



Embankments

Bridging of Sinkholes

Railway Junction Gröbers near Leipzig/Germany

High Strength **Fortrac**® Geogrids protect potential sinkholes



Knoten Gröbers, Aerial view 2001



Active sinkhole

Problem

A railway junction with up to 7 tracks alongside each other is located on a former coal mining area where extraction took place at depths as shallow as 30 m up until the 1930s. The railway embankment, with two tracks for high speed (ICE) trains (up to 300 km/hr), needs to be protected from potential sinkholes and unacceptable settlements (max. 3 mm differential settlement over 1.5 m rail spacing).

Solution

All detected cavities were injected with cement grout. The embankment was then constructed with a special over-bridging system:

- Firstly, a cement stabilised base layer (0.4 m thick);

- Secondly, a mineral layer (0/16 and 0/32), including warning layer, and two **Fortrac**® Geogrid layers with strengths up to 1200 kN/m, reinforcing in two directions (0.95 m thick);
- Finally, an upper cement stabilised bearing layer.

Over the cement stabilised bearing layer, a nonwoven separation layer was placed before installing the frost protection mineral layer in accordance with German Railway regulations DS 836.

As soon as a sinkhole becomes active, the warning layer will register its exact location. Then the **Fortrac**® Geogrids, with aramid yarns longitudinally and polyvinylalcohol yarns in the cross direction, will be activated, reinforcing the





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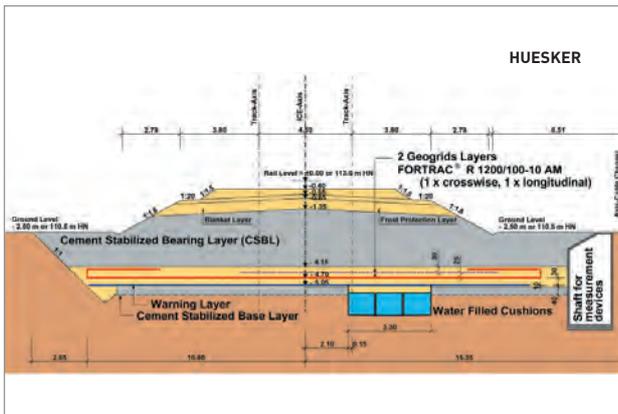
Bridging of Sinkholes



Result of an active sinkhole



Installation of **Fortrac®** Geogrids R 1200/100-10 AM



Testfield Gröbers
Simulation of a sinkhole 4,0 m x 8,0 m



Installation of warning layer and monitoring system

embankment and upper cement stabilised bearing layer (the system having a design life of one month). Within the month, the sinkhole must, and can, be injected without the need to close the railway tracks.

This unique system provides a solution combining a geosynthetic bearing layer with a computer operated warning system, resulting in permanent control of the situation.

Location: Gröbers, between Halle and Leipzig, Germany

Client: German Rail
(DB Projekt Verkehrsbau GmbH)

Design: VEPRO (tracks)
KuK (construction works)
HUESKER Synthetic (geosynthetics)
Glözl GmbH (warning system)

Contractor: ARGE „Knoten Gröbers“

Year of construction: 2000 - 2002

Products: **Fortrac®** R 1200/100-10 AM
including nonwoven
composite warning layer

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