PROJECT PROFILE
W 13 L130

mainmark

Mine ROM Bridge Re-supported & Re-levelled

INDUSTRY
Mining

STRUCTURE
ROM Bridge

PROBLEM
Ground substinence

LOCATION
Western Australia, Australia

DURATION / YEAR
12 days / 2013

TECHNOLOGY
Uretek Slab Lifting &
Uretek Deep Injection

BUSINESS UNIT
Mainmark Australia

Above, left: Aerial view of Run-Of-Mine pad and the side-tipper bridge.

Above, right: Centre section of the bridge before and after rectification.

Summary

Latent ground conditions on an iron ore mine site in Western Australia caused the footings of a 600 tonne ROM sidetipper bridge to subside up to 530mm over a 130m2 area. Side-tipper trucks haul loads from the Run of Mine (ROM) stocks and they dump their loads from an overhead bridge at the top of the ROM pad. This feeds the crusher located below.

Our team successfully re-supported the bridge, consolidated the foundation ground and raised the bridge approach footings and re-levelled the structure back to very close to its design levels.

This was achieved without hampering the production output rate of the mine and without the need for demolition or open excavation.

The bridge was corrected in twelve working days. This was done safely: without incident or any disruption.

Objectives

A key objective was to raise the structure as near as possible to the original design levels, whilst also taking into consideration the surrounding structural elements some of which had also subsided.

The other key objective was to strengthen the foundation ground of the bridge as much as possible.

A major aspect of this brief was to devise a method of working without hampering the production rate of the mine, which depended on a continuous flow of trucks delivering their payloads from the bridge and at the base of the bridge.

Solution

First Inspection Test Plan and Construction Risk Assessment Workshop was designed to allow our crew to work safely under the bridge and behind rigid barriers.

Then geotechnical investigation, including DCP testing, was undertaken to determine the weak sub-grade zones.

For the Uretek Deep-Injection process, injection tubes were installed to various depths, ranging from directly below the footings to approximately 6m below ground.

The liquid resins injected through very small diameter tubes followed the path of least resistance (weak soils and voids). The chemical expansion of the resins densified the substrate soil until the force required to compact further was equal to the force required to lift the weight of the ROM bridge structure.

Continuing the injection, the upward pressure of the expanding resins began to gradually lift the structure with a lifting pressure of up to 400kPa.

The need to avoid placing strain onto the surrounding structural elements meant that no particular element of the bridge could be lifted more than a few mm at a time. Every injection point (at approx 50 locations across the site) had to be injected not just once but dozens of times.

Above: Subsided bridge pier. Below: Rig amidst working haul trucks.

Above: Injection of resin simultaneously at 4 points.
Below: One element raised in relation to the adjacent one.

Footing movement was carefully monitored by a number of locally placed laser levels and slab level gauges.

Settlement was not uniform across the site nor even across a single section of footing, eg there was 140mm discrepancy across an 8 lineal meter section. So to ensure that the structure was not subjected to unnecessary strain, lift was limited to 40mm per phase of injection (typical injection area covered 8m^2).

Once the majority of lift was completed, the structure was loaded with additional weight directly over the injection zone. This ensured that soil was compacted enough to support the weight of the structure and the loads that would be imposed on it.

The bridge structure was raised to within ± 4mm of the required levels.

Bearing capacity of the soils was substantially improved in all areas treated (by 330% on average). In some locations it was increased by 550%.

Maximum lift recorded was approximately 530mm and no area failed to be raised to desired levels. Total material injected was 30tonnes: the equivalent of the volume of 50 large concrete trucks being placed under the bridge, all delivered through 16mm tubing.