

Embankment stabilisation using Permeation Grouting



INDUSTRY

Infrastructure

STRUCTURE

Sandy soil embankment

PROBLEM

Embankment stabilisation for excavation

LOCATION

WA, Australia

DURATION / YEAR

2016

TECHNOLOGY

Permeation Grouting, Hollow Bar Soil Nails, Shotcrete

BUSINESS UNIT

Mainmark Australia

Summary

As part of a rail upgrade project in Western Australia, to improve urban transport links, an unstable soil embankment needed to be consolidated to allow safe excavation within a railway corridor.

The expansion works required the addition of two spur lines, the creation of an additional 3m of flat ground, drainage installation on either side of the existing rail line, and a new railway station immediately south of the cutting.

The embankment soil was permeable and required stabilisation before excavation of the sandy soil could commence. The engineers' design specified for the large area to be stabilised in an almost horizontal plane, instead of the usual vertical plane.

As the rail line was to remain operational, the work had to be completed without causing any down-time. Due to safety constraints and hazards, the work could only be carried out during daylight hours, when temperatures were high as 54°C.

Mainmark stabilised the embankment using Permeation Grouting to a depth of 5m with ultrafine cement and installed Hollow Bar Soil Nails to provide slip plane control of the sandy embankment, followed by a shotcrete surface application. This provided a weathering surface and retained the grout-stabilised embankment.

The solution delivered safe stabilisation of the embankment, with a design life of 100 years.

Embankment stabilisation using Permeation Grouting continued

Objectives

Mainmark needed to provide stabilisation for a steep slope embankment that could be excavated without the risk of subsidence, then provide a base for a protective layer of a solution that could remain in place for 100 years. The client required the slope to look like natural ground, necessitating a horizontal rather than a vertical approach.

With the rail line servicing thousands of daily commuters, it was not possible to pause operations while the works were undertaken. The risk of high-speed trains interacting with the project materials or workers also needed to be considered and managed, with safety being paramount. Furthermore, overhead power lines were located close to the site, requiring works to be conducted in daylight hours for maximum visibility.

Additionally, it was a requirement that Mainmark complete the works without affecting surrounding residents, ensuring noise levels and traffic interruption were kept to a minimum.

Solution

Mainmark treated the soil by inserting permeation tubes through 3.5m of overburden to an additional 2.5m of depth into the treatment area. As a result, it was necessary to perform a complete and continual levels and layout survey.

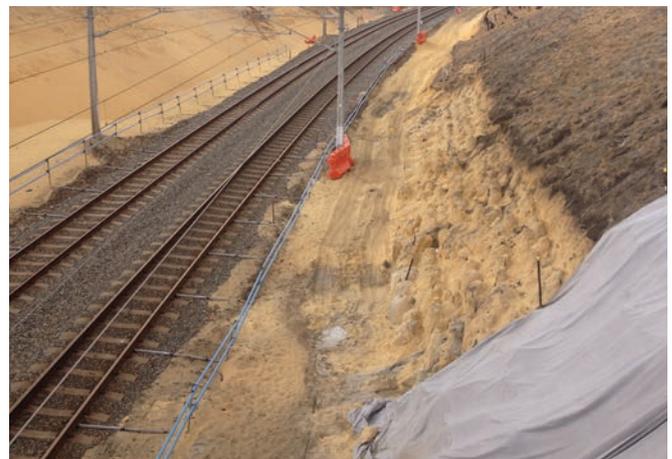
Following treatment, the overburden would be removed and the embankment could be cut and shaped. Mainmark then installed 9m Hollow Bar Soil Nails in a grid pattern, installed drainage, covered it with mesh and then applied shotcrete to the area to a minimum 150mm thickness at 32 MPa.



Installation of 9m deep Hollow Bar Soil Nails

Mainmark used its Permeation Grouting solution because it is the most reliable and widely-used pressure grouting technique. It quickly fills cracks, joints and other small defects in sand, making it ideal to stabilise the embankment.

The project caused no disruption to rail operations or surrounding residents. The railway saved millions of dollars by not having to shut down the line during the works. The result is a stabilised embankment that will remain safely in place for 100 years.



The slope after Permeation treatment and initial cut