Rail Accident Investigation Branch

Rail Accident Report

Collision at Exeter St Davids station
4 January 2010

Department for Transport

Report 10/2010
June 2010

This investigation was carried out in accordance with:

- the Railway Safety Directive 2004/49/EC;
- the Railways and Transport Safety Act 2003; and
- the Railways (Accident Investigation and Reporting) Regulations 2005.

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Contents

Preface

1 The sole purpose of a Rail Accident Investigation Branch (RAIB) investigation is to prevent future accidents and incidents and improve railway safety.

2 The RAIB does not establish blame, liability or carry out prosecutions.

Key Definitions

3 All dimensions and speeds in this report are given in metric units, except speed and locations on Network Rail, which are given in imperial dimensions, in accordance with normal railway practice. In this case the equivalent metric value is also given.

4 References to the trains involved in the collision are made relative to their origin or destination. The train that struck the train in platform 1 is referred to as the Barnstaple train. The stationary train in platform 1 that was struck is referred to as the Waterloo train.

5 The report contains abbreviations and technical terms (shown in *italics* the first time they appear in the report). These are explained in appendices A and B.

The Accident

Summary of the accident

6 At around 19:25 hrs on 4 January 2010, a passenger train from Barnstaple arriving in platform 1 at Exeter St Davids station collided with the rear of another passenger train which was stationary in the platform (see figures 1 and 2).

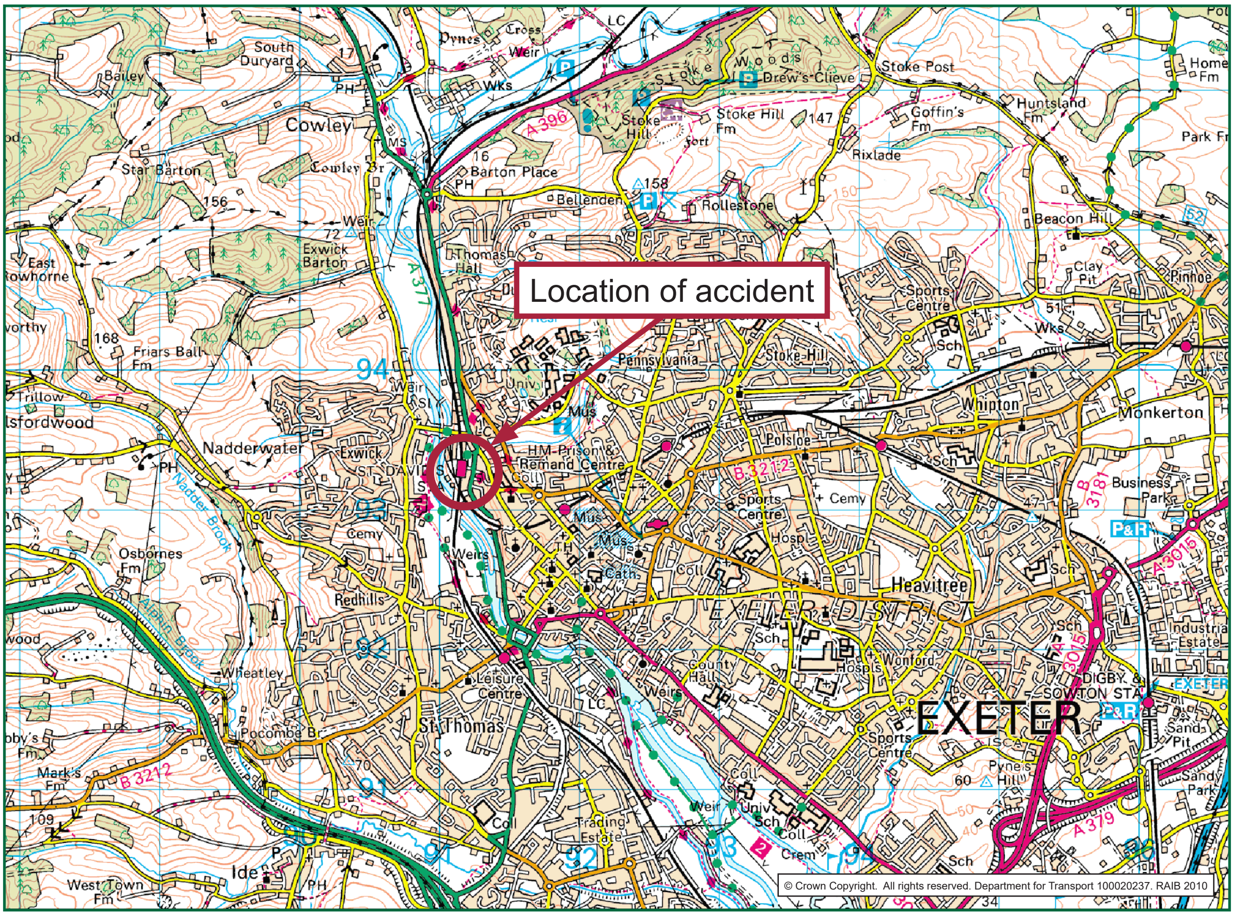

Figure 1: Extract from Ordnance Survey map showing location of accident

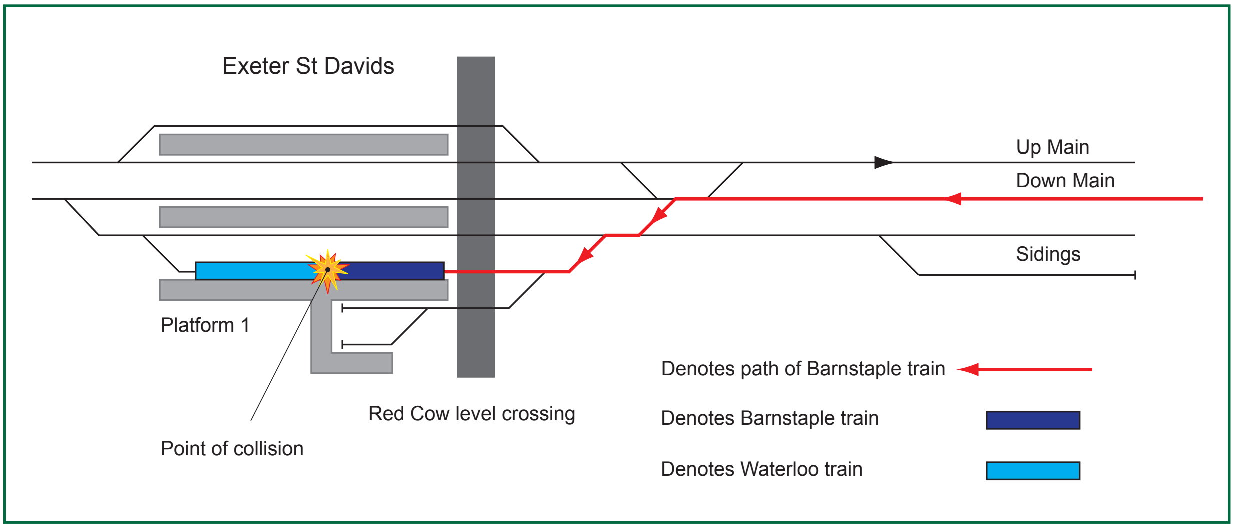

Figure 2: Layout of track and path of train involved

7 The driver of the train from Barnstaple had applied the brakes to stop behind the other train, but the train did not stop and a collision occurred at a speed of approximately 11 mph (18 km/h).

8 The collision caused injuries to six passengers and three members of staff. Four passengers were taken to hospital although none of them were detained. Both trains suffered minor damage.

Organisations involved

9 The train from Barnstaple was operated by First Great Western (FGW), who also employed the driver and conductor. The train was sub-leased from Northern Trains Limited who leased the train from Angel Trains. FGW maintained the train in accordance with Northern Trains' maintenance standards.

10 The stationary train in platform 1 was destined for London Waterloo and was operated by South West Trains, who also employed the driver and conductor.

11 Network Rail owns and maintains the track at Exeter St Davids station and Red Cow level crossing located on the eastern approach to Exeter St Davids.

12 Devon County Council applied road salt to the highway approaches on both sides of Red Cow level crossing but not to the crossing surface itself.

13 FGW, Network Rail, South West Trains and Devon County Council freely co-operated with the RAIB investigation.

Location

14 Exeter St Davids station is located on the main London Paddington to Penzance route. Five through platforms are provided. The collision occurred in platform 1 which is around 300 metres long and on a falling gradient of 1 in 287 for a train approaching from Barnstaple. The maximum speed at which trains are permitted to enter platform 1 is 25 mph (40 km/h). The signalling arrangements allow two trains to share platform 1 at the same time. This is scheduled to occur twice each day.

15 On the immediate approach to platform 1 from the east end of the station, trains pass over Red Cow closed circuit television (CCTV) level crossing (see figure 2). This level crossing is situated on a busy road linking the A377 with the Exwick area of Exeter.

16 The level crossing is provided with road traffic signals and full width barriers across the roadway. The barrier lowering sequence is initiated by the signaller who also operates a 'crossing clear' button, which enables railway signals to be cleared for approaching trains once the level crossing is seen on a monitor in the signal box to be in a safe state. The monitor is linked to CCTV cameras at the level crossing.

External circumstances

17 It was a clear and cold night. The temperature around the time of the accident was -4°C. The *dew point* was -5°C and the level of humidity was 93%. There was a light northerly wind.

Train(s) involved

18 The train from Barnstaple was formed of a class 142 'Pacer' diesel multiple unit (see figure 3). The train comprised two vehicles. It was around 31 metres in length and weighed 50 tonnes. There were 12 passengers and two members of crew on the train.

Figure 3: Class 142 'Pacer' unit involved in the accident at Exeter St Davids

19 Each vehicle on a class 142 unit has one axle at each end; a total of 4 axles per two-car unit. The trains are equipped with a three-step brake[1] that applies directly to the train wheels.

20 The Waterloo train was formed of two class 159 diesel multiple units coupled together to form a six-car train. The length of this train was around 135 metres and it weighed around 230 tonnes. There were nine passengers and two members of crew on the train.

Events preceding the accident

21 Around seven minutes before the collision, the train that was to form the 19:27 hrs South West Trains service from Exeter St Davids to London Waterloo arrived in platform 1 from sidings located to the east of Exeter St Davids station.

[1] The three normal braking positions on the class 142 unit are designated steps one, two and three. There is also an emergency braking position. Step one is the minimum braking position. Step three is equivalent to the maximum braking position. The emergency position guarantees the correct operation of the brakes in the event of an electrical control system failure but provides no increase in brake performance above that obtained from step three.

22 As soon as this train had passed over Red Cow level crossing, the barriers were lifted to enable road traffic to cross. Among the vehicles using the crossing was a road-salt spreading lorry. A total of 18 road vehicles passed over the crossing before the barriers were lowered again for the train from Barnstaple.

23 The driver of the Barnstaple train received the correct sequence of signals approaching platform 1 at Exeter St Davids station. The signalling sequence warned the driver that part of the platform was already occupied by another train.

24 The on-train data recorder (OTDR) showed that the driver made a step 1 brake application in the vicinity of Red Cow level crossing. This was around 139 metres from the rear of the Waterloo train. At this point the train's speed was 17 mph (27 km/h).

Events during the accident

25 Four seconds after the brake was applied, the wheels monitored by the OTDR started to slide. On realising that the train was not decelerating as expected, and that a collision might occur, the driver applied the train's emergency brake.

26 The train continued to slide for a further 100 metres and collided with the Waterloo train at a speed of around 11 mph (18 km/h).

Consequences of the accident

27 The collision caused injuries to six passengers and two members of staff on the Barnstaple train and one member of staff on the Waterloo train. Four of the injured passengers were taken to hospital although none of them were detained. Both trains suffered minor damage.

Events following the accident

28 Members of staff who witnessed the collision contacted the signaller to report the accident. They also called the Devon and Cornwall ambulance service to request assistance. Several members of staff offered assistance to the injured.

29 The signaller reported the accident to the control offices of Network Rail, the British Transport Police, South West Trains and FGW. On-call personnel were immediately dispatched to site with the first arriving around 20 minutes after the collision.

30 Following an examination of both trains to ensure they were in a safe condition to move, they were authorised to proceed, out of passenger service, to their depots for post-accident testing. The rail head from Red Cow level crossing into platform 1 was also examined. Platform 1 was reopened for normal working from 23:00 hrs.

The Investigation

Sources of evidence

31 The following sources of evidence were used:

- witness statements;
- OTDR data including that from the trains involved in the accident and other trains that reported low adhesion over Red Cow level crossing;
- OTDR data from other class 142 units approaching stationary trains in platform 1;
- CCTV recordings taken from the Waterloo service in platform 1;
- voice recordings;
- site photographs and measurements;
- weather reports for the Exeter area from December 2009 to February 2010;
- Network Rail track and level crossing information and maintenance records;
- testing and analysis of material found on swabs taken from the rail head and the wheels;
- FGW train maintenance records;
- FGW operational documents;
- Devon County Council salting records from December 2009 to February 2010 and salting lorry calibration records;
- research into the causes of low rail adhesion;
- Railway Group Standards concerning the fitment of *sanding* equipment; and
- previous RAIB investigations that had relevance to this accident.

Key facts and analysis

Identification of the immediate cause[2]

32 **The immediate cause of the accident was that the application of the brakes did not stop the Barnstaple train before it collided with the Waterloo train.**

Identification of causal[3] factors and contributory factors[4]

Low adhesion

33 **The driver of the train from Barnstaple applied the brakes in step 1 when the train was still 139 metres from the rear of the Waterloo train. When the driver applied the brakes, the wheels locked up after four seconds, severely affecting the deceleration of the train. Low adhesion at Red Cow level crossing and at the eastern end of platform 1 at Exeter St Davids station was a causal factor in this accident.**

34 The RAIB investigated low adhesion events in autumn 2005[5]. It described the relationship between adhesion and braking performance as follows:

> 'Levels of adhesion between wheel and rail are normally expressed as a coefficient of friction (symbol μ). The lower the value of μ, the lower the adhesion between wheel and rail. Typical values for μ for dry rail would be at least 0.20. In wet weather, this can fall to 0.10. Under severe low adhesion conditions, the value of μ can drop below 0.03. As trains rely on the coefficient of friction between wheel and rail to stop, the level of adhesion available is critical to the rate at which the train can decelerate. Many modern trains have four or five fixed braking rates available to the driver, the lowest of which will normally achieve a deceleration rate of 0.3 m/s^2 and the highest a rate of at least 1.2 m/s^2. Although the relationship is not exact, a braking rate of 0.3 m/s^2 can only be achieved if the value of μ is at least 0.03. The value of μ would need to be at least 0.12 to achieve an emergency braking rate of 1.2 m/s^2.'

35 The class 142 unit has a three-step brake system (see footnote to paragraph 19). In Step 1, it will normally achieve a deceleration rate of between 0.25m/s^2 and 0.3 m/s^2. The train from Barnstaple began to slide when the driver applied the brake in step 1. It can therefore be inferred that during the accident on 4 January 2010, the available level of adhesion between wheel and rail was below 0.03.

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[2] The condition, event or behaviour that directly resulted in the occurrence.

[3] Any condition, event or behaviour that was necessary for the occurrence. Avoiding or eliminating any one of these factors would have prevented it happening.

[4] Any condition, event or behaviour that affected or sustained the occurrence, or exacerbated the outcome. Eliminating one or more of these factors would not have prevented the occurrence but their presence made it more likely, or changed the outcome.

[5] Autumn Adhesion Investigation, Part 3: Review of adhesion-related incidents, Autumn 2005. RAIB report 25 (Part 3)/2006

36 Adhesion levels are sensitive to environmental conditions. Moisture can mix with minute amounts of contaminant on the rail head to cause low adhesion conditions which are only present for a short period of time. This is because the critical factor is normally not the contaminant itself, but the amount of moisture that is present. The lowest level of adhesion is likely to be present when there is a small amount of moisture present, which is why low adhesion incidents rarely occur during periods of heavier rain. Small amounts of moisture on the rail head can be caused by drizzle, dew, light snow and frost.

37 Following the collision a series of rail head swabs were taken from both rails between the eastern side of Red Cow level crossing and the point of collision, a distance of over 100 metres. The leading and trailing wheels of the class 142 unit were also swabbed. The analysis of the swabs did not show the presence of any known contaminants that can affect adhesion such as oil or leaf debris. This does not mean that contamination was not present, but rather that detection of the causes of contamination can sometimes be problematic.

38 Further low adhesion events were reported by train drivers at Exeter St Davids station on 6 January and 11 January 2010 (see paragraph 70 for further information on the latter incident). The factors common to all three occasions were that humidity was around 93% and it was cold and frosty.

39 It has not been possible to establish the exact cause of the low levels of adhesion present at Exeter St Davids at the time of the collision. However, the likely cause is the presence of moisture on the rail head, possibly reacting with minute amounts of contaminant.

40 FGW, South West Trains and Network Rail conducted a joint investigation into the accident and also concluded that it was not possible to establish the cause of the low levels of adhesion present. However, they did identify ice/frost and a leak from the canopy of platform 1 as possible sources of moisture on the rail head. They also considered that chlorine found on rail head swabs may have been indicative of the presence of salt. The team conducting the joint investigation thought that the chlorine could have melted the ground frost forming on the rail at the prevailing sub-zero temperature, and the combination of the chlorine and the moisture from thawing frost contributed to the presence of low adhesion. This issue is discussed further in paragraphs 48-54.

The lack of sanding equipment on the class 142 unit

41 **The class 142 unit was not equipped with a sanding system. The use of sand as a means of improving adhesion between the wheel and rail is well-established and of proven value. The lack of sanding equipment on the class 142 unit was a contributory factor in this accident.**

42 The application of sand when the driver realised that the train was sliding may either have prevented the accident or reduced the speed of the collision. It is likely that sand would have improved the level of adhesion sufficiently to sustain a step 1 brake application, but it may not have been enough to sustain a brake 2 application. As the RAIB's analysis shows that some step 2 braking may have been necessary to stop the Barnstaple train before it collided with the train ahead (see paragraph 59), it is not certain that the availability of sand would have prevented the collision, but the impact speed would have been significantly reduced.

43 The class 142 unit is specifically excluded by Railway Group Standard GM/RT 2461 'Sanding Equipment Fitted to Multiple Units and On-Track Machines' from being equipped with sanders. The standard mandates that there should be six axles behind the point at which sand is delivered. The class 142 train has only four axles in total.

44 This exclusion is aimed at mitigating the risk of sand preventing direct contact between the wheels and rails leading to a wrong-side *train detection* failure on lines where *track circuits* are used to detect trains.

45 This accident occurred outside the period when Network Rail applies adhesion-improving measures such as water-jetting to clean the rail head. Although low adhesion is often associated with autumn, and is prevalent at that time, some of the factors that contribute to low adhesion mean that isolated incidents can occur at any time of the year (paragraph 36). It can sometimes exist for a relatively short period of time before changes in environmental conditions result in an improvement in the level of adhesion available. The transient nature of low adhesion makes predicting where and when it will occur difficult and places greater emphasis on the need to equip trains to deal with low adhesion conditions at all times.

46 Most rolling stock operating over the main line network is equipped with a wheel slide protection (WSP) system, although FGW's class 142, 143 and 153 units used on local services in the south west are not. A WSP system detects when train wheels are sliding and releases/re-applies the train's brakes in order to maximise the rate of retardation for any given level of adhesion. Thus, while sanding is aimed at improving the level of adhesion available, a WSP system is primarily aimed at optimising use of the prevailing level of adhesion.

47 The class 142 unit involved in the collision at Exeter was not equipped with a WSP system. However, the RAIB does not consider this to be causal or contributory to the accident because the point at which the train started to slide was too close to the rear of the stationary train and the level of rail head adhesion too low, for a WSP system to offer any significant benefit. The level of adhesion available was unable to support a brake application in step 1 (paragraph 35). Braking in step 1 and a small amount of step 2 was necessary for the Barnstaple train to stop before reaching the Waterloo train (see paragraph 59). Even if a WSP system had been able to maximise the train's rate of retardation given the prevailing conditions, it would have been below the rate normally achieved in step 1 and the impact speed would not have been significantly reduced.

Other factors considered

The presence of chlorine on the rail head

48 The swab samples taken after the accident (paragraph 37) did identify that high levels of chlorine were present on many of the samples, including those of the leading wheels, the rails within the platform area and the rails at Red Cow level crossing. However, this was not considered causal or contributory to the accident.

49 A possible source of chlorine was from corrosion of the rails, due to their reaction with the salt used by local authorities to treat road surfaces. The road on the approach to Red Cow level crossing was treated with road salt shortly before the arrival of the train from Barnstaple (paragraph 22).

50 The road approaches either side of Red Cow level crossing have been treated as part of Devon County Council's road salting programme since the 1960s. The salt spreading system, which is linked to the vehicle speedometer, automatically maintains a spread rate of $10g/m^2$. Between 21 December 2009 and 11 January 2010, salt was applied on the road approaches to Red Cow level crossing on 36 occasions to prevent icing in sub-zero temperatures.

51 It is the policy of Devon County Council to apply road salt to the road surface as far as the stop line on the approach to the level crossing. The operator of the vehicle spreading the salt switches off the spreading system at that point and does not switch it on again until the vehicle is clear of the stop line on the other side of the level crossing.

52 Although the road salt may not have been directly applied to the level crossing surface and rails, it is possible for road vehicles to transfer the salt onto the level crossing from their tyres. Any salt that is transferred in this way can be further transferred along the railway by the wheels of passing trains.

53 A further series of rail head swabs were taken following a reported slide in the vicinity of Red Cow level crossing on the night of 11 January 2010 (see paragraph 70). The analysis of the swab samples showed small amounts of chlorine present, and only on some of the swabs.

54 The RAIB reviewed evidence from OTDR downloads from other trains that reported low adhesion after passing over Red Cow level crossing on the approach to Exeter St Davids. Records indicating when salting had taken place in the vicinity of the crossing were also reviewed and compared with the reported low adhesion events. The review did not identify a relationship between the time of the low adhesion reports from train drivers, and the time that salt had been applied to the road approaches to the level crossing. It is therefore unlikely that road salt drawn onto the level crossing and along the railway caused low adhesion on the evening of 4 January 2010.

The driving of the train

55 The driver's handling of the train on the approach to the stationary Waterloo train in platform 1 is not considered causal or contributory to the accident.

56 The driver of the Barnstaple train had been driving trains in the Exeter area for nine years. In October 2009 he had been involved in training new drivers to deal with low adhesion conditions. This training included dealing with an all-wheel slide on a class 142 unit.

57 The RAIB carried out a review of the driver's approach to Exeter St Davids station using data from the train's OTDR. The review included a comparison with OTDR data from other class 142 trains approaching an already-occupied platform 1.

58 During the journey from Barnstaple on 4 January 2010, the weather was cold throughout. The driver had stopped the train normally at several stations. The driver had also stopped at a red signal shortly before the accident. No low adhesion had been encountered during the journey and the driver had no reason to believe that he would have any difficulty stopping the train safely in the platform at Exeter St Davids.

59 The driver's strategy for stopping at Exeter St Davids station was to use a 'light and early' brake application in step 1 and make selective use of step 2 as necessary to ensure that the train stopped at an appropriate distance from the Waterloo train. The RAIB's analysis, based on the point at which the driver first applied the brake, indicates that under normal adhesion conditions this strategy would have resulted in the Barnstaple train stopping safely with a considerable margin for safety. The use of brake step 1 alone would almost have been sufficient to stop the train; minimal use of brake step 2 would also have been necessary.

60 When the driver applied the brakes on the approach to Exeter St Davids station, he did not immediately realise that the train was in an all-wheels slide. He was looking ahead towards the stationary Waterloo train and did not notice that, although the train was moving, the speedometer reading was 0 mph.

61 When the driver realised that the train was not decelerating as expected he made a full brake application. This was in accordance with the training and guidance provided by FGW. He judged that there was not enough distance available to release and reapply the brake.

62 The analysis of the driver's approach to platform 1 indicated that it was similar to that of other drivers, and was consistent with the training and guidance given by FGW on driving trains with tread brakes in low adhesion conditions.

63 Tests undertaken after the collision, in line with normal post-accident operating procedures, indicated that the driver was not under the influence of drugs or alcohol.

The performance of the train

64 The performance of the train is not considered causal or contributory to the accident.

65 The functioning of the train's brakes was normal on the journey from Barnstaple (paragraph 58). Following the accident, the unit's braking system was subject to a series of static and dynamic functional tests in accordance with FGW procedures. No brake faults were found that could have caused or contributed to the accident.

66 Data from the train's OTDR, which included information from the accident and post-accident dynamic tests, indicated that with adequate adhesion, brake step 1 was able to decelerate the train at an equivalent rate of around 2.6%g to 2.9%g. This rate of deceleration is consistent with the normal braking performance of the class 142 fleet.

Previous occurrences of a similar character

67 The RAIB's investigation into incidents at Esher[6] and Lewes[7] and the low adhesion investigation referred to in paragraph 34 describe low adhesion events that occurred in autumn 2005.

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[6] Autumn Adhesion Investigation: Part 1: Signals WK338 and WK336 Passed at Danger at Esher, 25 November 2005. RAIB report 25(Part 1)/2006.

[7] Autumn Adhesion Investigation: Part 2: Signal LW9 Passed at Danger at Lewes, 30 November 2005. RAIB report 25(Part 2)/2006.

68 The RAIB's investigation resulted in a recommendation to the Rail Safety and Standards Board that a review be undertaken of the relevant standard to identify ways in which the class 142 (and certain other excluded units) could be equipped with sanders. The recommendation was made in January 2007.

69 The RAIB conducted an investigation into a collision between a class 142 train and another train at Darlington station on 3 October 2009. It was identified that contamination of the rail head was the primary cause of the accident. A learning point from that investigation highlighted the need to expedite research into ways that class 142 units could be provided with sanding equipment, referred to in paragraph 68. The Rail Safety and Standards Board has advised that the industry is now considering whether there is a case to make changes in the overall arrangements for sanding, and will address this through research which is expected to commence in the summer of 2010.

70 On 11 January 2010, one week after the collision, a class 142 unit approaching platform 1 at Exeter St Davids station also experienced a slide while braking in step one in the vicinity of Red Cow level crossing. On this occasion platform 1 was not occupied by another train and the driver had sufficient time and distance available in which to release and reapply the brakes. Using this technique the driver was able to stop the train safely in the platform.

Severity of consequences

71 The consequences of the collision were mitigated by the following factors:

- the train speed at the point of collision was relatively low at around 11 mph (18 km/h); and
- both trains were lightly loaded; there were 14 persons on the Barnstaple service and 11 persons on the stationary Waterloo train.

Observations[8]

Crashworthiness issues

72 The damage to both trains was minor. However, on the class 142 unit, a large window located in the door giving access to the rear driving cab from the passenger saloon became detached from its frame and fell to the floor as a result of the impact (see figure 4). At the time of the collision there were no people in the vicinity of the window.

73 It was established that the glass unit sits in a bottom channel that is held in place by six welds which secure it into the door window frame. Of the six welds, two were in good condition, two were incomplete and exhibited signs of rust, and two had failed completely before the accident. The force of the collision overloaded the welds allowing the bottom channel to detach from the door frame and the glass unit to slide out (see figure 5). This created the potential for an injury for anyone who had been in the vicinity.

[8] An element discovered as part of the investigation that did not have a direct or indirect effect on the outcome of the accident but does deserve scrutiny.

Figure 4: Glass window ejected from door following collision

Figure 5: Failed welds (channel weld portion in top images and doorframe in bottom images) (Images courtesy of FGW)

Hazards in the vicinity of level crossings

74 It cannot be established whether the existence of a level crossing in the vicinity of the area where the driver of the Barnstaple train applied the train's brakes had any bearing on the level of adhesion available. However, where roads interface with the railway at level crossings, there exists the possibility that contaminants drawn onto the level crossing by passing road vehicles such as mud, oil, water or other deposits can be propagated onto the railway, thereby creating changes in rail head moisture levels or causing contamination.

75 This has limited significance where trains have no need to stop beyond a level crossing, but may constitute a hazard where there is a requirement to do so (primarily junction signals that may be at danger, buffer stops in *bay platforms* or occupied platforms where a second train is permitted to approach). Not all train operators systematically identify such locations in their route risk assessments and route training material.

Summary of Conclusions

Immediate cause

76 The immediate cause of the accident was that the driver's application of the brakes did not stop the Barnstaple train before it collided with the Waterloo train (paragraph 32).

Causal factor

77 A causal factor was a length of low adhesion at Red Cow level crossing and at the eastern end of platform 1 at Exeter St Davids station (paragraph 33).

Contributory factors

78 A contributory factor was the lack of sanding equipment on the class 142 unit (paragraph 41, see paragraph 82).

Additional observations

79 Although not linked to the accident at Exeter St Davids on 4 January 2010, the RAIB observes that:

a. the failure of the welds holding the window in the door giving access to the rear driving cab from the passenger saloon and subsequent detachment of the glass on the class 142 unit created the potential for an injury for anyone who had been in the vicinity (paragraph 73, see paragraph 80);

b. not all train operators systematically identify in their route risk assessments the potential hazards associated with low adhesion where there may be a need for trains to stop immediately beyond a level crossing (paragraph 75, **Recommendation 1**).

Actions reported that address factors which otherwise would have resulted in an RAIB recommendation

80 Following the accident, FGW issued an urgent safety advice in accordance with Railway Group Standard GE/RT8250 'Reporting High Risk Defects' to inform other operators of class 142 units of the door glass detachment weld issue.

81 In the light of this action addressing the factor identified in paragraph 79a, the RAIB has decided not to issue a further recommendation.

Previous recommendation relevant to this investigation

82 The following recommendation was made by the RAIB as a result of a previous investigation, which addresses the factor identified in paragraph 78 (see also paragraphs 68 and 69). It is therefore not remade so as to avoid duplication:

Autumn Adhesion Investigation, Part 3: Review of adhesion-related incidents, Autumn 2005. RAIB report 25(Part 3)/2006, issued January 2007

Recommendation 11 (for ease of reference, only the relevant text has been reproduced below)

RSSB to review the relevance of existing sanding parameters within GM/RT2461 and amend, enhance or supplement them with additional guidance where appropriate. The review is to encompass:

- *identification of ways in which currently excluded vehicles (e.g. classes 142-144, 153) can be equipped with sanders.*

Recommendations

83 The RAIB has made no recommendations to address causal or contributory factors

84 The following recommendation is made[9]:

Recommendation to address other factors observed during the investigation

1 *The purpose of this recommendation is to alert train drivers to the possibility of low adhesion conditions in the vicinity of level crossings located in close proximity to other hazards.*

Train operators should, for locations where hazards exist immediately beyond a level crossing such as high risk signals, bay platforms or stations with permissive working, highlight within their route risk assessments and route learning and briefing material the possibility of drivers encountering unexpected low adhesion conditions at that crossing and the risk arising from wheel slide (paragraph 79b).

[9] Those identified in the recommendation, have a general and ongoing obligation to comply with health and safety legislation and need to take this recommendation into account in ensuring the safety of their employees and others.

Additionally, for the purposes of regulation 12(1) of the Railways (Accident Investigation and Reporting) Regulations 2005, this recommendation is addressed to the Office of Rail Regulation to enable it to carry out its duties under regulation 12(2) to:

(a) ensure that recommendations are duly considered and where appropriate acted upon; and

(b) report back to RAIB details of any implementation measures, or the reasons why no implementation measures are being taken.

Copies of both the regulations and the accompanying guidance notes (paragraphs 167 to 171) can be found on RAIB's web site www.raib.gov.uk.

Appendices

Appendix A - Glossary of abbreviations and acronyms

CCTV	Closed Circuit Television
FGW	First Great Western
OTDR	On-train data recorder
RAIB	Rail Accident Investigation Branch
RSSB	Rail Safety and Standards Board
WSP	Wheel slide protection (system)

Appendix B - Glossary of terms

All definitions marked with an asterisk, thus (*), have been taken from Ellis's British Railway Engineering Encyclopaedia © Iain Ellis. www.iainellis.com.

Bay platform	A platform which has a buffer stop one end of the line.
Dew Point	The temperature at which water vapour in the air becomes saturated and condensation begins.
Sanding	The application of sand either automatically or manually to assist with adhesion during traction or braking.
Track circuit	An electrical or electronic device used to detect the absence of a train on a defined section of track using the running rails in an electric circuit.*
Train detection	Generic term for any system that proves the presence or absence of trains and rail vehicles on a particular section of line.*

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