Anchored walls

VOIE DES MERCUREAUX - HEAD OF BOIS DU PEU TUNNEL

BESANÇON - FRANCE

Anchored walls to reinforce side embankments and portals of a double-tube tunnel head

In the construction of the RN57 Besançon bypass, all that remains is to cross the Bois du Peu anticline, the South-Western extension of the La Citadelle buttress. The boring of a double-tube tunnel requires significant fitting work at the two portals of the tunnels, because of the mediocre quality of the covering soils and the instability of the drainage basin. As a result, the tunnel heads have had to be covered in a specific contract valued at over 12 million, representing half of the cost of the tunnels overall.

Works at the Doubs tunnel head are essential before the tunnel is bored. Anchored walls will have to be constructed to strengthen the lateral embankments and the tube heads.

Geology

Under a layer of scree are alternating banks of marl (loam rock) and limestone. These layers are inclined and cut through with a series of faults. The compartments produced by the faults present net slips.
The tectonic structure is com-

Aerial view of the site

CLIENT:	THE REGIONAL COUNCIL OF FRANCHE-COMTÉ, THE REGIONAL COUNCIL OF DOUBS, CITY OF BESANÇON
CONTRACTOR:	MAJOR WORKS SECTION, DEPARTMENTAL AMENITIES AUTHORITY FOR DOUBS
REPRESENTATIVE:	SOLÉTANCHE BACHY
EXCAVATIONS:	ROGER MARTIN
ANCHORED WALLS:	SIF-GROUTBOR
BLASTING:	RTS
WORKS TO LAST:	JUNE 6 DECEMBER 2004

QUANTITIES REALIZED:

- 15,170m of drilling
- 10,623m of HA bars Ø 40mm
- 189m of HA bars Ø 50mm
- 3,063m of passive ties
- 2,840lm of pipes
- 3,400m² of sprayed concrete, representing 900m² in place

SIF-GROUTBOR SA a SOLETANCHE BACHY Company

Model of the Bois du Peu tunnel head

Carrying out the drilling (Casagrande C6 drilling machine)

plex, as demonstrates the significant division of the cliffs overlooking the Doubs Valley.

CARRYING OUT THE WORKS

Anchoring

The support system relies on a number of geotechnical procedures: HA steel nails 40 or 50mm in diameter, glass fiber nails, 4T15, 5T15 and 6T15 anchor ties, and finally pipes.

The drilling is carried out with an in-hole drill 110mm or 150mm in diameter according to purpose. The 110mm diameter is used for 40mm steel nails, glass fiber nails and pipes. In the scree and highly fractured facies, the drilling frequently has to be tubed.

The drilling parameters (speed of progress, pressure on tool, torque) are systematically recorded and analyzed at each drilling, to verify compliance of the soil with the calculation hypotheses.

Two revolving cranes with 25m and 40m booms respectively operate on the site, and are used for delivery of anchorages to the required points and for lifting and positioning them inside the bore holes. The nails and ties, which can reach 27m in length, are thus introduced relatively easily into the downward bore holes.

The seals, meanwhile, are produced using cement mortar and not cast, because of the heavy fissuring of the limestone rock and the presence of karsts, which necessitate the use of a thick product in order to limit over-consumption. The mortar is injected under controlled volumes and pressures.

Sprayed concrete

The excavations are made by means of successive passes, 1.50m high. The sprayed concrete is 250mm thick ground the nails and 360mm thick ground the anchor ties. It is reinforced with two layers of steelmesh. An Enkadrain B10-25 drainage level is placed on the interface between the concrete and the soil. The dry-cast material has a water/cement ratio of between 0.40 and 0.45.

Results

On this site, located in an area of difficult weather conditions, work has been rapid because suitable means have been applied. The deadlines have therefore all been met. The anchored wall works employed 23 executives, technicians and specialist operators.