Piling into the Ravenna Port Hub Project

Raffaella Viola, from Comacchio, provides an insight into the piling and jet grouting work being undertaken with the Italian company's MC 22 and MC 30 rigs at the expansion of the Ravenna Port on the Adriatic coast of Italy

Located along a channel on Italy's Adriatic coast, the Ravenna Port is one of the Core Ports of the TEN-T networks and part of the Baltic-Adriatic Corridor and the Mediterranean Corridor. It is undergoing an unprecedented transformation phase with infrastructure works co-financed by the EU, the EIB and the Italian Government.

Based in Sarno, in the South of Italy, RCM Costruzioni is the majority partner of the Consorzio Stabile Grandi Lavori, the general contractor in charge of the Ravenna Port Hub Project.

During the project's first phase, to expand Ravenna Port's capacity, approximately five million cubic metres are scheduled to be removed in the outer and inner channels as the port is deepened from the current 11.5m to 12.5m. The work will involve the reconstruction of part of the existing docks (for over 6.5km length) and the construction of a new 1000m long dock on the Trattaroli Peninsula, where the new container terminal will be located.

In addition to improved accessibility for large ships, increased traffic and enhanced navigation safety, the completion of the project will expand the capacity and efficiency of the entire port system, with new areas that will be made available for production and logistics, spanning approximately 200 hectares.

This work constitutes the first phase of a broader development project that will take the seabed of the port down to -14.50m (phase two).

RECONSTRUCTION

The project's first phase is expected to be completed by the end of 2024. Dredging works began in 2022, followed by extensive reconstruction works that involved a total of 12 existing docks that needed to be adapted to the new depth.

Built during the 1960s by private investors, the existing docks have undergone a continuous transformation over the years, resulting in a variety of dock types (often just a few hundred metres long) with different structures, non-uniform project parameters and various states of repair. Most were built using anchored quay walls (diaphragm walls, sheet pile walls, precast reinforced concrete walls).

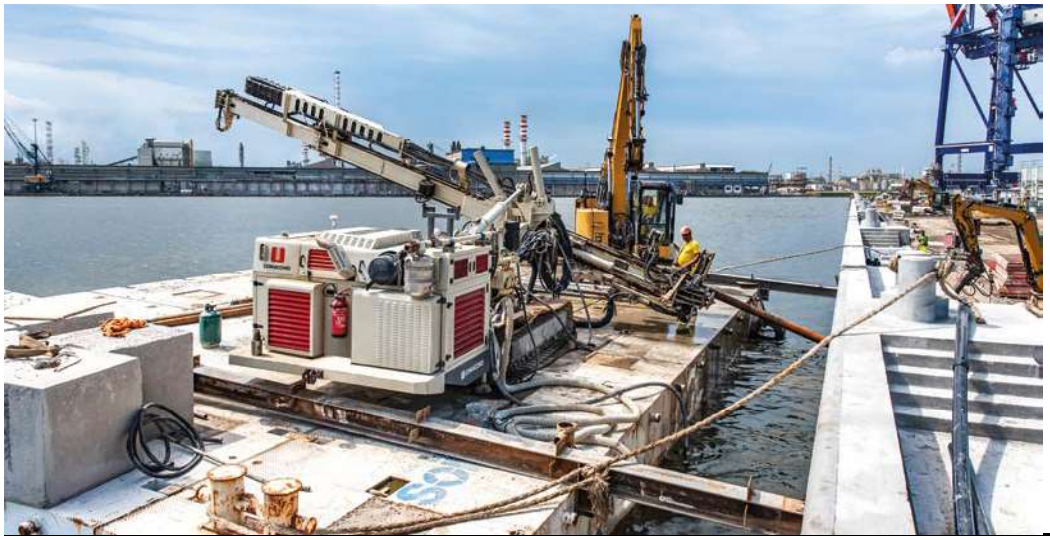
However, the robustness of the structures and the quality of the original materials are very variable. Moreover, due to the highly aggressive marine environment, some of the docks were affected by structural failure of the anchoring system caused by corrosion of anchor head components. Therefore, the design solutions adopted for the reconstruction of the docks were based on a variety of technologies, depending on geological conditions, the design and construction of the existing dock face, its reliability according to the current codes and the risks that have affected the structural integrity of the docks over the years.

EXTENSIVE UPGRADES

Existing structures were re-used, and the current quay line was maintained as far as possible, but an extensive upgrade was implemented to meet the demanding requirements of the Port Authority (i.e. 60kPa of surcharge load as compared to the 40kPa of the existing structures, the use of heavy mobile cranes, excavation of the seabed down to a depth of 12.50m).

The general construction solution adopted for the renovation of the docks envisages a concrete slab (typically 1m thick) placed on a foundation of three or four rows of piles.

The large-bored piles range from 0.6 to 1.2m in diameter depending on the location of the



The new dock wall at the Ravenna Port was anchored using the Dywidag threadbar system in combination with jet grouting technology utilising a Comacchio MC 22 rig

dock face, installed extending into the ground up to 36m below sea level. New anchors are added to provide the structure with horizontal restraint.

Bar anchor systems up to 40m long are installed using jet grouting injection of the bond part of the anchor. Depending on the structural requirements, jet grouting columns were also used for soil consolidation.

In some cases, new quay walls were installed in front of the existing ones using combi-walls and implementing deep vibratory methods to mitigate the liquefaction potential.

MIXED GEOLOGY

The typical subsoil of the Port of Ravenna originated from a recent geological evolution of the Po Plain and includes three main layers: the first, at 13.50m below sea level, is characterised by a sand layer representing the most recent phase of the still active holocenic regression; from 13.50m down to 26m below sea level, a layer of soft silty clay, with small lenses of sand and silt; below this layer are dense, grey sandy silts and silty sands.

Works are currently underway on the IFA, Sapir and TCR Dante docks. All micropiling, anchor installations and jet grouting treatments are carried out by the RCM Costruzioni team using Comacchio equipment.

The Sapir dock (between berths five and seven) extends for approximately 305m. The original structure consists of a 60cm thick diaphragm wall anchored at the top by 11.4m long tie-rods spaced 2m horizontally and tied to three inclined Franki piles. A new combi-wall and bored piles with 1200mm diameter up to -26m were installed as part of the reconstruction project. The new wall is anchored using the Dywidag threadbar system in combination with jet grouting technology. Anchor installation is performed utilising a Comacchio MC 22.

JET GROUTING

In the first phase, a casing is installed through the pockets of the new cope beam and through the original wall cope, reaching the 11.5 free length. Jet grouting rods and tools are used to drill up to the design length of 22m. The soil is grouted with a pressure of 350 bar during drilling, resulting in a very large grout body diameter (800–1000mm) for a 10.5m bond length. The rods are then removed, and the casing is further advanced to facilitate the installation of the 6m long, 47mm Y1050H Dywidag threaded bars.

The project involves the installation of a total of 126 anchors spaced at 2m. The handling of the casings, rods, and anchor bars is made possible thanks to the Comacchio CPH handling system, which allows for longer and heavier tooling, considerably speeding up production and improving safety on site.

Similar technology was adopted on the nearby dock, where anchors were installed up to 32m deep using 114mm pipes with coupling sleeves and a special drill bit with two jet grouting nozzles.

First, the drilling up to 15m deep was performed using water; drilling to the design depth was then carried out with high-pressure injection (350 bar), thus creating a jet grouted bond part with a diameter of 600mm and a length of 17m. In this case, anchor installation was also assisted by the CPH handling system.

BORED PILES

Jet grouting columns are being installed as part of the renovation of the TCR Dante dock, where RCM Costruzioni is currently operating with a Comacchio MC 30. The jet grouting treatment is the final part of the project that has involved the creation of a new combi-wall, followed by the construction of 1200mm bored piles to support the new dock structure. The consolidation with single fluid jet grouting technique involves the installation of six rows of 800mm columns, spaced at 2.5m, extending along the 300m long dock. Pre-cutting with water is used due to the presence of a silty clay layer.

A Comacchio MC 30 rig was used to install 126 columns with a length of 16.7m at a rate of 12 columns per day

The project envisages the installation of a total of 126 columns with a length of 16.7m. Work is running smoothly thanks to the Comacchio MC 30, reaching production rates of 12 columns per day.

The use of jet grouted anchors, in combination with jet grouting treatment of the soil, has proven to be efficient in obtaining high-capacity tie-backs, given the poor soil conditions.

All works were carried out in multiple phases to allow the terminals to maintain operations during construction.

Completion of the Ravenna Port Hub Project is scheduled for 2026. At the same time, a massive investment programme is being implemented to improve the road and railway connections of the Port. Other strategic projects include the creation of a new energy hub connected to the Port, with the addition of a new FSRU (Floating Storage and Regasification Units), a photovoltaic plant, two offshore wind farms and the construction of a Carbon Capture and Storage (CCS) plant. The objective is to make Ravenna an innovative strategic hub in the Mediterranean, connecting East and Central Europe.

"Proven to be efficient in obtaining high-capacity tie-backs"