Engineering Structures for Life

TRANSPORTS - ROADWAYS

Lisbon's Internal ring roadway (CRIL) - Buraca/Pontinha section

ABOUT

Benfica's Tunnel is part of IC17 – Lisbon's Internal Ring Roadway (CRIL), a perimeter highway to the city of Lisbon. This project is located in a heavily urbanised area. This subsection has improved the accesses in heavily populated areas, as is the case of *Buraca* and *Alfornelos*.

Benfica's tunnel crosses the Águas Livres Aqueduct and the subsidiary Aqueduto das Francesas. Important measures were taken to minimize the impact on these structures.

The tunnel composed by two galleries has a total length of 1446 m. The full extension may be subdivided into 3 distinct zones, according to the specific structural solutions adopted. It has been considered 29 different calculation sections.

Structural solution

The designed solution consisted in a double span reinforced concrete frame, built either by the top-down or cut-and-cover methods. In sections with more severe constraints, with nearby buildings, the top-down method was adopted.

The construction starts with central and lateral piles, then the roof slab. After slab concrete curing, the soil inside is mechanically excavated. The remaining 40% of the covered tunnel was built by the cut-and-cover method, with excavation preceding the execution of foundations, side walls, central columns and the roof slab.

FACTS

Year: 2008-2011
Client: Odebrecht
Services: Detailed design, Tunnel Design and Engineering, Geotechnical Engineering, Structural Engineering, Foundations design, Ground support and earth retaining structures, Geological and geotechnical studies, Excavations and earthworks design, Instrumentation & Monitoring, Consulting and on-site technical support

TEAM

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LOCATION

Lisbon, Portugal

Geotechnical solution

The support structure of the aqueducts is constituted by horizontal micro-piles, executed under the aqueducts and connected to prefabricated panels. The loads of the aqueduct are transmitted to the roof by prestressed bars, allowing the deformations control which resulted from deferred settlements.

The nearby buildings close to the tunnel was another major constraint. The most problematic case was the 11-storey building. Two levels of anchorage and directed drilling were used to avoid damage to the existing structures during the tunnel construction.

Engineering challenges

There were some important constraints in the design of this 2×3 lane tunnel, including nearby buildings, a previously built railway underpass that was integrated into the tunnel, and two underground rivers.

But the biggest engineering challenge consisted in the suspension of the the *Águas Livres* and *Francesas* Aqueducts, dating from the 18th century. Also, a building dated from 620 is located in the center of the tunnel at the union of the *Águas Livres* and *Francesas* Aqueducts, and also had to be preserved.

The structure of the tunnel structure and the support structure of these aqueducts were carefully studied, including a detailed analysis of the displacements, a special shoring and monitoring plan, so that the structure dating from the 18th century could be suspended on the roof of the tunnel, without affecting its integrity.

A delicate and meticulous construction approach was necessary with the purpose of preserving the ancient structures in stone masonry of very poor quality.

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