

Djebel Ouahch Tunnel



Constantine, Algeria

**Injection
& consolidation work**

Owner :

Agence des Autoroutes (ADA) - Ministry of Public Works

Main Contractor :

Cosider TP

Duration of works:

2017 - 2021 (in progress)



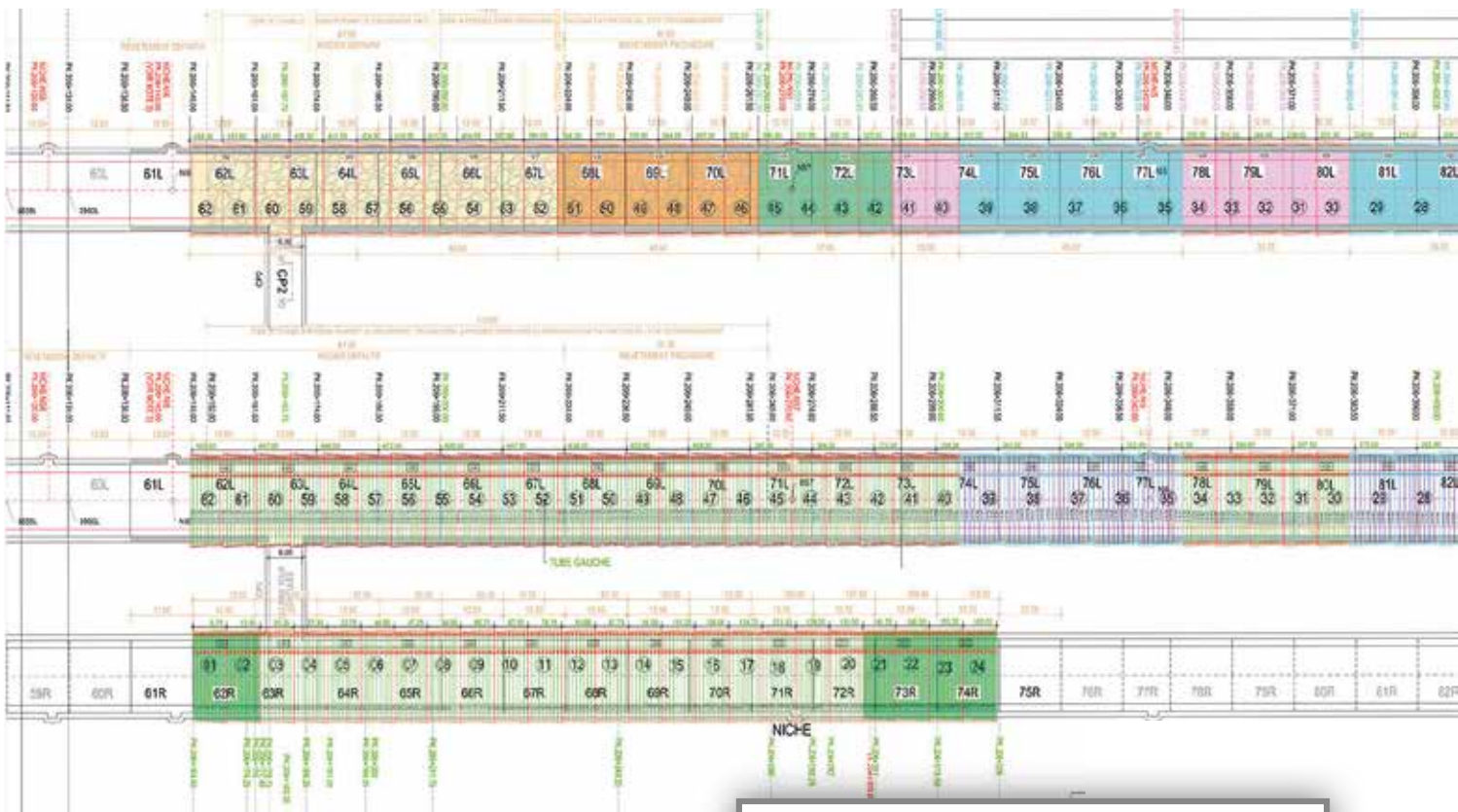
Introduction

Djebel El Ouhch tunnel T1 is part of the East-West Highway, with a length of 1216 km the project was divided into 3 lots West, center and East.

The Eastern lot with a length of 399 km was initially performed by a Japanese group consortium including TREVI participation. The long tunnel of almost 2 km is composed of 2 tubes, one left was always in phase of construction, and the other right one was operational and subject to a collapse on January 1st 2014, obliging the traffic to stop. The project owner decided to award the Rehabilitation works to the National enterprise COSIDER with TREVI as a subcontractor and SWS as the engineering design office .

gerously affected many sites and several highway roads. The main cause of this instability is the nature the conglomerates formation based on heterometric elements cemented by a clayey-sandy matrix, sands and gravels, gypsiferous clay and limestones.

Those materials are permeable and fragile, but certain sands and gravels have a great importance, because they help charge water into the rock massif. Some studies have confirmed that the fundamental role is played by the superficial water, the drainage and the slope effect that accelerate the soil instability process.



Trevi works

The project consisted principally of **consolidation works for the damaged galleries after the top of tunnel has collapsed**, causing the obstruction of the left tube and so many serious damages to the right tube, over a linear of 150 m to the right tube and 470 m to the left tube; the grouting for consolidation was carried out between the two tubes (*from the left to the right*) of the gallery and the left tube enlargement with forepoling and glass fibers rod.

Geology

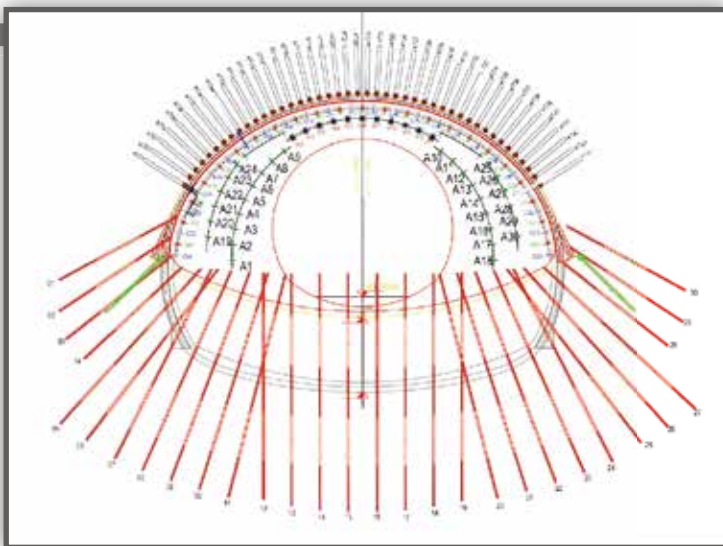
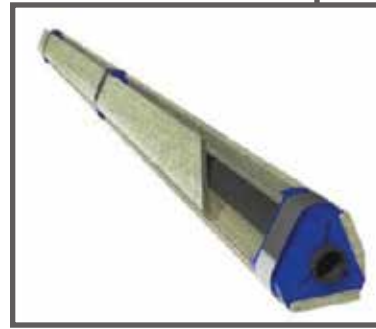
Constantine (*Djebel Ouahch*) is one of the Algerian regions that is mostly reached by the phenomenon of Landslide, because it is situated inside a complex geomorphological environment. The instability of the soil in this region dan-



Consolidation works from the right to the left tube



Fiberglass element used in phase 1 of the work



Enlargement section - Left tube



Niche zone - Right tube

General work phasing

Phase 1

CONSOLIDATION FROM THE RIGHT TUBE

The groutings for consolidation work were intended to reinforce the collapsed area.

Consolidation works are distributed as follows :

- Reinforcing the zone between the tubes by three-plate fiberglass elements
- Reinforcing the top heading
- Reinforcing the outline of the right tube

Phase 2a

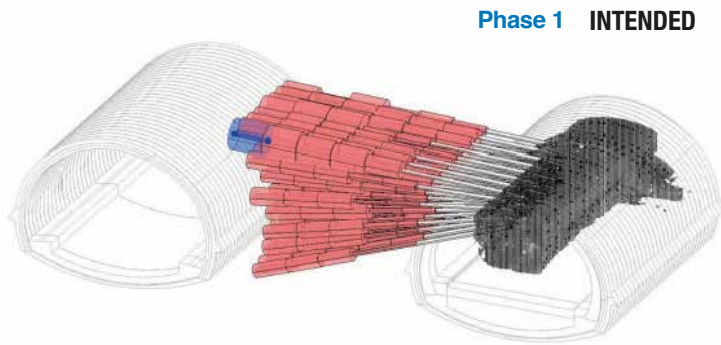
PILOT GALLERY ENLARGEMENT ZONE (LEFT TUBE-NORTH)

According to the approved work studies, a phasing was defined for the drilling and the enlargement of the pilot gallery from the north front of the left tube, this last is defined as a sectioning work progression after implementing the appropriate protection:

Strengthening works:

- Installation of the fiber-glassed bolts 40/60 mm on the front and on the top heading outline.
- Installation of steel tubes (*forepole umbrella*) \varnothing 127 thickness of 10 mm
- Strengthening with bolts of fiberglass the inverted arch

Excavation works and definitive lining (*by Client*)

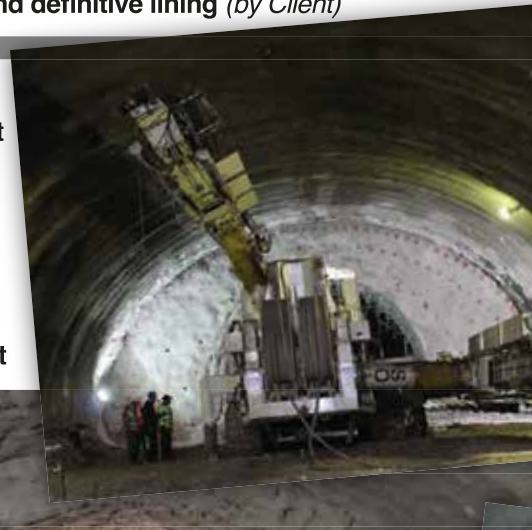


Phase 2a

Strengthening the front with fiber-glassed bolts injected with cement grout

Phase 2a

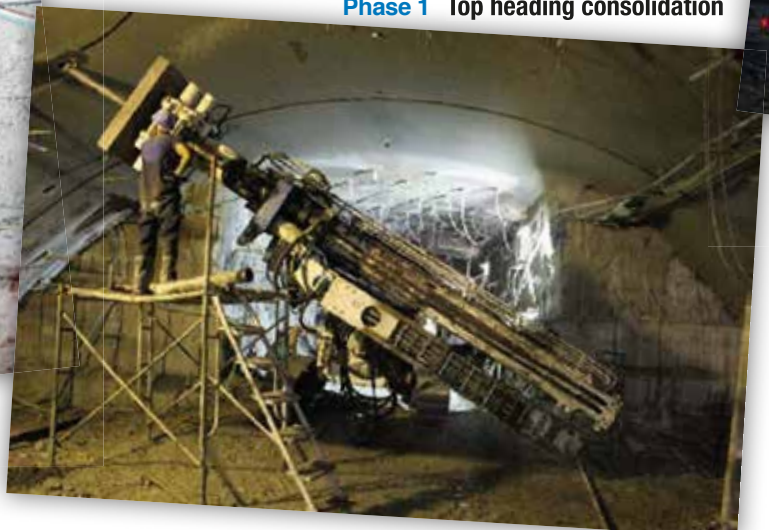
Shotcreting on the front



Phase 1 Top heading consolidation



Phase 1 Consolidation of the zone between the tubes



Phase 2b

COLLAPSED AREA (LEFT TUBE-SOUTH)

The works on this front have started only when a considerable advancement was reached concerning the consolidation work from the right tube.

The phasing executed inside this collapsed zone is defined under a certain number of particularities due to the geological and geotechnical state of the collapsed soil in addition to the existing inverts that need to be demolished as well as the engines buried in the soil.

For this reason, the engineering office has elaborated the phasing as follows :

Strengthening works:

- Reinforcement of the front with fiber glass bolts

- Installation of the fore-poles umbrella
- Installation of the micro-piles at the level of the bench
- Reinforcement of the inverted arch with Fit bolts

Excavation works and definitive lining (by Client)

Phase 3

RIGH TUBE REPAIR (by Client)



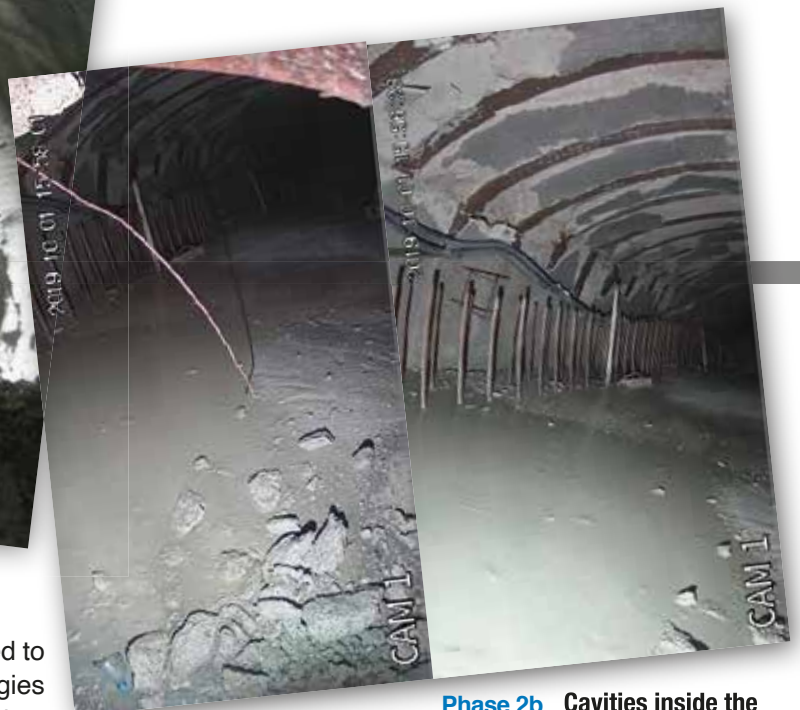
Phase 2b

Phase 2b

Strengthening and filling the collapsed front



Phase 2a



Phase 2b Cavities inside the collapsed area

Conclusion

For better and reinforcement of the areas most exposed to risk on this site, TREVI has delivered certain technologies that helped increase the resistance against landslides. This fundamental solution has erased the cause itself by improving the natural conditions.

71.725 Im

consolidation

with glass fibers

8969 Im

micropiles

82.686 Im

forepoling & preconsolidation
in progress

1690 Im

preliminary survey drilling

Onsite visit of the Italian
ambassador 01.02.2021



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