

DESIGN AND CONSTRUCTION OF A 130.000 SQM LOGISTIC PLATFORM IN TRIESTE'S PORT, ICOP & LWN: AN ORGANIZATION, LOGISTIC AND POWERFUL RIGS WINNING COMBINATION

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The Trieste's port is the most favorable sea connection for goods handling direction South-Est to the corridor North, Centre and Est Europe; a new logistic platform has been designed wrapping ca 1/4 of one million square meters to the sea in order to load and unload Ro-Ro & container vessels and various material. An approx 150.000 square meters sea suspended monolithic and prestressed dock has been designed. A sediment tank of ca. 500,000 cubic meter capacity is as well realized. Main works: consolidation and foundation for the sediment tanks (dragging and piling works), construction of water proof confinement beach diaphragm walls (mixed technique cutter soil mix and sheet piles), river diversion foundations (secant piles), drainage trenches and heavy off shore piling works.

THE WORK

The intervention for the realization of the first operational phase works related to the logistic platform in the port of Trieste, consists in the development of the area enclosed between the docks timber yard, the former Sidemar/Italsider yards, including the connection between the Dock and the Sediment tank (currently under construction) and the new North-end of the dock timber-yard, the connection between the same and the area of the Serva Iron-foundry; the intervention is part of the larger project for the Trieste's logistic platform construction

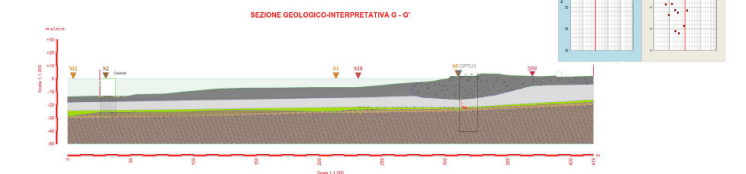


GEOLOGICAL ASPECTS

It is basically a material of anthropogenic origin used for the offshore land reclamation area toward the Trieste seaport since the early 1800's. The geological complex of the whole area is based Trieste's flysch overlaid by more recent quaternary sedimentary complexes of different origin.

- The Flyschoid complex is characterized by a rhythmic alternation of arenaceous layers and marly of variable thicknesses.
- Above the intact flysch there is an altered level with variable power known as "cristallo" or "cappellaccio", in which the arenaceous lithotypes are variably altered, while the marne are reduced to clayey silts of plastic consistency.
- The physical and mechanical characteristics of these materials are extremely variable, highlighted by the succession of different sedimentation environments, from continental to marine.

Terreno	γ (kN/m³)	C (kPa)	φ (°)	c _v (kPa)	E' (MPa)
Successione a mare					
Limiti argilliferi AL1	16,5	0	22	10	1,5
Argille limose grigio-verdi AL2	16,5	5	23	50	2,5
Successione a terra					
Riparti R	18,0	0	25	-	3,0
Limiti argilliferi AL3	17,0	20	24	80	5,0
Termini di alterazione del flysch					



DESCRIPTION OF MARITIME AND STRUCTURAL WORKS

The containment of non-hazardous dredging materials used to fill up the land reclamation caissons will be ensured by the following interventions:

- Realization of a combined diaphragm wall, tubular piles and sheet piles; on the south and partially west area of intervention.
- Realization of a perimeter diaphragm wall, connected to the combined diaphragm wall.
- From the existing frontline caissons, suitably waterproofed, to the realization of a sheet piling just in front/parallel of said caissons and connected to the combined diaphragm wall (west side, facing the sea).

The intervention in numbers:

- Total concession area: - 12,3 ha
- Quay length: 431 m
- Ro-Ro mooring dock platform (considering the possible installation of a floating mobile dock)
- Cantilever dock platform to be realized with piles and slabs: 74.350 m², including approx. 3.050 m² corresponding to the Ro-Ro dock platform external to the perimeter of the reclaimed land
- Capacity of the containment area under the cantilever dock platform: over 500.000 m³, about 80.000 m³ of which filled, during the construction phase, with compatible materials resulting from the drilling of piles and from the technical dredging, functional to the construction works.

The seabed along the new dock platform has a depth which varies between 10 and 13 meters on the sea level and, only closed to the timber yard, dredging is required to reach the project depth: about 15.700 m³ of non-dangerous and therefore compatible excavation material will be taken out. The height of the new dock platform, along the mooring edge, is equal to 3,10 m: the height, on-shore, may vary thus to allow the collection of rainwater.

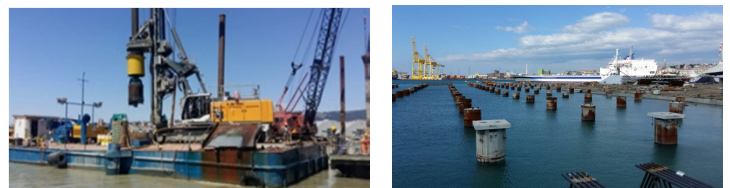


DRILLED PILES

The slab of the logistic platform, as part of the works related to the first operation phase, is sitting on 864 drilled piles about which 793 are with a Ø 1.270 mm and 71 are with a Ø 1.100, all headed on the unaltered flysch.

In addition to this there are also other 55 spiral steel piles for the realization of the combined walls (king piles Ø 1.625, thk. 16 mm with a variable length between 18 and 39 m with interposed AZ 17- 700 extended at least until the embedment on the cohesive top). Ro-Ro dock platform is also sitting on secant piles (Ø 880 mm) of variable length 16:23 m, thus in order to realize the drainage area of the Baiamonti river.

The same technology is used in place of the CSM diaphragm walling in some sections of the shoreline where the presence of boulders and the narrow spaces available is not applicable. With the Ø 1.270 m piles drilled will be realized a main grid 10x10 m then top up with a deck realized with a monolithic post-tensioned concrete slab.

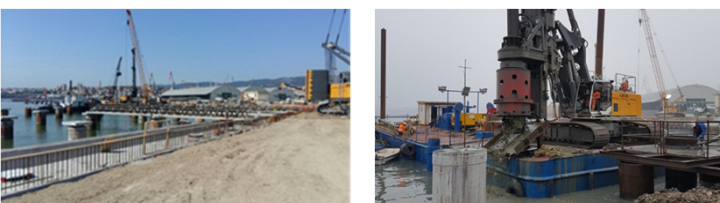


THE DRILLING RIG ON PONTOON LB36-410 AND THE CRANE LR1300

Icop S.p.A. for the pontoon driven off-shore drilling activities has decided, the first in Italy with this model, to rely on a Liebherr LB36-410 drilling rig.

The main technical feature of this machine are:

- Operating weight: 115 ton => greater weight, greater stiffness, less vibrations therefore minor deviations and risks of interference with close piles especially when used in CSP-FoW method (besides minor possible breakages due to fatigue).
- Motor power: 390 kW - more power means not only be faster in all functions but also having spare power in potential critical situations i.e., for example, at high depths (in double head or FDP), with strong lateral friction (potentially in soil with sandy matrix), with heavy bored columns full of material....
- Consumption: low-consumption engines having an innovative concept called ECO-Mode able to limit the consumption of fuel.



Two types of cranes have been used for the material handling. The classic HS855, crawler crane "heavy duty" with 120 ton lifting capacity, 114 ton operating weight and 450 kW installed power. It is used for various works from the lifting of the pile casing, to the handling of powerful vibrators for the driving of pile casing or sheet piles. But the real queen of the jobsite is the new LR1300, 290 ton crawler crane, with 300 ton lifting capacity and 390 kW engine. The machine, despite its considerable dimensions, is easy to transport and is designed to be assembled autonomously.



It is used for the handling of the cantilever deck. In layman's terms only with such equipment you can get the following features needed in Trieste:

- Boom length: 50 m
- Working weight: 12 ton
- Boom working angle: 34,88 °
- Max reachable distance: approx. 40 m
- Maximum load discharge in the heaviest position: 6 kg/cm²

Based on the above-mentioned features, it has been specifically sized and designed the deck platform and above it has been designed the geometries of the slabs to be laid, optimizing the dimensions and consequently minimizing the handling time and the related costs.