

Innovative and efficient technology, Atlas Copco's contribution to the Oriente Tunnel project.

The solution to road mobility between the Aburrá Valley and San Nicolás, to join Medellín with the José María Cordova International Airport in Rionegro requires all knowledge in Colombian engineering and the latest technology in perforation, to beat the mountain's resistance between the two valleys.

This project is handled by a committee of the 72 most important engineering firms in Antioquia. They work using the highest quality standards and the most advanced Atlas Copco perforation equipment, Atlas Copco is an international Swedish company with more than 140 years of experience in the field, world leaders in innovative mining, tunneling, and road infrastructure equipment.

The project consists of an intersection of the double-lane Las Palmas highway that goes into the twin unidirectional tunnels in the Seminario sector, each 754 meters long. After these tunnels there's an open air road measuring 4,5 kilometers, of which 1,5 kilometers are bridges and double-lane viaducts.

This viaduct joins the tunnels in Santa Elena. These two unidirectional stretches are 8,2 kilometers long reaching a 600-meter road in the San Nicolás valley before finally reaching a viaduct in the Sajonia roundabout, that connects with the airport's road.

Once the project's finished, which is estimated to be delivered by late 2018, the travel time between Medellín and the Jose María Córdova airport will be reduced from 45 to 18 minutes.

"The current road is clogged, it's very hard to use, especially during certain days. An alternate route becomes necessary and that's what the tunnel is solving", says engineer Germán Rueda, manager of the Aburrá – Oriente Tunnel construction concession, and the person responsible for this megaproject's success.

Project's challenges

Since its technical studies, the Aburrá – Oriente Tunnel Connection Project has set great engineering challenges, especially in environmental preservation and protection.

Water sources protection is a subject that reunited the surrounding communities and is a permanent commitment of the engineers.

To preserve these water sources, the Project uses technology that had never been seen before in the country, with strict mitigation methods, which guarantee every law and requirement set by environmental authorities.

These technologies are supplied by Atlas Copco, a company committed with sustainable productivity. It provides perforation equipment, injection pumps and other equipment necessary to guarantee a good performance.

For this Project, the first blasting meters were made using electronic detonators; a novelty in Colombian engineering, as Germán Rueda explains.

“It's the first and only tunnel in Colombia to use electronic detonators, this allows us to control vibrations as there's a large population close to the tunnel, many local residents who would be disturbed by these vibrations”.

“From an environmental point of view, this is one of the tunnels with the least environmental impact, by restricting water and keeping superficial water sources from drying”, adds Rueda.

The management and protection of water became the greatest challenge for this project. A commitment to a strict management of water sources inside the tunnel was necessary to get the environmental license, so as not to disrupt subterranean water flow in the excavation area.

“To achieve it we had to implement micro cement injection technics, of structural cement, polyurethane resin, and colloidal silica. This way we contain water and keep it from entering the tunnel. This sets us apart from every other tunnel being built in the country”, he concludes.

The technological solution

Perforation in the tunnels was made using equipment known as “Jumbos”. In the project there are two Boomer E2C and two Boomer XE3C, using the RCS 5 (Rig Control System) system that automatically controls perforation, ensuring peak precision and a higher productivity.

This is the first time this technology is used in South America, and it is supplied by Atlas Copco to accomplish specific project requirements. The Swedish company has been in charge of training personnel and providing technical support for the correct use of the equipment.

With this system, the perforation points are incorporated into the application and the team is responsible of marking them in the terrain by using laser navigation, which turns the equipment operator into an operation’s supervisor. This way an increase in efficiency is achieved.

In the Aburrá – Oriente tunnel concession, the tunnels are built using the perforation and blasting methods; the Boomer XE3C team, with its RHS (Rod Handling System) system perforates rock up to 25 meters deep, to accomplish pre-injections of micro filtrated concrete, which protect water sources.

“This terrain injections system before excavation, to seal every possible water leak into the tunnel. This way, during perforation and blasting the tunnel is already waterproof. Another consequence of these pre-injections is the sealing and hardening of the clump, which makes it more competent”, assures the project’s building director, José Luis Mancipe.

“In Colombia, this is the first tunnel to use the pre-injections method to control filtration, this is the first tunnel with these sorts of requirements”, concludes Mancipe.

After pre-injections, there’s a 4,5-meter blasting perforation, these perforations are rigged with explosives, which are detonated, left over material is transported to pre established deposits.

Meanwhile, the tunnel is stabilized with concrete, reinforced by fiber and steel bolts. There are four blasting per pre-injection procedure, this way water source safety is ensured.

“Without the sorts of technological innovation in Atlas Copco equipment, tunnel construction would be very slow and risky, because of the uneven terrain and perforation times”, assures Jorge Ávila, equipment and maintenance director in the project.

“In the past, with older equipment we were perforating in 5 to 6 hours what we can do now in 2 because of the performance and technology provided by Atlas Copco equipment, because they only need perforation parameters and then work on their own”, says Ávila.

The challenge is colossal, if one keeps in mind the tunnel length and precision required by the project. Meanwhile a three-armed Boomer XE3C makes its way through the eastern side, and these must meet with a 5-centimeter error margin.

Environmental mitigation

The great challenge, as well as the great achievement of the Aburrá – Oriente tunnel concession, is the environmental management of the project. Since its beginning, rigorous environmental studies were performed, which consisted of terrain incursions and anticipating mitigation plans.

Four months before starting the project, local fauna was scared off, recollected, and relocated; a labor that continues alongside the project. By November 2015, 349 reptiles, 4 birds, 176 amphibians, and 22 mammals were rescued, for a total of 551 specimens.

Also, a forestry use and ecological restoration program moves forward; aiming to minimize impact in the local ecosystems.

Likewise, special care's been kept with nearby hillsides and slopes, which remain under constant monitoring and restoration of their plant layer after use. Open air water flow is also kept under surveillance and control, to ensure its preservation.

“One of our biggest worries in this project has been harm to superficial water sources. Over the tunnel layout there's a significant amount of water sources and a big demand for water in the local population. This is why we perform the pre-injections, to guarantee their conservation. This way we ensure minimal filtration in the tunnel and basically no disruptions above ground”, assures José Luis Mancipe. “Until now, with our constant surveillance and preventive measures, there's been no harm to water sources”, he concludes.

The social responsibility in this project includes employment in the region. The concession includes priority to the employment of locals and has been turned into an economic catalyst in the area.

Atlas Copco's integral service

Atlas Copco's involvement in the Aburrá – Oriente tunnel concession doesn't just involve equipment and technology, it also includes technical consulting, which commits engineer Andrés Julián Valencia, who leads everything related to the technical support provided by Atlas Copco to its customers.

Engineer Valencia is accompanied by Damián Saldarriaga, perforation contract leader, and Eduard Martinez, support technician, who shares his knowledge of everything related to equipment and new technologies provided by Atlas Copco to the project.

“In the project we deliver a thorough accompaniment, which allows us to keep excellent relations with our client”, assures Valencia.

“We don't limit ourselves to deal with supply, we also incorporate a control process that allows us to measure perforation tool's performance, and track it. Based on this data and everything we find in the field we can advise our clients aiming to reduce their cost per perforated meter”, assures Damián Saldarriaga.

However, Atlas Copco's technical support accompaniment wouldn't be complete if they didn't have access to the information of new technologies related to their supplied equipment.

"This equipment allows us to do a follow-up on perforation parameters, data is extracted from them thanks to the RCS technology, which we can visualize in the *Underground Manager*. When we visualize these parameters it's like we could lay eyes on every drill hole, we can check water and rotation pressure, we can find out if the rock is fractured, if it's hard, if the operator advanced too fast, and all this allows us to track and give support to our perforation tools. Thanks to this technology we can maximize our tool's life span", concludes Saldarriaga.

To Edwin Infante, resident engineer in the Eastern portal of the tunnel, the work delivered by Atlas Copco's equipment is excellent. "The trust put on Atlas Copco on a global scale is reflected in this project, the support service and latest technology is unique, and it shows here in the project", he assures.

The Aburrá – Oriente tunnel has turned into a reference for newer infrastructure projects in the country and Colombian engineering, and Atlas Copco contributes with technology and sustainable productivity to this project's success.