasting dolphins (with rubber fenders and 2 x 100 t SWL hook assembly);
- a jetty trestle, to support piping and road, from the shore approach to the unloading platform (n°7 steel truss bridges, with spans ranging from 42.0 m to 72.0 m);
- walkways to breasting dolphins and seaside mooring dolphins, spanning up to 50 m each.

Due to the severity of morphological and environmental conditions, two different foundation typologies are adopted:

- Shallow water (up to-15.0/-16.0 m): single steel tubular piles of large diameter, to support the jetty bridge;
- Deep water (from -30. m to -70.0 m): n°10 steel jackets, supported by n°4 skirt piles each, for the unloading platform deck and for dolphins.

All structures are steel tubular trusses.

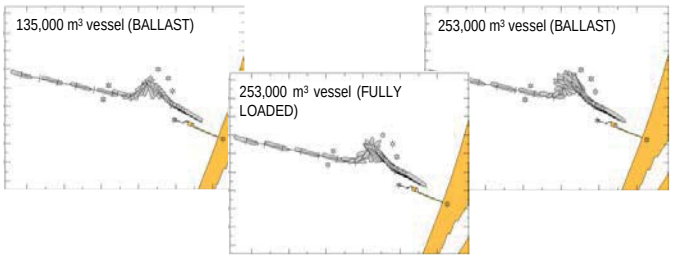
Superstructures are made up by steel tubular truss structures, with long spans to minimise the number of foundations.

The structural types maximise the prefabrication of large elements to be installed in few offshore operations.

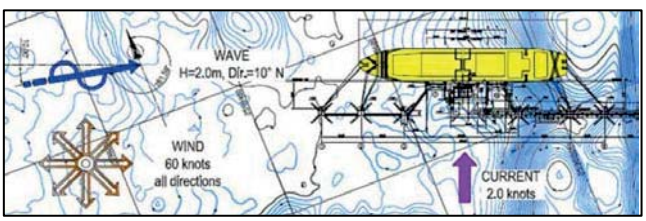
Manoeuvring and mooring analysis

The company carried out the mooring analysis and the fast time simulation study for LNG Terminal. The activities have been undertaken to investigate the mooring and manoeuvring aspects at the new LNG jetty, for different operative conditions (classified as “normal” and “emergency”) and for different ship dimensions.

Therefore the mooring analysis carried out by using mathematical simulation program aimed at checking the feasibility of mooring a vessel at a berth in various circumstances and to confirm the suitability of mooring layout has been carried out for ships from 70.000 to 270.000 m^3. The fast time mathematical simulation model for vessel manoeuvring have been used for simulating a vessel with a capacity of 135,000 m^3 (in ballast conditions) and two different vessels with a capacity of 253,000 m^3 (both in full loaded and in ballast conditions).



Jetty - Manoeuvring analysis



Jetty - Mooring analysis

CONSTANTA SOUTH CONTAINER TERMINAL (CSCT): STUDY OF PAVEMENTS FOR YARD EXTENSION PROJECT

Location:	Constanta - Romania
Client:	Constanta South Container Terminal (CSCT)– Dubai Ports World
Services:	Pavement assessment study
Period:	10/2005 - 02/2006
Construction cost:	n.a.

Project Description:

The Port of Constanta is the largest container port of the Black Sea and is the natural southern gateway to Eastern and Central Europe. Due to its strategic location it has become a transhipment hub for the Black Sea region.

The whole area was reclaimed some 20 years ago with sediments dredged from the channel connecting the Danube river with the Black Sea. The sediments where dumped in a water depth of -14 metres reaching an elevation of +2 metres.

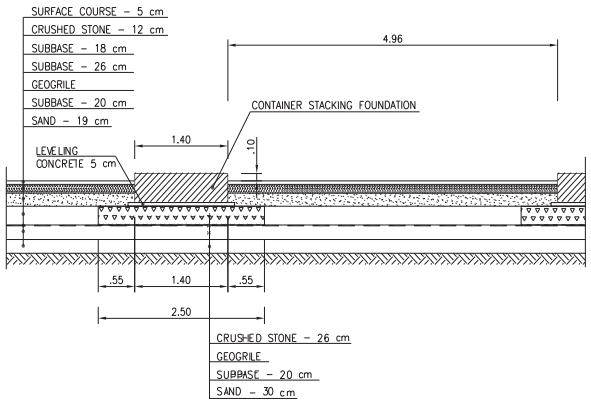
The pavement, constructed only on part of the reclaimed area (see fig. above), was with different layers and materials according to the use foreseen.

During the terminal operation, CSCT has experienced a critical settlement of the pavement structure supporting the containers in the stocking yard.

The Scope of this Study was therefore the analysis of these settlements, in order to explain the causes and the possible future risk of failure.

The pavement structure of the container stocking area (see fig. below) was constructed with reinforced concrete beams on which containers were supposed to be stacked, transmitting an overall load of up to 720 tons.

In a few years of port operations these beams underwent significant settlements.



Through the use of sophisticated 3D and 2D models it was possible to demonstrate that the vertical displacements were due to a lack of soil bearing capacity. In fact, the rigid type of pavement adopted meant the concentration of the loads of the containers only on the concrete beams with the resulting overall failure of the pavement due to the poor geotechnical characteristics of the soil below (clay).

The critical condition observed could be explained by the rigidity of the supporting structures (the concrete beams) and by their limited width in relation to the heavy loads transmitted by the corners of the containers. The modelling also helped to define the hypothetical beam width with which could guarantee an acceptable factor of safety.

For these land uses, a flexible rather than a rigid pavement structure should be preferred, because by allowing a local settlement of the pavement (of approximately 1.2 cm which is the dimension of the protruding corner) it avoids an overall failure. In fact, once the 1.2 cm settlement has taken place, the container rests completely on the pavement and the overall load is distributed over the entire base (2,440m x 12.035m), thus reducing the stresses transmitted through the pavement into the underlying embankment.

The services executed by TECHNITAL included:

- Site visit and data collection (soil investigation, available design of the proposed infrastructures, etc);
- Geotechnical study of the area to establish the stratigraphy and the soil properties;
- Analysis of the behaviour of the foundation soils and designed structures from the geotechnical point of view;
- Settlements of the area versus time;
- Bearing capacity of the foundation in the short and long term;
- Assessment of the existing pavement and/or identification of the recommended design improvements for future expansions.

NAVIGATION STUDY FOR LNG TERMINAL AT PANIGAGLIA – LA SPEZIA

Location:	La Spezia, Italy
Client:	Tecon S.r.l.
Services:	Navigation study with mathematical model ti optimize port layout for modernization and upgrading of LNG facilities.
Period:	09/2005 - 10/2005
Construction cost:	n.a.

Project Description:

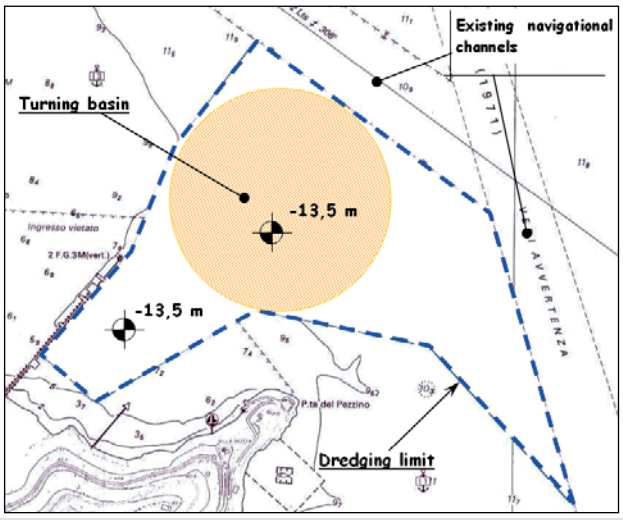
The study covers the nautical aspects of a wider Project regarding the “Modernization and Upgrading of Panigaglia LNG Facilities” in the Gulf of La Spezia.

The figures below show the present layouts of the site with the storage tanks and vaporisation units and of the terminal.
The main purpose of the study was to determine the works

necessary to render the present terminal suitable for LNG carriers with cargo capacity of 145,000 m^3.

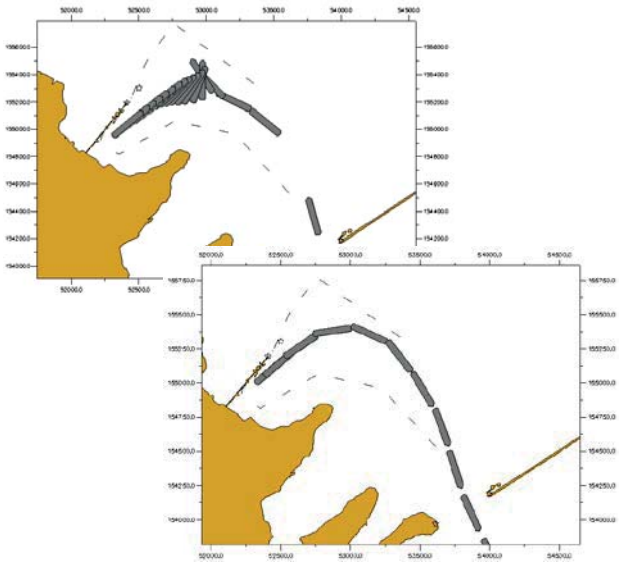
The objective was achieved with a navigation study carried out with help of a fast time simulator (SHIPMA).

In the preliminary stage (pre-model phase) nautical assessment was carried out on the basis of International Recommendations (PIANC, BS, etc.) to define width and depths of approaching channel and turning basin (see blue contour below).



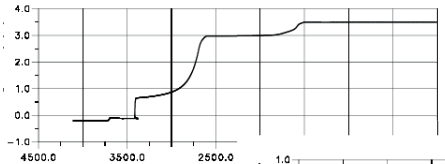
All nautical aspects to make the navigation safe (land contour with re-shaped terminal, depths after dredging, new channel and turning basin) were successively inputted in the SHIPMA model that is capable of performing (by means of an auto-pilot) typical harbour manoeuvres like turning, reverse sailing and berthing. The effect of stern/bow thrusters and tug/s assistance is also computed if needed.

Entrance/exit manoeuvres under representative weather conditions were conducted with the design ship according to a project plan agreed with the Client (below is a departure).

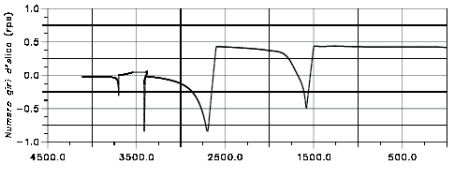


The simulation results were produced in the form of:

- Track plot showing the evolution of the position, course and heading of the ship;
- Data plots containing:
  - rudder angle, number of propeller revs, ship speed, course deviation and distance to the desired track;
  -
  - environmental parameters including wind speed and wave height and relate forces on the ship, flow velocity, water depth etc..



Ship’s speed along the track



Ship’s rudder along the track

Operational procedures were reviewed according to the results of simulation programs.

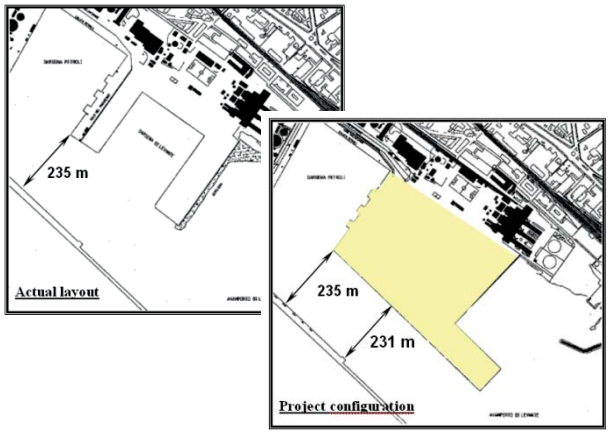
NAVIGATION STUDY FOR NEW CONTAINER TERMINAL IN THE PORT OF NAPLES

Location:	Naples, Italy
Client:	Port Authority of Naples
Services:	Study with navigation fast time simulator
Period:	07/2003 - 10/2003
Construction cost:	n.a.

Project Description:

This Study was strongly desired by the Client, who wished to evaluate the navigation condition for the tankers directed to the inner oil terminals, before proceeding with the detailed design of the new container terminal at Port of Naples (see location in the figure below).

With reference to the figure below, the main purpose of the Study is to demonstrate, using a fast time simulator, that a minimum width of 231 m is sufficient to guarantee safe navigation in the channel between the detached breakwater and the new quay.



The objective was achieved with a navigational study carried out with help of a fast time simulator (SHIPMA).

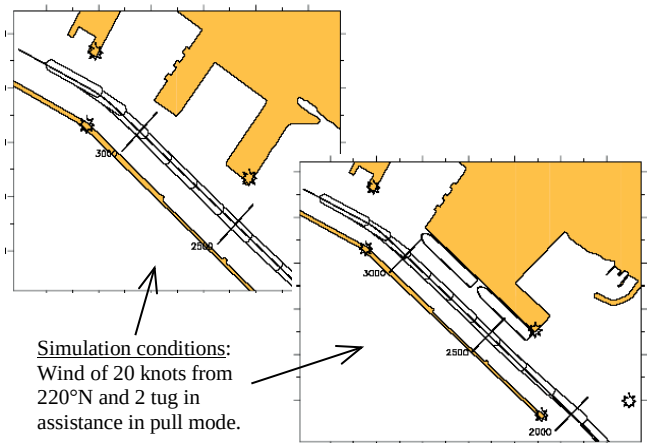
In the preliminary stage (pre-model phase) nautical assessment was carried out on the basis of International Recommendations (PIANC, BS, etc.) to define width, alignment and buoys along the navigation channel.

A 90,000 DWT Tanker vessel (Length=233m, Beam =42m; Draft=11.1m, with no stern/bow thrusters and single rudder/single propeller) was used to assess the manoeuvring conditions in two scenarios:

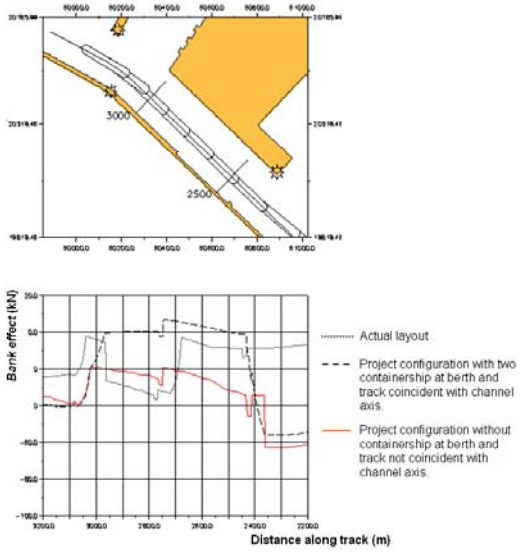
- present layout;
- final configuration (with or without the ships berthed at the new quay).

After the definition of the design ship, the schematisation of land contour, depths, wave and wind was conducted and inputted in the SHIPMA model that is capable of performing (by means of an auto-pilot) typical harbour manoeuvres like turning, reverse sailing and berthing. The effect of stern/bow thrusters and tug/s assistance is also computed if needed.

Finally entrance/exit manoeuvres under representative weather conditions were conducted according to two different project plans, one for each scenario.



Navigation in restricted waters was a peculiarity of the study. To evaluate the related effects the capability of SHIPMA to describe the bank effect was appreciated.



The results of the simulation were produced in form of:

- Track plot showing the evolution of the position, course and heading of the ship;
- Data plots containing:
  - rudder angle, number of propeller revs, ship speed, course deviation and distance to the desired track;
  - environmental parameters including wind speed and wave height and relate forces on the ship, flow velocity, water depth etc.

NAVIGATION STUDY FOR NEW LOCK FOR CARGO VESSELS AT THE PORT INLET OF MALAMOCCO

Location:	Venice lagoon, Italy
Client:	*Venezia Nuova* Consortioum for Ministry of Public Works
Services:	Navigation study, traffic study , feasibility study
Period:	04/2001- 03/2002
Construction cost:	n.a.

Project Description:

A lock for cargo vessels was designed to guarantee the continuity of navigation during the period of closure of the mobile barriers located at the three inlets to protect Venice from the flooding caused by high tides.

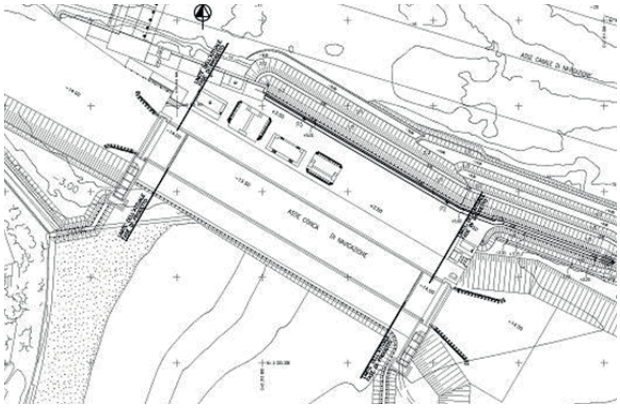
The main purpose of the present study was:

- definition of optimum dimensions and location of the lock in the inlet channel, suitable for navigation and environment requirements;
- traffic study to evaluate the benefit of the lock in terms of queue reduction during the closure time of the mobile barriers.

The evaluation of the types of structures suitable for the works was also carried out.

Regarding the second point, an appropriate simulation model to analyse the management of the traffic queue was used (GPSS, General Purpose Simulation System implemented by Minuteman Software), after calibration with more recent available information about traffic statistics and ship dimensions.

The figure below shows the final layout derived from the present study, followed by a sketch plan of the lock.

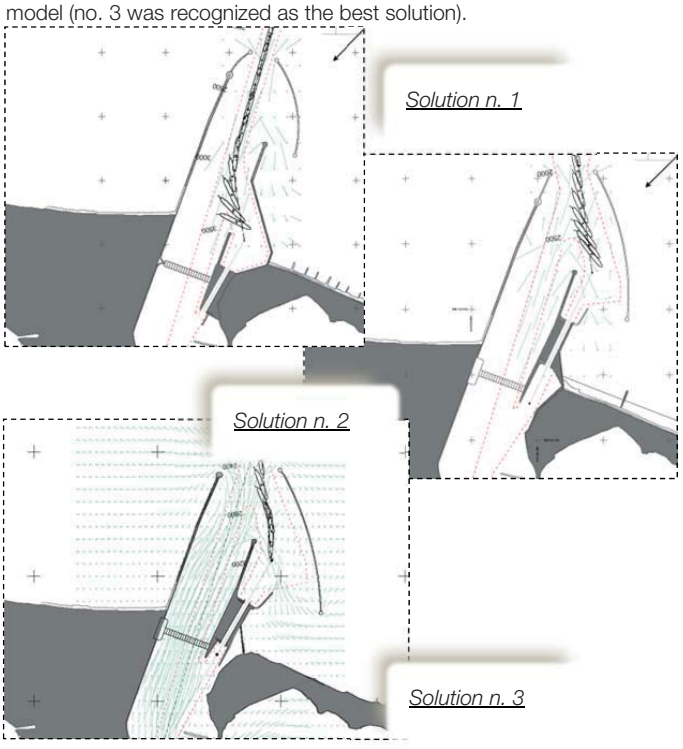


The navigational assessments executed in two successive phases were very extensive: the first regarding the correct positioning of the lock in the inlet channel and the second regarding the correct layout of protection work (detached breakwater designed to reduce the wave agitation in front of lock entrance).

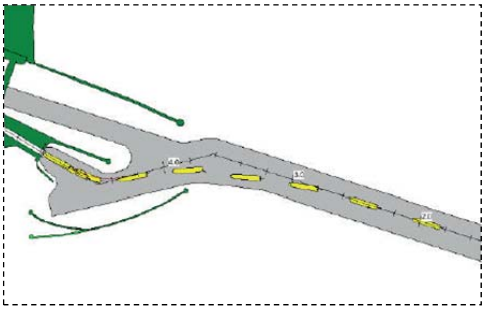
An extensive simulation program was then conducted with SHIPMA model that is capable of performing (by means of an autopilot) typical harbour manoeuvres like turning, reverse sailing, berthing, tug assistance and use of thrusters.

The results of the simulation was produced in the form of track plots showing the evolution of the position, course and heading of the ship and data plots containing time history of steering parameters (rudder angle, number of propeller revs, ship speed, course deviation and distance to the desired track along the track including environmental parameters such as current speed and wave height and relate forces on the ship) along the track.

The correct position of the lock was then determined with SHIPMA model (no. 3 was recognized as the best solution).



The final layout of the detached breakwater was defined with the help of real time simulator applied by our consultants. The new geometry mounted on the old one (from solution no. 3) is shown in the figure below.

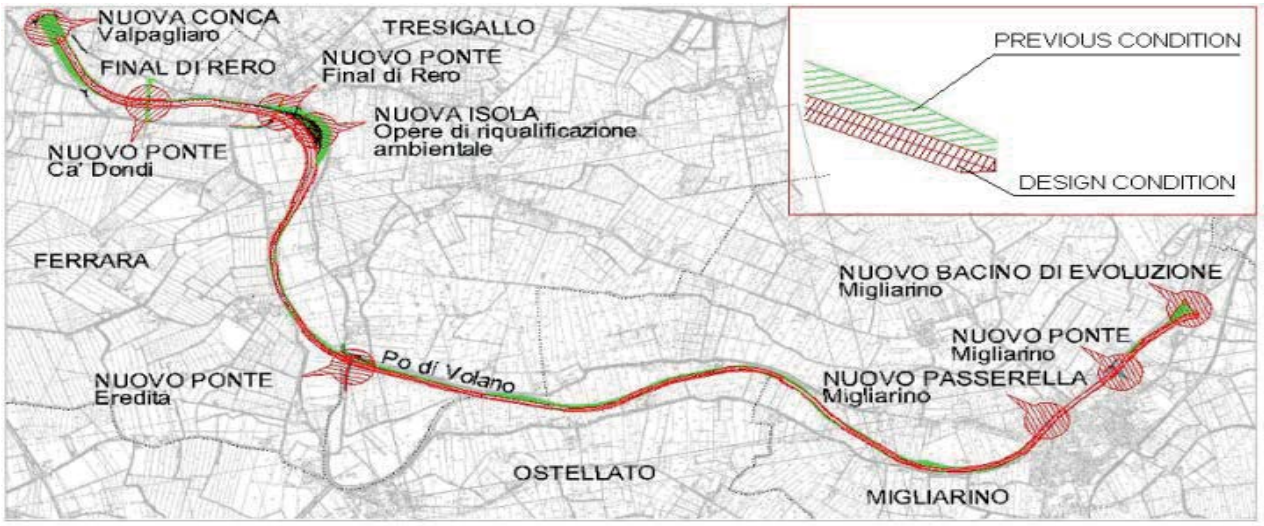


Inland Waterways and Canals

UPGRADING TO CLASS V TRAFFIC OF THE FERRARESE WATERWAY, LOT 2: FINAL SECTION DI RERO - MIGLIARINO

Location:	Italy
Client:	ARNI – Azienda Provinciale di Ferrara (Provincial Authority for Inland Navigation)
Services:	Environmental impact assessment; preliminary, detailed and construction design for the works to upgrade the section to class V traffic; coordination of safety in the design phase; construction supervision
Period:	11/2001 – 06/2007 (design); 02/2013 – 03/2016 (supervision)
Construction cost:	€ 23,452,000

Project Description:



Over the past years, the situation of the Ferrara waterway deteriorated rapidly, as a result of modifications due to the inadequacy of the drainage system of the river Po di Volano (which represents the main basin). Furthermore, another aspect that accelerated the deterioration of the hydraulic situation: the continuous use of part of the drainage system for supplying the irrigation network for the adjacent fields, with the result that the drainage system ion its course to the Adriatic Sea is deprived of the spring storm-enhanced flows.

The foreseen targets of the project are the improvement of the inland navigation conditions, and the enhancement of the use of the entire area, from the point of view of both navigation and built-up zones (cycle paths, stopping and picnic areas along the waterway etc.).

The interventions were carried out steps concerned three particular branches:

- *Realization of new bridges*: in many zones along the waterway, to enhance the use of the area, it seemed necessary to build new bridges and footbridges, made in steel (like in the case of those at Cà Dondi and Final di Rero) or in wood (footbridge at Tresigallo build-up area), or to improve the existing ones by the insertion of technologically more advanced parts. Thus even to allow (after the adaptation works of the river) the new class of ships to pass under the bridges.
- *Improvement of Valpagliaro navigation lock:* the work consisted in modifying the lock dimensions, lengthening it by almost 15 metres in the current direction: this modification allows even 110 m-long ships to navigate inside the river. Of course, this implied demolishing the old vertical-lift gate in the upper part of the lock chamber, and rebuilding a gate 15 metres before the previous location. Furthermore, some other parts of the river course have been modified, in order to give a smoother profile to some of the existing bights.

- *Environmental aspects*: in order to minimize the environmental impact due to all the interventions, it was decided to re-naturalize those parts of the natural levees involved in some interventions (such as the building of the bridges), and consequently modified. In particular, it must be mentioned the insertion of green areas on the entire surface of the island located near Final di Rero.

VENETIAN LITTORAL WATERWAY: REHABILITATION WORKS

Location:	Venice, Italy
Client:	SISTEMI TERRITORIALI S.p.A.
Services:	Construction design; site assistance
Period:	08/2008 - 10/2009
Construction cost:	€ 18,326,500

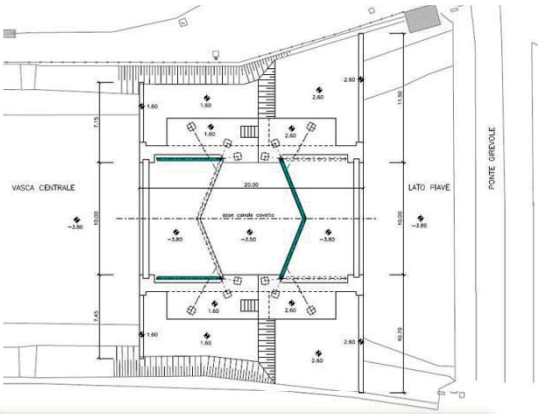
Project Description:

The project concerns the upgrading of the section of waterway between the “Cavallino” lock and the Tagliamento river mouth to make it compatible with the European IV category, and the demolition and reconstruction of the “ponte Spano” vertical-lift bridge in Jesolo (VE).

The rehabilitation of the waterway involves the adjustment of canal depths, the restoration of deteriorated embankments and the functional retrieval of four existing lock structures.

In particular, one of these locks, “Cortellazzo” lock, has to be completely demolished and rebuilt. The remaining three locks (“Revedoli” on the homonymous canal, ”Bevazzana” on the “Nuovo” canal, ”Cavallino” on the Sile river) are subject to restoration works and electro-mechanical system maintenance.

The project includes the provision of a brand-new radio-controlled system for managing the four locks remotely.

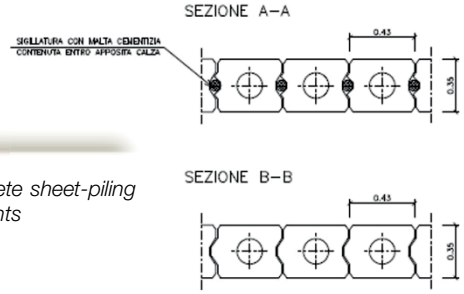


East side structure of the Cortellazzo lock gate: design plan

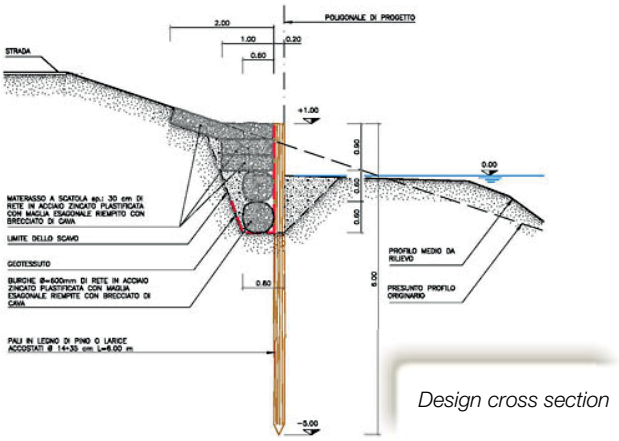
The deteriorated embankments to be restored are located in Sile River nearby the Cavallino lock, and along the “Cavetta”, “Saetta-Palangon”, “Revedoli” and “del Morto” canals.

The typical design section used in embankments rehabilitation is made of wooden (either pine or larch) sheet-piling, diameter 14 – 35 cm, length 6 m.

The wood types to be used have been chosen on the basis of durability and eco-compatibility criteria.



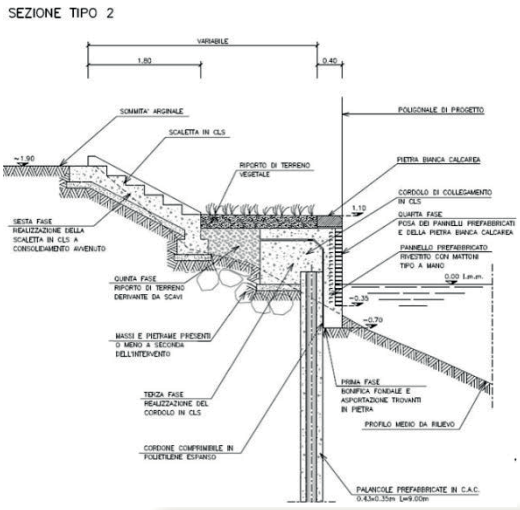
Concrete sheet-piling elements



Design cross section

The rear side of the piling is composed of pre-cast elements called “burghe” and anti-erosion stone mattresses wrapped in plasticised galvanized metal nets, sewed together to guarantee the resistance of the system. Geo-textile is placed behind the wooden piling in order to hold back the fine soil particles and prevent erosion. Moreover, the stability of the embankment will be increased by the vegetal colonisation that will rapidly develop on the back elements. Nevertheless, the overall stability of the river banks does not rely on the existence of the wooden piling. In fact, even in case of wood deterioration in the long-term, the long service of the new embankment structures is guaranteed.

In the nearby Cavallino lock, on the other hand, the embankment structure is realised by means of concrete sheet-piling as illustrated in Fig. 3 and 4.



Concrete sheet-piling cross section

ENVIRONMENTAL PROTECTION OF THE SARCA RIVER - LAKE GARDA - MINCIO RIVER - MANTUAN LAKES SYSTEM

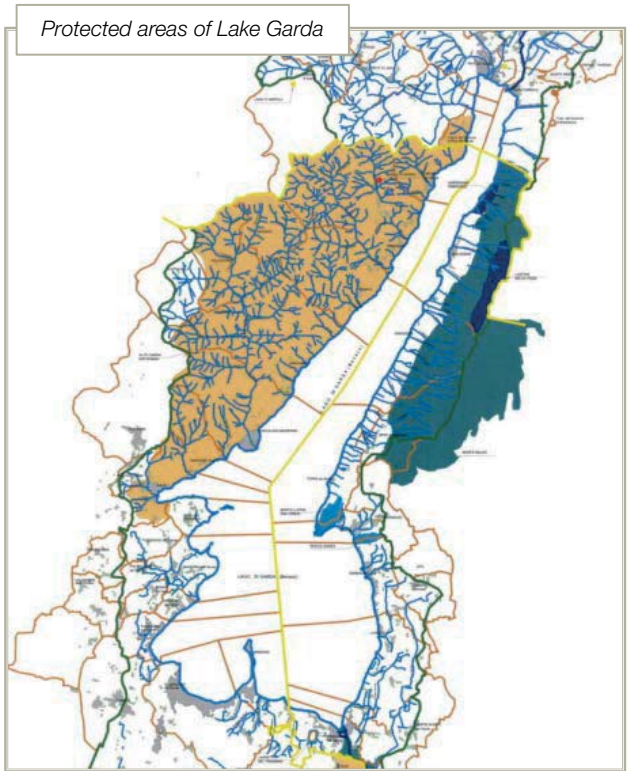
Location:	Italy
Client:	Po River Basin Authority
Services:	Land use studies, hydraulic and hydrodynamic studies, hydraulic modelling, environmental studies
Period:	02/1996 – 02/1997
Construction cost:	N.A.

Project Description:

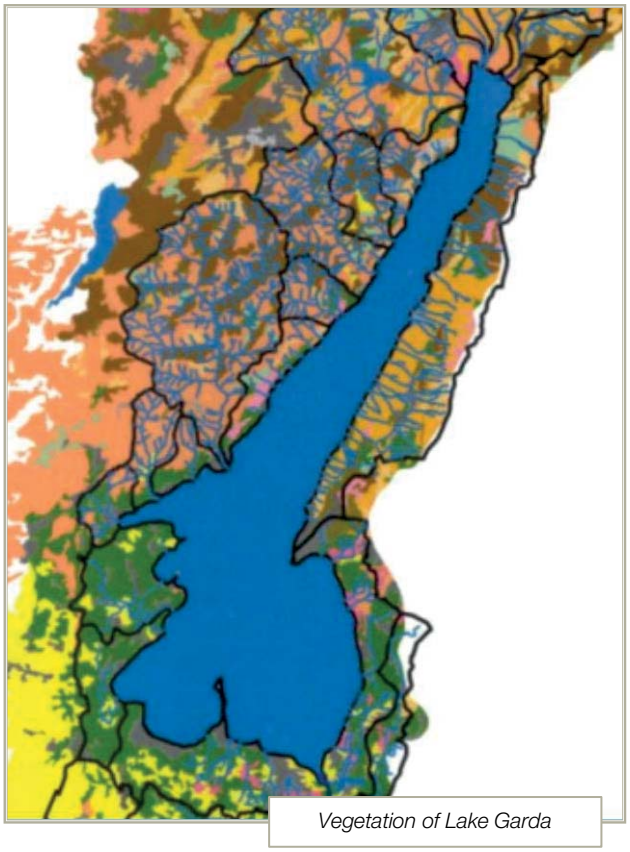
Sarca river

The aim of the study is to define an exhaustive framework of knowledge regarding the environmental quality of the area and to supply the elements needed to:

Protected areas of Lake Garda



- improve the quality of the water in the basin in relation the integrated and optimum use of the water resource, taking into consideration the tourist-recreational prerogative of the area;
- define the principal alternative actions to optimize the water treatment system and the recycling of the treated waste water;
- define the restrictions for using both the water and the land, identifying criteria, standards and regulations to reduce the impact of anthropogenic activities on the territory;
- identify the tools required for monitoring the efficacy of the actions.



Vegetation of Lake Garda

Mantua lakes

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