Connecting two Italian towns

GDI has been given an insight into the works that are underway near the town of Sona, in the province of Verona, on one of the nine transnational corridors forming the Trans-European Transport Network, where tunnel excavation has required the use of ground improvement solutions

Infrastructure development is one of the priorities set by the Italian government to achieve the transition to more sustainable mobility and relaunch the economy after the COVID-pandemic.

Italy plays a key role in the development of a European transport strategy based on an intermodal approach and the nine transnational corridors forming the Trans-European Transport Network (TEN-T). In fact, four of the nine European Corridors cross Italy, one of them being the Mediterranean Core Corridor connecting Northern Italy with the Iberian Peninsula and Eastern European countries.

As part of the Mediterranean Core Corridor, the high-speed/high-capacity (HS/HC) railway line that will connect Milan to Verona is partly open and partly under construction.

One of the segments currently being built, around 48km along the edge of the Po Valley, will link the two cities of Brescia and Verona. The HS/HC railway line will follow the existing A4 motorway for 30km, passing through a tunnel system under the motorway in Lonato del Garda and resurfacing on the Southern side of the A4. The project involves consolidation works for the excavation of the 3.7km long San Giorgio tunnel which will cross the A4 motorway near the municipality of Sona, not far from Garda Lake. The consolidation is carried out with the help of vertical jet grouted columns that are installed from the surface ahead of the excavation face, for a total length of about 400m.

During work on the Mediterranean Core Corridor the contractor Fondamenta Srl has been dewatering between 150 to 250m³ of return spoil every day

TEST FIELD

Before works could start in February 2021, a test field that took several months was set up to clarify the production method and parameters. Among other parameters, the achievable diameters of the columns, strength, drilling accuracy, uniformity, amount of spoil return and disposal of spoil return with varying production parameters were to be defined.

Following the findings obtained from the test field, drilling is carried out with a double fluid jet system with the use of 114mm high-pressure rods. The treatment has a depth of about 25m and the drilling is performed with the help of two Comacchio MC 30 machines in jet grouting configuration, allowing a reach of up to 33m depth in a single pass.

"Each jet grouted column that is built has its own specific profile," explains Ivan Pollazzon, site manager for Fondamenta Srl, the company that was awarded the contract on behalf of the general contractor Cepav due. "The type of treatment varies according to the soil conditions and depth and must follow a precise sequence dictated by the project. Given the number of columns to construct, the deviation required and the variability of the treatment parameters, we have invested in a modern geo-localisation system

that communicates with the data-logger that equips the Comacchio machines. In this way, on-hole positioning is completely automated and extremely accurate, which would be impossible to obtain manually. The drilling and injection parameters are stored in the memory of the data logger, which automatically manages the injection phase for each individual column. The only thing the operator has to do is press a button."

Unlike other systems, treatment depth measurement is not done relative to the working level, but it is measured relative to sea level, thus ensuring maximum accuracy. All drilling and injection data for each jet-grouted column are stored and exported into the daily production reports documenting the project.

"The soil in this hilly area is characterised by the presence of relatively coarse material with a silty matrix up to 10-15m depth, followed by clay layers that are sometimes quite heavy is not easy to treat. We have, therefore, decided to use pre-cutting with water at 350/400-bar, while the cement slurry injection is done at 400-bar," says Pollazzon. "This allows us to reach the 1,200mm column diameter required by the project, even in these challenging ground conditions."

INJECTION PLANT

The injection plant consists of two Metax and Lorenzetto mixing units paired with two Tecniwell TW800 triplex pumps powered by 800hp engines, while the water for the pre-cutting is supplied by two 700hp Metax MP7 pumps capable of delivering about 520L of water at 350/370-bar.

With the help of this state-of-the-art equipment, the crew has managed to obtain production of over 50 columns per day, equal to over 300m³ of injected concrete, working in two eight-hour shifts seven days a week.

Work proceeded on the south side of the highway, for a total of almost 3,600 columns that was completed by mid-August. Subsequently, the motorway was temporary diverted to run over the consolidated area, allowing works to continue to the north along the remaining route of the tunnel, where another 4,200 jet grouted columns are being installed for tunnel excavation consolidation and 600 columns for the two ventilation shafts.

"One of the main difficulties posed by the project was precisely that of working very close to the motorway, a few metres from a transportation artery that runs through the most densely populated and highly industrialised areas in northern Italy, one of the most trafficked motorways of the country. No closing or traffic disruption was allowed. The main requirement was ensuring safety and minimise interference and inconvenience. To 'protect' the motorway we constructed a pile wall adjacent to the carriageway. Pre-cutting with water has allowed the elimination of compressed air which could otherwise have caused potential swelling, explosions and problems, with consequent damage to the motorway.

"On the other hand, we had to invest a lot of resources to manage the spoil return resulting from this process. The volume of the return spoil is considerable and its composition has varying concentration of cement and soil," says Pollazzon.

DEWATERING

The need to dewater about 200/300m³ per day of return spoil has led Fondamenta to invest in a Gennaretti SPACI 22 plant equipped with a decanter centrifuge which allows it to significantly accelerate the drying process. Thanks to a 20m³/h centrifugal pump, 150 to 250m³ of return spoil are processed every day, depending on its composition. The water is completely clarified and put back into circulation through a system of pipes and tanks designed and set up by Fondamenta technicians.

Two Comacchio MC 30 rigs in jet grouting configuration are reaching depths of up to 33m depth in a single pass on the edge of the Po Valley in Italy

"In this way, we can work in an almost closed-loop system. After a pre-treatment phase with a desander that separates the coarse particles, the spoil goes through homogenisation tanks and finally ends up in the centrifuge, which separates both the cement and the remains of silt and clay. The dewatered cake is easily shovelable and can be loaded straight into a dump truck for disposal.

"Thanks to this system we have been able to greatly simplify the handling of the return spoil and recover more than half of the water we consume daily. In addition to economic savings, this has helped us a lot in the job site logistics, which otherwise would have been considerably slowed down due to the large volumes of water," says Pollazzon.

This is not the first time that Fondamenta Srl has been involved in large-scale infrastructure and construction projects in Italy and abroad. The Milan based company has completed the construction of almost the totality of piles supporting the New Bridge in Genoa (built to replace the collapsed Morandi bridge) and took part in Monaco's prestigious L'Anse du Portier (Portier Cove) land extension project.

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