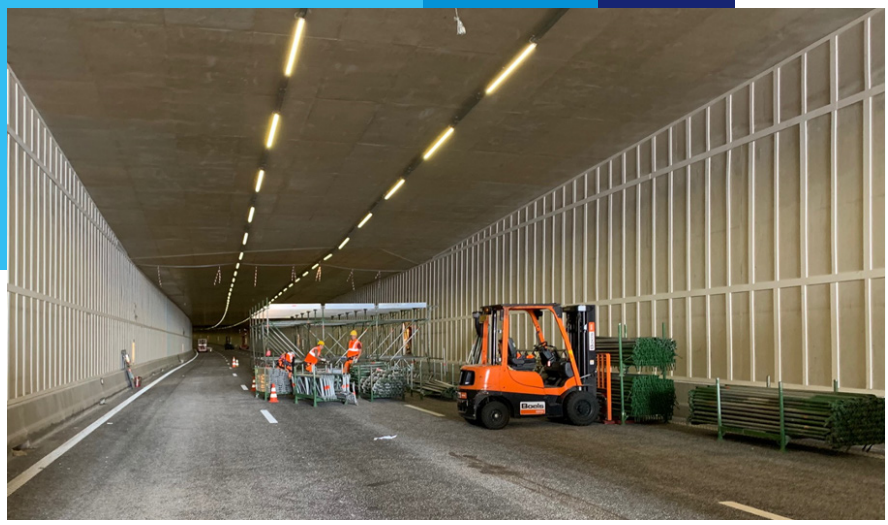
Promat

Case Study

# THE GAASPERDAMMER TUNNEL PROJECT

## How to protect an innovative tunnel project against fire



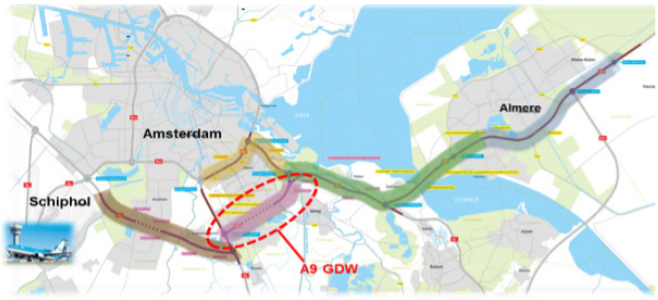
The Gaasperdammer Tunnel is a new tunnel at highway A-9 in Amsterdam in the vicinity of the Gaasp River. The tunnel is part of the DBFM (Design, Build, Finance, and Manage) IXAS consortium, consisting of Ballast Nedam, 3i, Fluor, and Heijmans. The fireproofing installer was KAEFER Construction GmbH-International Tunnel Protection (KITP). The tunnel is three kilometers (1,9 miles) long and consists of 5 tubes. The tunnel is a land tunnel: It is constructed half in-depth, half above ground. Such a land tunnel has two advantages: to increase the capacity for road users and reduce traffic congestion, and to ensure a considerable reduction in noise in the urban areas alongside the tunnel.

## Specifications and Requirements

Certain specifications and requirements existed regarding the fire protection of the Gaasperdammer Tunnel. The concrete tunnel structure had to withstand a 60-minute and 120-minute Rijkswaterstaat (RWS) time-temperature curve in terms of the RWS/TNO (TNO Center for Fire Safety) test procedure 'Fire Protection for Tunnels', 2008-Efectis-R0695. After 60 or 120 minutes, the concrete structure had to exhibit the following: a maximum temperature on the interface of 380 °C; a maximum temperature on the rebar of 250 °C; and no spalling on construal concrete.

## Passive Fire Protection System

A non-spalling concrete mixture called the 'ROK mixture' was used for the tunnel. This mixture had been successfully




tested in 2000. In 2017 RWS retested this mixture and discovered that all the elements started spalling in several minutes. At this point the tunnel was already under construction, and RWS decided to finish the tunnel first, including all the technical installations. Further tests on the bare concrete elements of the tunnel proved to be disappointing: The elements spalled after about 10 minutes. RWS determined, therefore, that the tunnel required another solution: passive fire protection boards fixed with removable anchors. The opening of the tunnel was set for 27 April 2020, with no deviation from that date possible. Promat was the only manufacturer that was able to produce 295.000 square meters of boards in such a short period of time.

## Engineering and Testing the Solutions

Promat was asked to engineer and install the fire protection solutions and to witness the tests. The spalling temperature of the mixtures used in the tunnel had to be ascertained. All the following factors influence spalling:

- The type of concrete and additives
- The time-temperature curve
- The moisture content of the concrete
- The pressure on the concrete slab
- The bending and deformation of the large-scale element
- The expansion of concrete during a fire
- The concrete strength
- The water/cement factor

Promat successfully tested the 60-minute solution with 22 mm PROMATECT®-T. RWS chose to use 25 mm. Promat successfully tested the 120-minute solution with 30 mm PROMATECT®-T mounted on 15 mm PROMATECT®-T backerstrips. RWS chose to use 33 mm.

## Tunnel Technical Installation

Because the tunnel was finished and the Tunnel Technical Installation (TTI) was installed and tested, Promat had to test smart solutions for the first aid boxes and light lines and to make sure that they did not have to be removed. Cameras and speakers were removed and reinstalled in the same spots. Regarding first aid boxes, Promat was fortunate in that there was enough space next to each box for a 30 mm PROMATECT®-T board and that the backside of the box was already protected with a 2 x 20 mm PROMATECT®-T. A 30 mm PROMATECT®-T board with an intumescent strip PROMASEAL®-WF stapled on the backside could be mounted to ensure that the possible gap would be closed. This solution was successfully tested > 120 minutes. Regarding the light lines, the IXAS consortium did not want them removed. Because they were mounted to the ceiling with steel brackets, Promat had to engineer a solution. To prevent heat transfer via the brackets, PROMATECT®-T compound (a PROMATECT®-T mortar) was used to fill the gap around the brackets and half boards were used to protect the ceiling. This solution, too, was successfully tested > 120 minutes.

## Conclusion

The Gaasperdammer Tunnel construction was a project of enormous scope. Included, for example, were 15.000 square meters of pre-fabricated concrete girders to be placed, 235.000 cubic meters of concrete to be poured, 550.000 cubic meters of soil to be removed—and 295.000 square meters of PROMATECT®-T fireproofing to be installed. To a large extent the Gaasperdammer Tunnel represents a remarkable achievement on the part of Promat. Promat produced the required number of fire protection boards within the stipulated time frame, mounted all the boards within a period of ten months, successfully conducted the requisite testing of the structure, and engineered and tested solutions to accommodate first aid boxes and light lines already in place.

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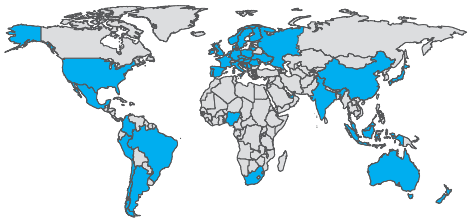
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