

# M25 B Carriageway J9

## Road Surface Failure Investigation Report



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### Document history

Revision	Purpose Description	Originated	Checked	Reviewed	Authorised	Date
First Draft	For Information	█				24/11/14
Second Draft	For Information	█				3/12/14
Third Draft	Final with Executive Summary	█	█	█	█	16/12/14

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## **Executive Summary**

### **Introduction**

On 13/14 November 2014 Connect Plus experienced a major failure in the replacement of a concrete bay in lane 2 of the M25 near junction 9 on the anti-clockwise carriageway. Connect Plus (CP) has developed an innovative rapid cure concrete product that permits the replacement of failed concrete bays over two consecutive nights, with limited disruption to customers. Concrete surfacing represents approximately 9% of the M25 itself or 38 lane kilometres. Over 200 bays have been replaced to date.

This investigation report has been drafted in consultation with the Highways Agency (HA) and with the full support, knowledge and experience from Connect Plus, Connect Plus Services (CPS) and Balfour Beatty - acting as the Principal Contractor for the works. The facts in this report and the conclusions drawn represent the combined view of the all the parties.

Significant disruption was experienced to customers and network communities following the overnight works to replace three concrete bays. Traffic management was laid out at 10.00 hrs on 13 November to undertake the works and removed before one of the bays had achieved the appropriate strength at around 05.00 hrs on 14 November. The road was then closed by the police from 06:00 until 04.40 the following morning (15 November).

Traffic queues on the anti-clockwise carriageway extended for more than 13 miles, beyond J12. In opening up the road prematurely, damage was caused to approximately twenty five vehicles with one customer reporting a minor injury. The event was widely reported in the media including BBC, ITV, local, national and trade press.

At the core of this investigation, it was found that insufficient control was in place to ensure the product mix was compliant with the CP Design Specification and that there were weaknesses within the management processes that allowed the carriageway to be opened prematurely, putting customers at risk. Although contingency plant and materials were on site during the shift, (including a back-up volumetric mixer), there was no formal plan linked to an escalation process explaining how these resources should be used and when.

Although weather had been fully considered for the planned works, no consideration had been made to the complications of the forecasted heavy rain on any contingency measures should they be needed.

This investigation report focuses on four critical areas; the works methodology, the management of the works, the rapid cure concrete mix specification and the use of volumetric mixers.

### **Execution Methodology and Management of the Works**

The investigating team is satisfied through the evidence provided by contemporaneous records and staff interviews that the execution of the works was in accordance with the Balfour Beatty Method Statement. Records and other evidence from the shift demonstrate that staff and operatives had sufficient experience and competence to deliver multiple bay replacements during a shift.

The planned process was executed following the controls set out in the Balfour Beatty Inspection and Test Plan, a key component to the Method Statement (which forms part of

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the Balfour Beatty Quality Management System). However, the Inspection and Test Plan failed to include as part of the Quality Check Sheet, a clear escalation process at the final hold point, if it was found that the test results had not achieved sufficient strength or temperature. Further, there was an inadequate process and procedure to use the backup resources as part of a contingency plan. In fact there was no formal contingency plan.

A number of recommendations will now be implemented.

A new Site Test Record containing all data for each concrete batch will now be produced which clearly states the acceptable test results required by the CP Design Specification.

A new escalation process will be introduced as part of the Quality Check Sheet, if the test results fail the CP Design Specification.

A new Contingency Plan will be introduced (as part of the Method Statement and Inspection and Test Plan), detailed arrangements for implementation that clearly lays out the organisational structure for escalation. The pre-planning will now include an extended weather window for any contingency measures required in addition to the planned works duration. The Contingency Plan will also include dynamic risk factors including changing weather conditions.

The new Site Testing Record, Contingency Plan, Method Statement and Inspection and Test Plan including the new escalation process will all be subject to a robust briefing to all suppliers before every shift.

Traffic management is put out on the M25 Network around 10,000 times annually by Connect Plus and Connect Plus Services. Staff and operatives are acutely aware of the disruption of Traffic Management to customers and most management processes, method statements and programmes are designed and risk assessed to only work on the road within the permitted hours of 22:00-05:00. On the morning of the 14th November there was heightened pressure on the site staff to remove the Traffic Management before the rapidly-deteriorating weather conditions impacted the early peak traffic levels which in turn would pose an increased risk to the safety of the workforce.

The DBFO Contract Payment Mechanism (Paymech) which includes lane closure charges for over runs, is passed down to the suppliers – in this case Balfour Beatty. There is however no suggestion from this investigation that the teams were additionally incentivised to open the road in favour of avoiding significant lane closure charges.

As part of discussions with the workforce including the site supervisors, there was a general sense that they felt ‘under pressure’ to open the road. All parties involved in this investigation are concerned with this finding and wish to address this key strategic issue as part a wider review with the HA.

### **Rapid Cure Concrete Specification and Batching using Volumetric Mixers**

The rapid cure concrete mix has been developed by Connect Plus over three years, working in conjunction with HA Netserv and the Connect Plus Framework Suppliers including Balfour Beatty. Connect Plus activated a full programme of bay replacements in 2013 following successful trials in 2011/2012. Over one hundred bay replacements were successfully complete in 2013 by the supply chain with a further ninety six during 2014. The Connect Plus annual programme of concrete bay replacements always commences with extensive

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laboratory and off network yard trials. Balfour Beatty conducted 7 trials during 2014 and attended the trials by other suppliers.

Concrete bay replacements require small volumes of rapid strength gain capable of curing to a required strength of 25N/mm<sup>2</sup> in 4½ hours. This 'product' or specialist mix requires the use of an on-site volumetric mixer. The 'product' has high cement content and requires the strict control of water as part of the batching process. A product temperature threshold of 35°C is required to demonstrate adequate hydration of the cement. A final Schmidt Hammer hardness test is also carried out to verify pre-opening strength.

Detailed guidance for the concrete, its constituents and the set-up of volumetric mixers was produced in 2012 and then developed into the current CP Design Specification. The responsibility for the final mix on site lies with each supplier.

It is unlikely that Connect Plus can rely on the results of the chemical analysis carried out on the failed concrete bay, primarily because of the condition of the samples taken. Using data from site however, the parties have concluded that this product batch had excess free water though a higher than expected moisture content in the sand and an incorrectly calibrated water flow meter on the volumetric mixer. The site team had to rework the concrete to achieve a normal final surface texture which, in hindsight, was an early warning that the concrete was not in accordance with the CP Design Specification.

A number of preventative actions have been identified to address this failure.

The Connect Plus Guidance Notes and CP Design Specification will be amended to include requirements for material control testing and volumetric mixer pre-shift set-up.

A specialist materials engineer will now be on call at all times. They will be able to provide advice and participate in the decision making following activation of the escalation process as part of the new Contingency Plan.

Additional audits and spot checks during all future concrete bay replacement works will be undertaken.

Site staff and operatives will be re-briefed on all aspects of the works including the new Contingency Plan, Method Statement and Inspection and Test Plan.

Re-briefing activities will be undertaken to ensure that the staff involved at each stage fully understand the requirements and also the criticality of each test or measure. The implementation of the new Site Test Record for the batch as noted in 2.3.1 will also assist with comprehensive demonstration of compliance.

The parties are satisfied with the investigation that has been undertaken to address the deficiencies in the Method Statement and Inspection and Test Plan and the incorrect control of the concrete batch to ensure compliance with the specified design mix. Given the significant safety risks highlighted by this event the parties will complete further reviews to ensure that future works are designed, planned, completed and handed back safely in accordance with the approved systems of Connect Plus. Connect Plus Services, Balfour Beatty and the supply chain.

This report does not address the operational and communication activities throughout the period of failure and repair between Connect Plus, Connect Plus Services, Balfour Beatty,

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the Emergency Services and the Highways Agency. This will be subject to the normal Cold Debrief that is currently being arranged by the Highways Agency's Emergency Planner.