Oliver Stewart
Senior Executive, RAIB Relationship and Recommendation Handling
Telephone 020 7282 3864
E-mail oliver.stewart@orr.gsi.gov.uk

OFFICE OF RAIL AND ROAD

15 October 2019

Mr Andrew Hall
Deputy Chief Inspector of Rail Accidents
Cullen House
Berkshire Copse Rd
Aldershot
Hampshire GU11 2HP

Dear Andrew,

RAIB Report: Partial failure of a structure inside Balcombe Tunnel, West Sussex on 23 September 2011

I write to provide an update[1] on the action taken in respect of recommendation 2 addressed to ORR in the above report, published on 15 August 2013.

The annex to this letter provides details of the action taken regarding the recommendation. The status of recommendation 2 is **'implemented'**.

We do not propose to take any further action in respect of the recommendation, unless we become aware that any of the information provided has become inaccurate, in which case I will write to you again.

We will publish this response on the ORR website on 16 October 2019.

Yours sincerely,

Oliver Stewart

[1] In accordance with Regulation 12(2)(b) of the Railways (Accident Investigation and Reporting) Regulations 2005

Recommendation 2

The purpose of this recommendation is to prevent the further use of polyester resin anchors where their long-term performance may compromise safety.

Network Rail should implement procedures to prevent the use of polyester resin anchors in circumstances where dampness or shrinkage may affect the safe performance of an asset.

ORR decision

1. Network Rail have revised their procedures for using polyester resin anchors, specifically standard NR/L2/CIV/003 and form 002, which now refers to BS 8539 (Code of Practice for the selection and installation of post-installed anchors in concrete and masonry) with regard to the selection and testing of anchors.

2. After reviewing the information provided ORR has concluded that, in accordance with the Railways (Accident Investigation and Reporting) Regulations 2005, Network Rail has:

- taken the recommendation into consideration; and
- has taken action to implement it

Status: Implemented.

Previously reported to RAIB

3. When we last reported on 15 December 2015 we advised that Network Rail had provided the following update on 23 November 2015:

> *Network Rail remains on target to address this recommendation by 11 March 2016. Closure of this recommendation is dependent on roll out of version 16 of the Tunnel Condition Marking Index (TCMI) reporting template. The proposed TCMIv16 has been completed and is currently subject to the last scheduled field trials for final user acceptance and finalisation. Until field trials are concluded, and the need for any further revisions/ amendments ascertained, some risk remains in the programme. The March completion date includes some contingency to accommodate this, so currently Network Rail has no reason to believe the completion date is at risk at this time.*

Update

4. On 13 September 2019 Network Rail provided a closure statement which included the following summary:
Network Rail has completed the actions noted in the plan submitted to the ORR in February 2014 to address the intention of recommendation No 2 from the RAIB report into the Balcombe Incident. The recommendation action plan was developed following a joint meeting with the ORR on 12th February of 2014 to agree suitable actions to meet the intention of the recommendation.

At this time, Network Rail had rejected recommendation No2 on the basis that it was thought the inference was to ban the use of polyester resin on the NR Network. The rejection of the rec was on the grounds that a blanket ban was an inappropriate and disproportionate response which did not address the applicable fundamental underlying causes identified in the RAIB report.

Network Rail agreed to accept the recommendation on the basis that the intention could be met by undertaking steps to ensure the appropriate use of all types of fixing when designing and specifying works. Actions undertaken:

Part A

- *IP Project Engineers and Works Delivery have been briefed on the relevant points of the Balcombe investigations and the guidelines and standards, published post the Balcombe Incident which should be used by designers when specifying the use of chemical fixings. (BS8539:2012). The agenda and minutes of the IP Buildings and Civils Discipline Review Group meeting held on 2nd of September 2014, together with the presentation delivered are attached for information. Workshops were also scheduled between TS Structure Asset Management/ NR Infrastructure Projects and Network Ops to disseminate lessons learnt from this incident and the actions undertaken to address the recommendations arising from both the RAIB and Network Rail Investigation.*
- *Network Rail organised a specific topic briefing to be delivered by industry specialists on the correct specification, installation and ongoing management of structures with resin fixings. Graham Daws Associates and Orica Limited attend the Structures Community meeting of 12th March 2014 to discuss the correct use of chemical anchors. Minutes of this meeting and the presented information are attached.*
- *Guidance has been placed in Safety Central highlighting that the use of chemical fixings in designs should comply with BS 8539: 2012. This standard has been published since the Balcombe incident and includes requirements for suitable and sufficient site investigation to be carried out to ensure that the correct fixings are specified, that designs take into account site specific conditions and that appropriate measures are undertaken to ensure quality control during installation of fixings. A copy of this Safety Central briefing is included with this closure statement for information Part B*
- *Confirmation has been received from gate keepers within the Civil Engineering, Electrification, Track, Switches & Crossings, Signalling, and Communications disciplines that reviews have been undertaken of all of their Standard Designs and Details (SDD's). No designs have been withdrawn or require amending under the context of this recommendation.*
- *Each gatekeeper completed the review of the designs within their own discipline, looking for SDD's where polyester resin fixings are specified but could be susceptible to shrinkage or damp /wet conditions i.e. where the anchor is acting substantially in tension or where there was insufficient design redundancy.*

UPDATE 10 SEPT 2019: Following ORR Quarterly Liaison Meeting (QLM) on 4 September, ORR has agreed to close the recommendation based on the following updates to NR/L2/CIV/003 that is currently going through post-implementation review. 1) Clause 11.6 should be retained as written; 2) Clause 12.1 stipulates

information that would be required to produce a testing and inspection plan; 3) Form 002 contains an explicit reference to BS 8539 regarding the selection and testing of anchors. Copies of the changes have been provided to ORR which were accepted at QLM.

Previously reported to RAIB

Recommendation 2

The purpose of this recommendation is to prevent the further use of polyester resin anchors where their long-term performance may compromise safety.

Network Rail should implement procedures to prevent the use of polyester resin anchors in circumstances where dampness or shrinkage may affect the safe performance of an asset.

ORR Decision

1. ORR agrees with Network Rail's argument that a blanket ban on polyester resin anchors is inappropriate and disproportionate and that such an approach would be outside of the requirements of this recommendation.

2. ORR considers that Network Rail should take action to ensure that these fixings are not used in circumstances where they might compromise safety. To address this Network Rail has taken the position that the issue of BS 8539 (post the Balcombe incident) resolves the recommendation because designers and engineers following its requirements would lead to the appropriate fixings being specified. Network Rail has, however, made no reference to compliance with this Standard in its Company Standards or Letters of Instruction. It is, however, referred to in the Shared Learning, which is essentially an historical document).

3. Assuming that the relevant text from BS 8539 is sufficient, and ORR has requested details of this from Network Rail, it remains our view that some further action is also required by Network Rail, to ensure that designers and engineers have regard to the Standard. A passive expectation that they will do so is considered unacceptable. This view is supported by the findings of a recent survey carried out by *New Civil Engineer*:

NCE 10-9-2015
Concrete fixings surv

4. ORR also notes that Network Rail's IP electrification team has altered its drawings to refer to BS 8539, which represents good practice that should be followed by other relevant parts of the organisation.

5. ORR is currently reviewing the 'Balcombe Tunnel Rec 2 SDD Review Rev A', provided by Network Rail on 23 November 2015, and will provide a further update to RAIB in due course.

6. After reviewing information received ORR has concluded that, in accordance with the Railways (Accident Investigation and Reporting) Regulations 2005, Network Rail has:

- taken the recommendation into consideration; and
- is taking action to implement it.

Status: *In Progress (from Implementation ongoing).* ORR will advise RAIB when actions to address this recommendation have been completed.

Brief summary of what was previously reported on 18 August 2014

7. ORR was satisfied that Network Rail was taking action to address the risk identified by the RAIB recommendation in an alternative way.

Update

8. On 23 April 2015 ORR wrote to Network Rail seeking confirmation of whether this recommendation had been implemented by the previously expected date of 31 August 2014.

9. On 18 May 2015 Network Rail provided the following update:

> *The actions to address this recommendation are still being progressed by Network Rail. Extensions of time (EOT) requests have been processed against this recommendation, the latest of which notes a closure date of 28th August 2015.*
> *The latest EOT details progress made against the action plan including completed workshops and briefings held in conjunction with Infrastructure Projects and Works Delivery, published guidance on the investigation, specification and installation of post-installed anchors in masonry and concrete, and changes to design standards to mandate positive affirmation of the compatibility of specified materials.*
> *In addition to the above, the latest EOT confirms that Network Rail has completed a review all civils and electrification Standard Design Details (SDD's). The review has concluded that no SDD's exist that are singularly reliant on resin, or that exhibit a lack of design redundancy. Consequently, no SDD's have been withdrawn as a result of the review. Confirmation is still being sought from disciplines other than Civils and Electrification, of the status of their review into their own SDDS's. The latest extension in the completion date to close this recommendation is to obtain this confirmation.*
> *Finally the review of NR standards governing the design and specification of works, the assurance of onsite construction works and the completion of health and safety files is complete. The review noted sufficient clauses within current network rail standards to satisfy the intention of the recommendation.*

10. On 18 June 2015 ORR asked Network Rail for its view on ORR's opinion that SDDs should specifically prevent the use of polyester resin anchors and whether any plans were in place to update the documents to reflect this position.

11. On 28 July 2015 Network Rail provided the following response:

> *The original recommendation action plan was developed following a joint meeting with the ORR on 12th February of 2014 to agree suitable actions to meet the intention of the recommendation. At this time, Network Rail had rejected recommendation No2 on the basis that it was thought the inference was to ban the use of polyester resin on the NR Network. The rejection of the rec was on the grounds that a blanket ban was an inappropriate and disproportionate response.*
> *At the meeting with the ORR, Network Rail agreed to accept the recommendation on the basis that the intention could be met by undertaking steps to ensure the appropriate use of all types of fixing when designing and specifying works.*

Network Rail believes that the 'specific and proactive' prevention of the use of polyester resin neither meets the intention of the rec (to prevent its inappropriate use) nor is based on sound civil engineering principles.
At the recommendation review meeting of 4 June, NR believes that it did not state that the provision of BS8539:2012 would prevent the use of resin anchors, but it does advocate and promote the appropriate use of any type of post installed fixing in masonry and concrete. Its use, in conjunction with appropriate site investigation, correct design and material specification, sufficient quality assurance of the installation (including appropriate inspection and testing) and determination of ongoing management and examination requirements would lead to the correct use of any type of fixing which would include polyester resin in suitable applications.
Network Rail has reviewed all civil engineering and electrification SDD's to ensure no standard design or detail includes the inappropriate use of resin. This action is as identified in the action plan developed following Network Rails meeting with the ORR in February 2014.

12. On 19 October 2015 NR provided the following closure statement:

Network Rail has completed the actions noted in the plan submitted to the ORR in February 2014 to address the intention of recommendation 2 from the RAIB report into the Balcombe Incident.
The recommendation action plan was developed following a joint meeting with the ORR on 12 February 2014 to agree suitable actions to meet the intention of the recommendation. At this time, Network Rail had rejected recommendation 2 on the basis that it was thought the inference was to ban the use of polyester resin on the Network Rail Network. The rejection of the recommendation was on the grounds that a blanket ban was an inappropriate and disproportionate response which did not address the applicable fundamental underlying causes identified in the RAIB report. Network Rail agreed to accept the recommendation on the basis that the intention could be met by undertaking steps to ensure the appropriate use of all types of fixing when designing and specifying works.

Actions undertaken:

Part A

IP Project Engineers and Works Delivery have been briefed on the relevant points of the Balcombe investigations and the guidelines and standards, published post the Balcombe Incident which should be used by designers when specifying the use of chemical fixings. (BS8539:2012). The agenda and minutes of the IP Buildings and Civils Discipline Review Group meeting held on 2 September 2014, together with the presentation delivered are provided for information.


IP Buildings and Civils Discipline Review Actic


NAT-000000-ECV-Standards briefing agend


Chemical Anchors Balcombe RAIB Rec 2

Workshops were also scheduled between TS Structure Asset Management/ NR Infrastructure Projects and Network Ops to disseminate lessons learnt from this incident and the actions undertaken to address the recommendations arising from both the RAIB and Network Rail investigation.
Network Rail organised a specific topic briefing to be delivered by industry specialists on the correct specification, installation and ongoing management of structures with resin fixings. Graham Daws Associates and Orica Limited attend the Structures Community meeting of 12 March 2014 to discuss the correct use of chemical anchors. Minutes of this meeting and the presented information provided.


Structures Community Meeting M


Graham Daws Associates Orica Ltd p

Guidance has been placed in Safety Central highlighting that the use of chemical fixings in designs should comply with BS 8539: 2012. This standard has been published since the Balcombe incident and includes requirements for suitable and sufficient site investigation to be carried out to ensure that the correct fixings are specified, that designs take into account site specific conditions and that appropriate measures are undertaken to ensure quality control during installation of fixings. A copy of this Safety Central briefing is included with this closure statement for information.


Shared Learning NRL14-04 designing ai

Part B

Confirmation has been received from gate keepers within the Civil Engineering, Electrification, Track, Switches & Crossings, Signalling, and Communications disciplines that reviews have been undertaken of all of their Standard Designs and Details (SDD's). No designs have been withdrawn or require amending under the context of this recommendation. Each gatekeeper completed the review of the designs within their own discipline, looking for SDD's where polyester resin fixings are specified but could be susceptible to shrinkage or damp /wet conditions i.e. where the anchor is acting substantially in tension or where there was insufficient design redundancy.

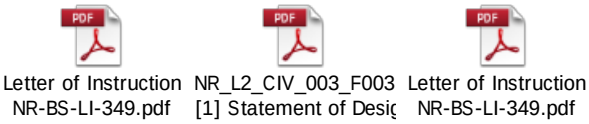
Part C

Network Rail reviewed the following standards governing the design and specification of works, the assurance of onsite construction works and the completion of health and safety file (and the need inform the management regime of the asset - i.e. adapt the Tunnel Management Strategy following works in a tunnel example). Where necessary, revisions have been made as detailed below:

- *NRIL2/INF/02202 reviewed but not revised. Existing clauses mandate that the COM Co-Ordinator and the asset maintainer agree on the content of the Asset Management Plan following such alterations or works. As Built*

drawings indicating these alterations are to be produced with evidence of their existence placed in the Health and Safety File;

- *NR/L3/MTC/089 reviewed but not revised. Clauses confirm the content of the asset management plan, maintenance responsibilities and the maintenance requirements of new or novel products are specified;*
- *NRISP CIV1084 'The Management of Existing Tunnels' has been reviewed but not revised. This standard mandates a requirement to review and amend as necessary, Tunnel Management Strategies (TMS) when maintenance or other works are proposed or completed;*
- *NR Standard NR/L3/CIV/003 "Engineering Assurance of Building and Civil Engineering works" has been reviewed and revised by the publication of Letter of Instruction LI/349. The revision requires designers to make positive affirmation as to the compatibility of materials specified in designs and in consideration of their application. In conjunction with publication of LI/349, Design Forms NR/L3/CIV/003/F002 'Statement of Design Intent' and NR/L3/CIV/003/F003 'Certificate of Design and Check' have all been amended and republished to capture the designers' positive confirmation of materials compatibility.*



Summary

By providing guidance in accordance with BS 8539:2012, by ensuring that no standard designs and details are in use which utilise resin anchors predominantly in tension, subject to prolonged damp or wet conditions, or are lacking sufficient design redundancy, and by reviewing and revising standards and design proformas to ensure that materials are correctly specified, Network Rail has implement procedures to prevent the use of polyester resin anchors in circumstances where dampness or shrinkage may affect the safe performance of an asset. These completed actions prevent the further use of polyester resin anchors in circumstances where their long-term performance may compromise safety.

13. On 23 November 2015 Network Rail provided the following update:

The contents of British Standard BS8539:2012 is appropriate for the design of such installations as those within Balcombe Tunnel. The Standard also goes further to cross reference with European Technical Approvals guidelines (ETAg) for certain materials and design considerations.
In relation to prevention of re-occurrence of the Balcombe failure, the following clauses within the standard are of particular interest:-

- *4.1. Roles and Responsibilities of Designers, Suppliers, Specifiers, Installation Contractors and Testers*
- *5.2 – 5.5 Design Considerations*
- *7.3.6 Installation Aspects Specific to Resin Anchor Systems*

- *7.6. Installing Anchors in Masonry*
- *8 Supervision*
- *9 Testing*

14. Network Rail also provided a copy of ‘Balcombe Tunnel Rec 2 SDD Review Rev A’ which provides outputs from each of the individual disciplines that undertook a review of their Standard Design and Details.

Balcombe Tunnel Rec2 SDD Review Rev