

13.5 m wide motorway tunnel. In swelling anhydrite rock cross-sections up to 265 m²

Tunnel routier de 13,5 m de large
Section excavée de jusqu'à 265 m²
dans un sol d'anhydrite gonflante

Longueur totale: 2 x 2.350 dont 1.780 m percés en souterrain
Section: 200 m² dans un sol de pierreries meubles et 265 m² dans la zone d'anhydrite
Coût des travaux: 604 millions de DM pour la totalité du projet
Durée des travaux 7/95–11/99
Date de mise en service: 1999

Le trafic routier dans la zone de l'échangeur de Leonberg exige une amélioration fondamentale du flux de circulation. Le tracé actuel au niveau de l'échangeur, le tunnel dans la calotte de l'Engelberg, équipé de deux voies seulement dans chaque sens, et la pente de 6 % de la voie d'accès constituent un goulot d'étranglement. Les travaux de transformation comprennent une jonction entre l'autoroute A 8 et l'autoroute A 81 ainsi que des travaux d'extension et de constructions nouvelles sur la A 8 au niveau de Leonberg.

Au niveau d'Engelberg, l'extension de la A 81 à trois voies plus bande d'arrêt d'urgence dans chaque direction nécessite la construction d'un tunnel à deux tubes. Les sections en sont déterminées par les exigences géométriques imposées par la circulation, les consignes de sécurité, les gaines de ventilation et la géologie des terrains.

Une largeur de chaussée de 13,5 m plus un trottoir d'urgence de 1 m de large sont nécessaires, ainsi qu'un gabarit de 4,5 m pour permettre la mise en place des installations de guidage du trafic. En outre, une extension à quatre voies est nécessaire au niveau du portail sud.

La crête de l'Engelberg est constituée des couches du trias supérieur typiques de la géologie de l'Allemagne du sud. Le tunnel traverse pour l'essentiel du gypse keupérien lessivé avec des bancs irréguliers et brisés d'argilite de faible stabilité avec de faibles affluences d'eau. Une petite section du tracé traverse du gypse keupérien non lessivé et sec de consistance rocheuse. Des interstratifications d'anhydrite et de coresites génèrent de fortes pressions de gonflement en cas d'affluence d'eau.

Les deux tubes du tunnel ont été attaqués du côté nord et leurs tracés sont pratiquement parallèles. Le creusement a été effectué par excavation et à l'explosif. Du fait des caractéristiques de stabilité à prendre en compte, du temps requis pour l'avancement et de la portée des engins, un avancement par sections partielles (jusqu'à 7 sections) pour des sections excavées de 200 et 265 m² s'est avéré nécessaire. L'attaque en calotte subdivisée en trois sections (paroi gauche, paroi droite et calotte) précède l'attaque en banc

(banc gauche, banc droit). L'attaque au radier (gauche, droite) suit l'attaque en banc. L'intervalle entre ces attaques dépend des conditions rencontrées sur le terrain.

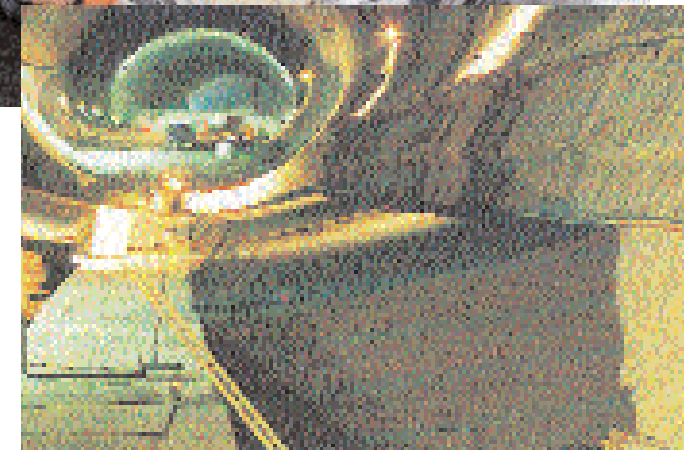
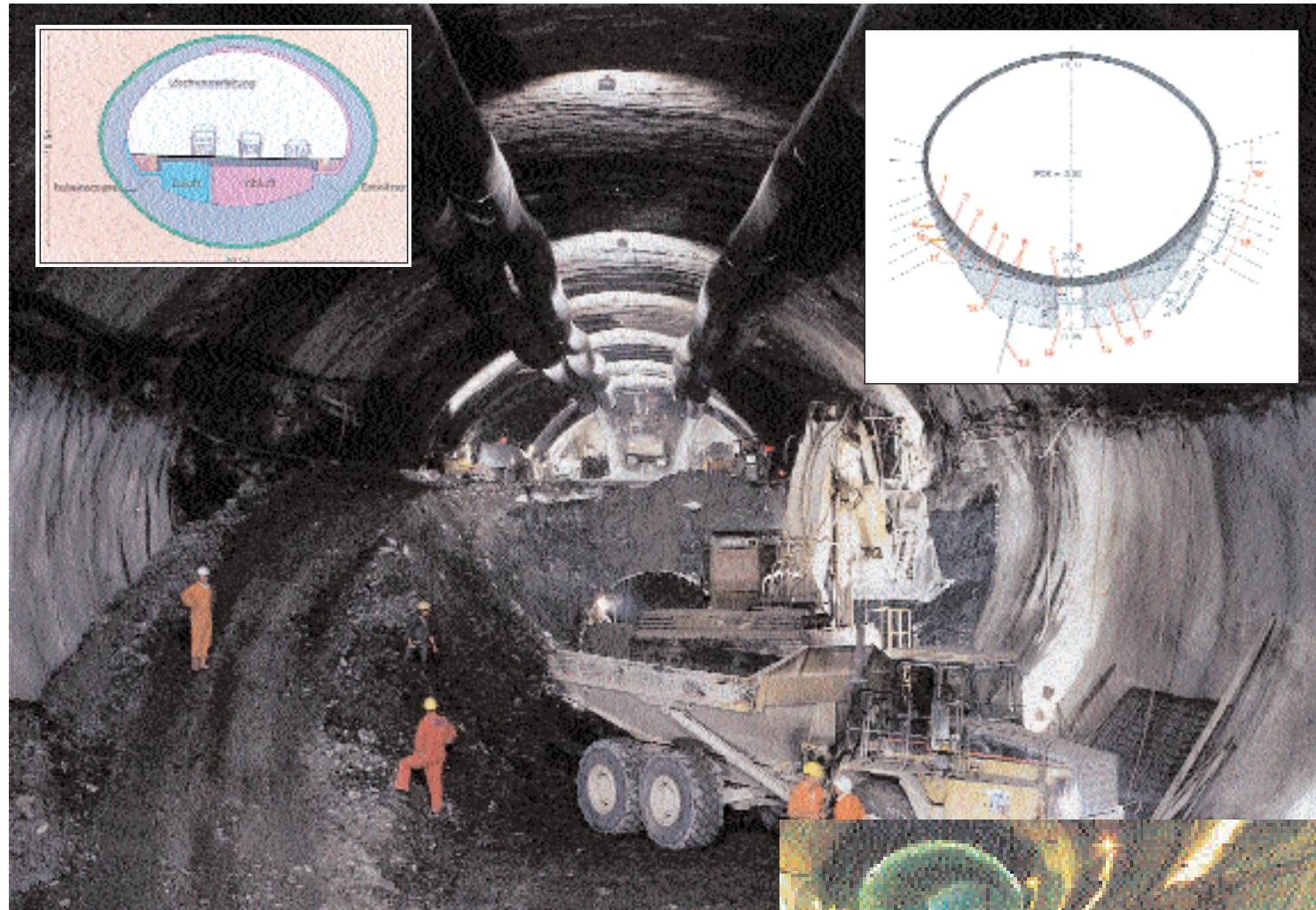
La coque interne du tunnel est réalisée en béton armé B 35 d'une épaisseur de 70 cm dans la section standard. Dans les zones d'anhydrite, l'épaisseur atteint 3 m au niveau du radier et 1 m dans la voûte pour pouvoir absorber les pressions de gonflement. Sur toute sa longueur, le tunnel est étanchéifié sur sa face externe par une feuille de polyéthylène d'une épaisseur de 3 mm.

The daily congestion around the Leonberg motorway hub called for a radical improvement to get traffic moving again. The bottleneck results on the one hand, from the build-up in the cloverleaf, on the other, from the existing Engelberg Tunnel which has only 2 lanes per direction and a 6 % gradient at the portals. The reconstruction project foresees linking up the A 8 with the A 81 as well as the development and new construction of the A 8 in the Leonberg area.

A base tunnel comprising 2 tubes is necessary in the Leonberg area for developing the A 81 to accommodate 3 lanes per direction, as well as hard shoulders. A carriageway width of 13.5 m with an additional 1 m wide emergency footpath at both sides is needed, given a clear height of 4.5 m for traffic guidance installations. Furthermore, an expansion at the south portal to accommodate 4 lanes must also be taken into account.

The Engelberg range comprises Keuper layers typical for South Germany. The tunnel route largely passes through leached gypsum Keuper with irregular beds of broken, low-strength mudstone with some water inflow. A short section of the route penetrates unleached, dry, rocky gypsum Keuper. The anhydrite and coresites to be found there create high swelling pressure in contact with water. Both tunnel tubes were driven exclusively from the north and practically parallel to one another. The heading was accomplished by means of excavators and blasting using the shotcreting method. The cross-section of 200/265 m² was driven with up to 7 part cross-sections on account of the ground stability, the time required per round with supporting and the range possessed by the equipment. The tunnel inner shell comprises reinforced B 35 concrete with a thickness of 70 cm in the standard cross-section. In the anhydrite zone, the tunnel inner shell is up to 3 m thick in the base invert and 1 m in the roof area so that swelling pressures can be accommodated. The tunnel has been sealed with a 3 mm thick, externally placed PE membrane.

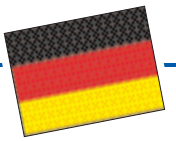
The measure is one of 12 privately pre-financed pilot projects in the Federal Republic of Germany. The financing of the project was one of the requirements in the call for tenders. During the construction phase, the client is not called upon to make any payment. The overall costs are repaid in 15 equal instalments after the project is completed.



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Name of Project/Nom du projet
Engelberg-Basistunnel

Location/Région
Baden-Württemberg

Tunnel Use/Destination du tunnel
Motorway Tunnel

Client/Maitre d'ouvrage
Bundesrepublik Deutschland
(Land Baden-Württemberg, Landesamt für Straßenwesen Autobahnbetriebsamt Heilbronn, Bauleitung Stuttgart)

Consulting Engineer/Planification et direction des travaux
Ingenieurbüro Müller + Hereth
Ingenieurgruppe Bauen

Autobahnbetriebsamt Heilbronn, Bauleitung
Stuttgart mit der Ingenieurgesellschaft Bung und Weidleplan

Contractor/Exécution
Ed. Züblin AG, Bilfinger + Berger Bau AG,
Hochtief AG, C. Baresel AG, Wayss & Freytag AG,
Wolff & Müller GmbH & Co. KG

Total Length: 2 x 2,530 m including a 1,780 m mined section

Cross-Section: 200 m² in soft rock resp. 265 m² in anhydrite

Production Costs: 604 mill. DM for the complete project

Construction Time: 7/95 till 11/99

Date of Completion: 1999

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