

M180 CONCRETE ROAD REFURBISHMENT



Introduction

National Highways has embarked on a programme to renew existing concrete pavement on the Strategic Road Network (SRN), where critical failures have focused the need to develop a comprehensive response to the safety concerns associated with this pavement.

National Highway's Area 12 in Yorkshire contains a number of heavily utilised sections of concrete carriageways which need enhanced maintenance including stabilisation, levelling and replacement of existing concrete slabs.

This includes the M180 which runs along the south side of the River Humber, connecting Scunthorpe to the Humber Bridge and Grimsby. Heavy traffic flows, water ingress and uneven settlement have created voids under sections of the concrete pavement making the carriageway unstable leading to failures.

Metrail Construction Limited, as one of the UK's leading road infrastructure repair specialists has stepped up to the challenge in association with Otto Alte-Teigeler GmbH (OAT) of Germany to provide innovative, cost effective and time efficient solutions to support National Highways.

OAT is one of the world's leading experts in the maintenance and renewal of concrete roads both internationally and in Germany, where it plays a major role in maintaining the German autobahn network.

Overview

Project	M180 road rehabilitation between Junction 1 and Junction 3 (5 km stretch)
Executed by	Metrail Construction limited
Duration	4 month
Services	Stabilisation, Levelling, Slab replacement
Procedure	Resin Injection



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Scope of Work

Based on a successful practical demonstration of the techniques involved and extensive technical discussions, main contractor A One+ awarded Metrail the contract to stabilise the concrete pavement on a five-kilometre stretch of the east bound carriageway of the M180 between Junctions 1 and 3.

As an alternative to complete replacement of the running surface of the motorway Metrail has been able to offer a cost effective and long-term solution to stabilise the concrete carriageway. The technique for achieving this entails drilling through the concrete and injecting a highly specialised resin product, which displaces any trapped ground water and fills all voids in the sub-formation thus stabilising the concrete pavement.



Programme

Work commenced in October 2021 and was completed at the end February 2022.

A contra-flow system was put in place to allow unfettered access to the carriageway over the whole of the contract programme.

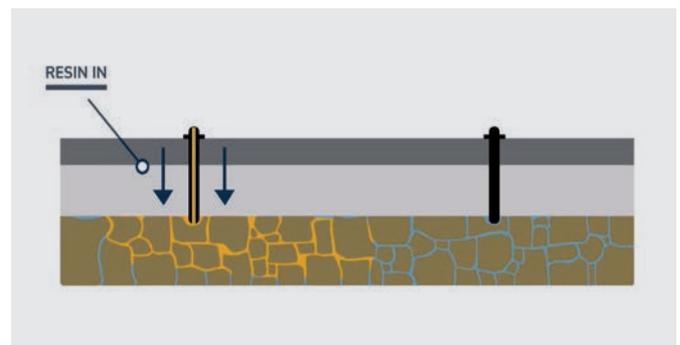
The asphalt running surface over the length of the site was removed prior to the stabilisation programme starting. Once the programme was completed a new asphalt surface was laid and the motorway re-opened to traffic.

Technology

The resin employed has been specifically designed for the stabilisation of concrete slabs on high-speed roads in Germany, where most of the critical roads are built using concrete slabs. This creates a significant maintenance challenge. A particular problem is "rocking slabs" but not exclusively.

The resin is a two-component silicate resin which cures to 90% full strength within 15 minutes. Full compressive strength of c.50n/mm² is achieved within the hour.

The product was developed to have relatively high strength but still with sufficient elasticity to absorb vibration and be crack resistant under load. The resin has a long product life (up to 30years), good adhesion to the upper concrete slab, and excellent penetration and void filling capability.



This product is designed to survive under the road surface, whilst subject to unbalanced loads, combinations of pressure, tension and shear, and the dynamic effects of traffic, for much longer than brittle cement-based systems.

Resin manufacturer, Minova, made sure that a full stock of resin components was available throughout the contract programme to reduce any risk of the project being delayed. The resin, which has a density 1.4 times that of water, is able to force any excess water out from under the slab, unlike traditional cementitious products that are mixed with water. As the market leaders in Germany, OAT use over 400 tonnes of this product a year on the autobahn network.

A key feature of the technique and specifically the formula of the resin, is that the road can be open to traffic 15 minutes after application.

Methodology

Over 20,000 holes needed to be drilled into the concrete slabs between Junction 1 and 3.

Drilling of the concrete slabs is carried out using hand-held drilling tools or an automated drill rig. A standard 600 x 600 mm grid pattern is adopted from the edge of each slab equivalent to one hole per 0.4m².

Packers are mechanically fixed into the holes in the slab which allow the resin to be injected through the slab into the subsoil.

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The resin components are then mixed on site in a specialist mixing unit and pumped into the injection ports in the slab. The resin is injected at a controlled pressure which ensures that any cumulated water is forced out and free spaces/voids are completely filled.



The process is continuously monitored using geodetic equipment. Packer surfaces are mechanically removed and any excess resin is removed from the road surface.

Once the stabilisation programme was complete a second phase of the project to repair and seal the joints between the slabs was carried out using Maxicrete, a proprietary concrete repair system specifically designed to repair defects in concrete pavements.

Conclusion

Measurements taken by James Fisher Testing Services before and after each stabilisation shift using a Falling Weight Deflectometer to record the effectiveness of the process suggest the pavement response has significantly improved after the treatment. The collected deflections for pavement evaluation purposes based on CD 227 mean that the overall stretch of pavement could be classified as Class A.

Metrail's aim is always to deliver high quality work and the Metrail focus on careful planning to ensure safety, quality and on-time delivery has been paramount.

The work is expected to reduce the frequency of roadworks along this busy section, which is used by around 16,000 vehicles a day.

Esref Ulas, National Highways Project Manager has commented that:

“The M180 was built around 40 years ago and has served our customers well but recently we've had to carry out a number of unplanned roadworks on this section due to water damage, which we know has been frustrating for people. This new approach to stabilising the concrete should make those unplanned roadworks a thing of the past. The resin is designed for longevity and should extend the life of the road's surface by another 10 years or more.”



Martyn Sherwood, Managing Director of Metrail said: “The unique formula of the resin used and its rapid hardening capability, which allows carriageways to be opened much more quickly, is cost effective and a gamechanger for concrete road maintenance in the UK.”

