RAIB
Rail Accident Investigation Branch

Rail Accident Report

Fatal accident at Moor Lane footpath crossing, Staines
16 April 2008

Department for Transport

Report 27/2008
December 2008

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.

Any enquiries about this publication should be sent to:

RAIB
The Wharf
Stores Road
Derby UK
DE21 4BA

Email: enquiries@raib.gov.uk
Telephone: 01332 253300
Fax: 01332 253301
Website: www.raib.gov.uk

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Contents

Introduction

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.

3 Access was freely given by Network Rail and South West Trains to their staff, data and records in connection with the investigation.

4 Appendices at the rear of this report contain the following glossaries:

- acronyms and abbreviations are explained in Appendix A; and
- technical terms (shown in *italics* the first time they appear in the report) are explained in Appendix B.

5 All mileages are measured from a datum point at London (Waterloo)

Summary of the report

Key facts about the accident

6 At about 08:10 hrs on 16 April 2008, a train travelling from London (Waterloo) to Windsor & Eton struck and fatally injured a pedestrian on Moor Lane footpath level crossing, near Staines, Surrey.

7 There was no damage to the train or the railway infrastructure.

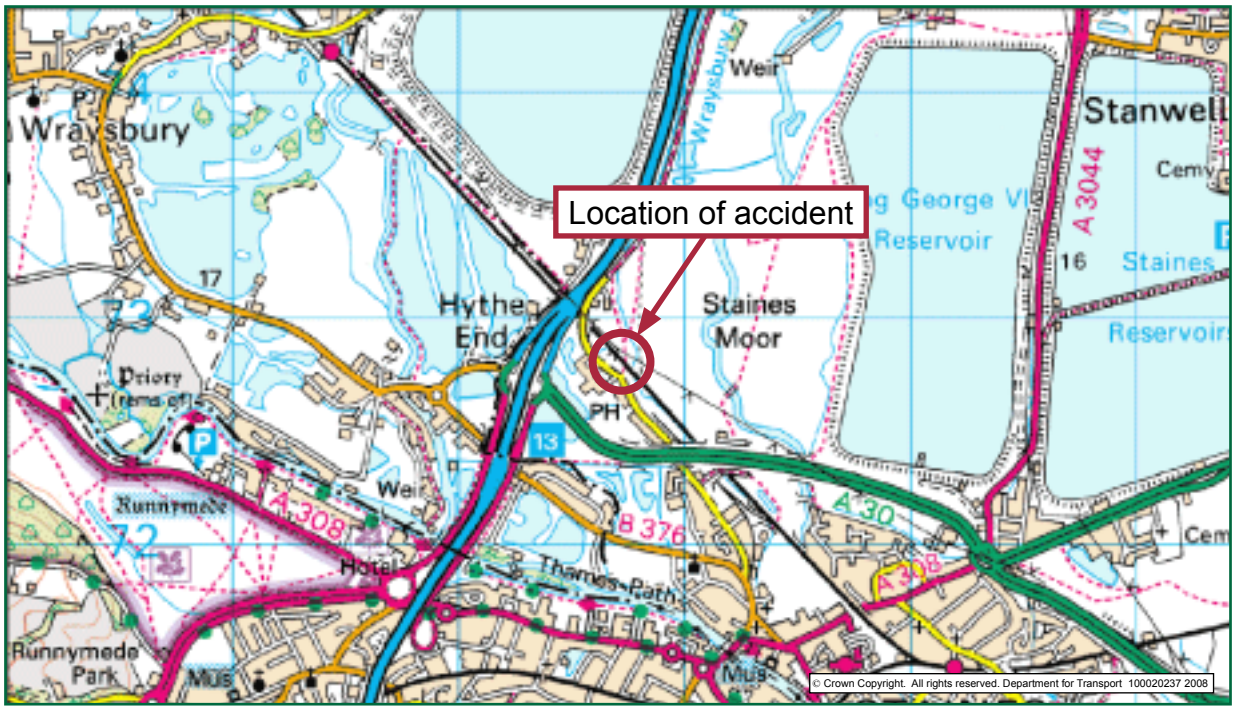

Figure 1: Extract from Ordnance Survey map showing location of accident

Immediate cause, causal and contributory factors, underlying causes

8 The immediate cause of the accident was that the pedestrian fell to the ground on the crossing and was unable to avoid being struck by the approaching train.

9 Causal factors were:

a. the pedestrian did not stop, look and listen before stepping onto the crossing;

b. the surface of the crossing was slippery; and

c. Network Rail had not added a non-slip surface to the crossing, although this had been considered by Railtrack in 1996 and requested by Her Majesty's Railway Inspectorate (HMRI) in 2005.

10 The following factors were considered to be contributory:

a. the angle, relative to the railway, of the south-eastern approach path and the crossing itself;

b. the relative quietness of the combination of a modern train and track recently relaid with *continuous welded rail* (CWR); and

c. the level of background noise at the crossing.

11 The underlying causes of the accident were:

a. the risk assessment processes operated for footpath crossings by Railtrack and more recently by Network Rail did not identify the risk of slipping on a timber surface, and as a result a non-slip surface was not provided at the crossing; and

b. the difficulty of closing the level crossing, and its consequent continued availability to members of the public as a footpath.

Recommendations

12 Recommendations can be found in paragraph 148. They relate to the following areas:

- the provision of non-slip surfaces at footpath crossings;
- the operation of Network Rail's computer system for managing maintenance activities; and
- the guidance Network Rail provides to its staff who carry out the assessment and inspection of level crossings.

The Accident

Summary of the accident

13 At about 08:10 hrs on Wednesday 16 April 2008, the 07:28 hrs train (2U13) from London (Waterloo) to Windsor & Eton (Riverside), travelling at about 52 mph (84 km/h), struck and fatally injured one of two pedestrians who were on Moor Lane footpath level crossing, near Staines, Surrey.

The parties involved

14 The level crossing is on the railway between Staines and Windsor, which is owned, operated and maintained by Network Rail (Wessex area).

15 The train was operated by South West Trains (SWT), and the train crew (driver and guard) were SWT employees.

16 The pedestrians involved in the accident, Mrs Terri Mansell and Ms G, were both local residents. They were in the habit of walking about once a week on Staines moor, using the crossing to reach the moor from Mrs Mansell's home nearby, and had been doing so for many years.

17 Both women were active and in good health, and were wearing appropriate shoes for walking on the muddy pathways on the moor.

Location

18 The railway from Staines to Windsor runs generally in a straight line in a north-westerly direction across the low-lying land between Staines and the first station on the branch at Wraysbury (Figure 1). The railway is double track, electrified on the conductor rail system at 750 volts DC. Moor Lane crossing, at 20 miles 19 chains, is one of five footpath crossings on the line. There are 'whistle' boards (a letter W in a circle, instructing train drivers to sound the warning horn) on the rail approaches to the crossing in both directions, positioned 275 m from the crossing. The line has a service of two passenger trains per hour in each direction, between 05:30 and 23:30. There is no freight traffic.

19 The crossing (Figure 2) carries a public footpath which runs from Moor Lane itself, about 50 m south-west of the railway, onto Staines Moor. It is used by people walking on the moor, and is part of the Colne Valley Way footpath.

20 South-east of the crossing, the railway crosses over the Wraysbury river on a girder bridge. A short distance on the Staines side of this, and about 75m from the crossing, are the abutments of the former bridge carrying the now-closed railway from West Drayton to Staines West over the Staines – Windsor line.

21 The M25 motorway crosses over the railway about 360 m north-west of the crossing, and the A30 Staines by-pass also passes over the railway, about 540 m south-east. Heathrow airport is about 4 miles (6 km) north-east. There is therefore considerable background noise from these roads and from air traffic.

Figure 2: Moor Lane crossing from the south-east

External circumstances

22 On the morning of 16 April the weather was sunny. Shortly after 08:00 hrs there was a light breeze (2 mph) from east-north-east, and the temperature was about 6° C.

The train

23 The train was formed of two four-car class 450 *electric multiple-units* (EMU), 450570 and 450547. These units were built in 2005, and were equipped from new with on-train data recorder (OTDR) equipment to record a wide range of data, including the train speed, the driver's use of the traction and braking controls, and operation of the warning horn.

Events during the accident

24 The train left Staines on time at 08:07 hrs, and accelerated to close to the line speed of 60 mph (97 km/h) as it approached the A30 bridge. The driver sounded the low tone of the two-tone warning horn for 0.5 seconds as the train was about 65 m from the 'whistle' board for Moor Lane crossing, which is positioned 275 m from the crossing itself.

25 Shortly after passing the 'whistle' board the train driver saw two people starting to cross over Moor Lane crossing, coming from the left-hand side (looking ahead, in the direction the train was travelling). He sounded the horn again, continuously for three seconds, and then applied the emergency brake. At this point the train was travelling at 59 mph (95 km/h) and was about 80 m, or three seconds running time, from the crossing.

26 The two people at the crossing were one behind the other. Mrs Mansell, who was leading, had got almost to the middle of the crossing when she exclaimed that there was a train coming, turned, appeared to slip, and fell to the ground, facing back the way she had come. Ms G, following, was just stepping onto the crossing. She saw that the train was very close and stepped back off the crossing.

27 Mrs Mansell began to get up, but was unable to move far enough to get clear of the crossing before she was struck by the train about three seconds after she fell.

28 At the moment when the front of the train reached the crossing, it was travelling at 52 mph (84 km/h), with the brakes applied. The train stopped with its rear end about two metres past the crossing.

Consequences of the accident

29 Mrs Mansell, who was struck by the train, was thrown about six metres and landed in the *cess* close to the left–hand side of the track. She was killed instantly. Ms G was not hurt, but was severely shocked by what had happened.

Events following the accident

30 The train driver contacted Feltham signal box, using the radio in his cab, and requested the emergency services. He also asked for trains on the other line to be stopped, and for the electric current to be isolated. Paramedics attended the accident site, but were unable to revive the casualty.

31 The passengers in the train were moved to the front four coaches (where they were out of sight of the casualty). Once the emergency services had finished their work at the scene of the accident, at about 10:00 hrs, the train was returned to Staines, where the passengers left the train.

32 The train was then taken to sidings near Staines station, where it was examined by the RAIB.

The Investigation

Sources of evidence

33 The RAIB has obtained evidence from:

- the data recorder on the train;
- examination of the train and level crossing;
- interviews with witnesses;
- tests on the crossing surface; and
- Network Rail's records relating to inspection, maintenance and risk assessment of level crossings in the Wessex route.

Key information and analysis

Moor Lane crossing

History

34 The railway from Staines to Windsor and Eton (Riverside) was authorised by the Windsor, Staines and South Western Railway (No.1) Act 1847, and opened in 1848.

35 There is no reference to the provision of a level crossing at Moor Lane within the authorising Act (or subsequently), but it was provided within Parcel No.130 in the Parish of Staines shown on the Deposited Plan for the 1847 Act, described as "Waste, Common and Water Ditches, Owners: Lord and Lords of the Manor of Yeoveney, Occupiers: The Inhabitant Householders of Staines". A Public Footpath over the railway was claimed as No.18 in Staines Urban District Council under the provisions of the National Parks & Access to the Countryside Act, 1949, for which stiles had by that time already been provided (although there is no record of when or why they came into existence). The present arrangements at the crossing can be traced back to 1990 in Network Rail's records and probably existed for many years before that.

The crossing

36 The description of the crossing is as on the date of the accident. Network Rail have since made changes to the crossing (paragraph 146).

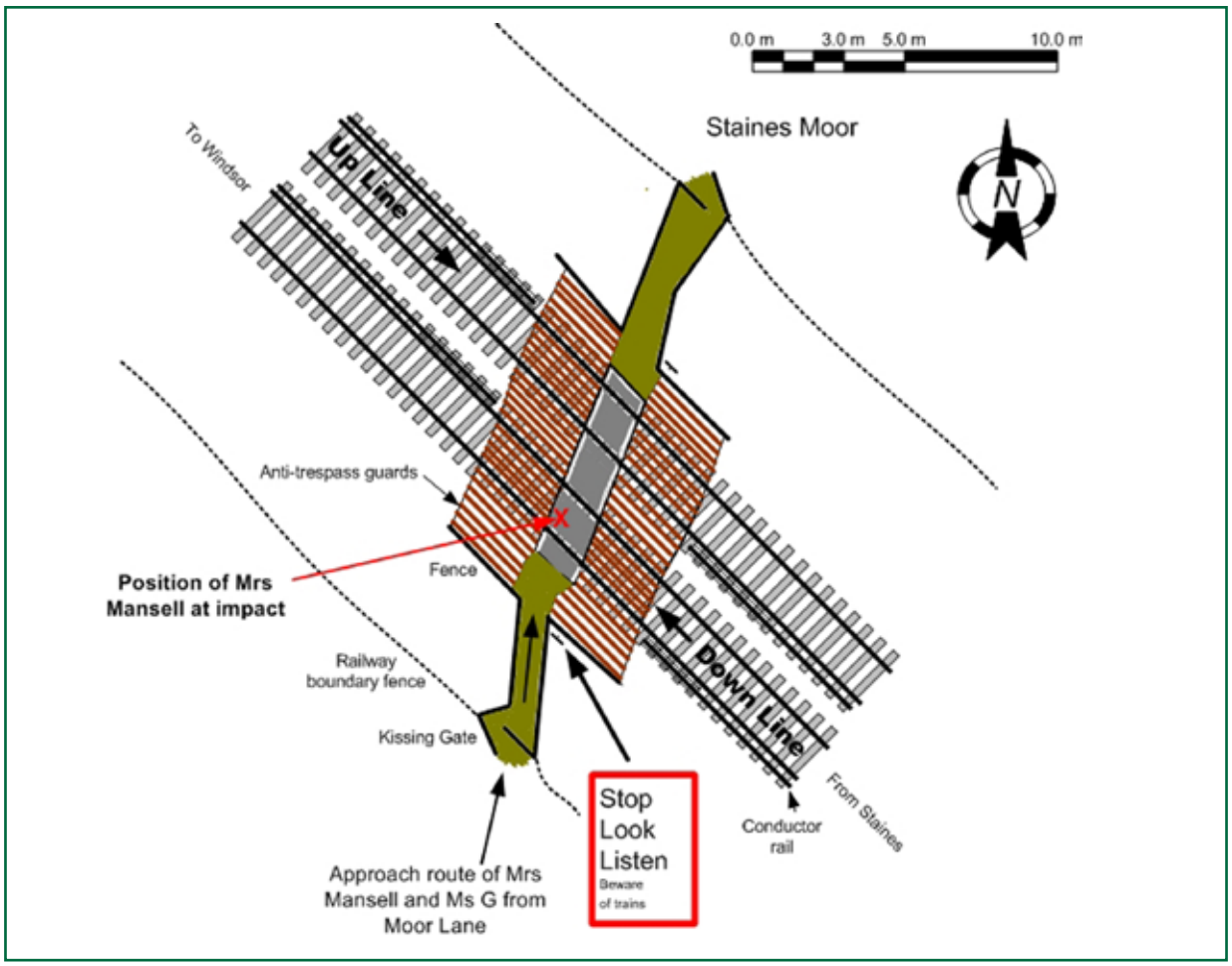

Figure 3: Plan of crossing

37 The approach to the crossing from Moor Lane is by two paths which converge immediately outside the railway boundary. There is a 'kissing' gate in the boundary fence, and beyond this the path runs between chain-link fences about 1m apart up to a point about 1.4 m from the nearest rail of the *down line*. The path is not at right angles to the railway, but approaches at about 45°. The path emerges from dense bushes close to the boundary fence, which stop about 3 m from the railway itself. There is a notice warning pedestrians to stop, look and listen, positioned on the right-hand side of the approach path about 2.5 m from the nearest rail (Figure 3). The crossing itself has a boarded timber surface, reached by a single step up from the approach path. It crosses the track at an angle of 66°. The boards of the crossing surface run parallel to the direction of the footpath, except for those on the outside (cess side) of the rails on both lines, which are parallel to the rails (Figure 4). There are 1.5 m high chain link fences extending from the end of the footpath for about 3 m, running parallel with the railway in both directions.

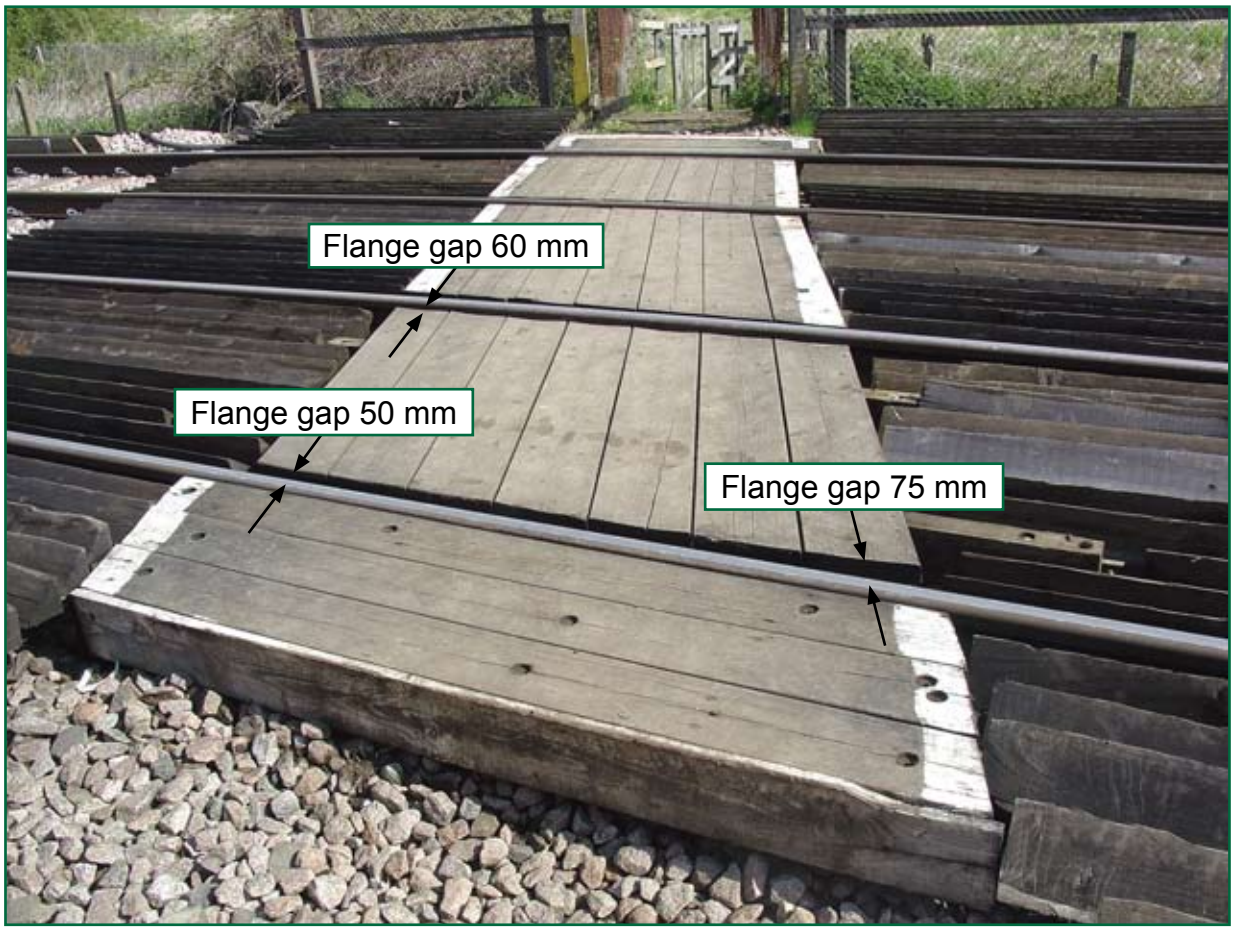

Figure 4: Moor Lane crossing surface, from the south side

38 The conductor rails are interrupted at the crossing, and the gap extends over about 7 m. On either side of the crossing there are anti-trespass guards, consisting of triangular section timbers approximately 2.6 m long, fixed parallel to the rails at 80-100 mm intervals. These guards extend across the full width of the crossing between the fences on both sides. They are fixed close to the edge of the crossing surface, and terminated about 300 mm short of the ends of the conductor rails on both lines. There is in some cases a gap of up to 120 mm between the crossing surface and the end of the anti-trespass guard (Figure 5).

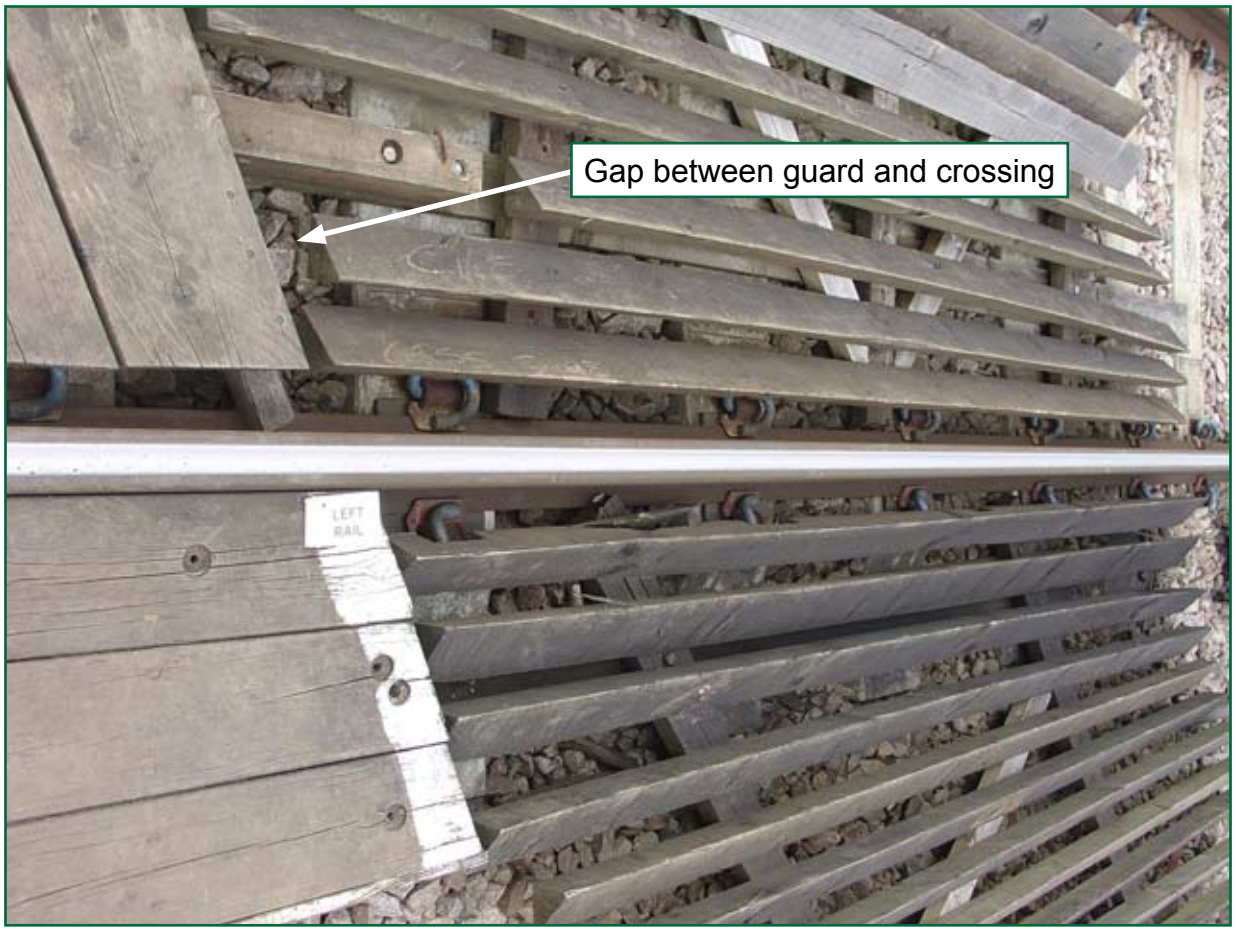

Figure 5: Anti-trespass guards

39 The crossing surface has gaps where the rails of both lines pass through it. These gaps are partly filled by the rails themselves, but there is a space on the inner side of each rail to permit wheel flanges to pass. Dimensions given in Network Rail's company standard (NR/SP/TRK/040 'Level crossing surface systems'), specify that level crossing surface systems at public road crossings should be 1300 mm wide (plus or minus 3 mm), producing a flange gap of between 66 and 69 mm. At Moor Lane, which is a footpath crossing, the size of these *flangeways* was outside this range. By the cess (left-hand) rail of the down line, the flangeway width varied from 50 to 75 mm over the length of the crossing. By the *six-foot* (right-hand) rail of the down line the flangeway width was generally 60 mm (Figure 4). On the *up line* the flangeways were wider: the six-foot rail flangeway was between 95 and 105 mm, and the cess rail flangeway was 80 mm.

40 There are white lines, about 50 mm wide, painted along both edges of the crossing. At the time of the accident these lines were missing from the timbers in the *four-foot* of the down line (Figure 4).

Inspection and risk assessment

41 Network Rail and its predecessors have had an inspection regime for level crossings for many years. From 1996 this was supplemented by a risk assessment process, which was initially combined with crossing inspection, but only applied to automatic crossings.

42 The records for Moor Lane crossing show that an inspection in 1996 concluded that a non-slip surface was required at the crossing, but no action was taken to implement this.

43 In 1998 the risk assessment process was extended to all crossings, initially through the use of Railtrack line Procedure RT/LS/P/026. This document made reference to the 'Railway Safety Principles and Guidance' Part 2 section E (RSPG 2E), which was published by HSE in 1996. Paragraph 197 of RSPG 2E says:

> 'Where the surface is other than ballast or stone chippings, a non-slip surface should be provided.'

44 It is specifically stated in paragraph 9 of RSPG 2E that the document 'does not apply retrospectively to existing crossings'. Railtrack took this exclusion into account when producing its own procedures. The first issue (December 1998) of line procedure RT/LS/P/026 said that:

> 'For existing crossings constructed before publication of the HSE document, the instructions shown in RT/LS/S/012 shall be applied, supplemented by those shown in "Part 2 Section E" where this is reasonably practicable.'

45 The document referred to, RT/LS/S/012 'Inspection and risk assessment forms for UWC, footpath and bridleway level crossings', contained forms to be used when carrying out risk assessments on footpath crossings. These concentrated mainly on warning times for approaching trains, and the time taken to traverse the crossing, with the aim of ensuring that adequate protection was available for users. The form for footpath crossings collected data on the crossing surface in the form of a tick-box entry for ballast, timber, tarmac/ trail (a proprietary rubberised surfacing system) or other (unspecified) surface. There was nothing on the form prompting the user to comment or make any judgement on the condition or suitability of the surface. There was no guidance on what 'reasonably practicable' might mean, or on who should make any decision on changes.

46 *Railway Group Standard* GI/RT7012 'Requirements for Level Crossings' (which superseded earlier standards covering level crossings in 2004) stipulates general requirements for crossing surfaces (section G2.1):

> 'The surface of the crossing and its immediate approaches shall:
>
> a) enable the crossing to carry safely the road traffic likely to use it
>
> b) enable pedestrians, cyclists, horse riders and animals likely to use the crossing to do so safely
>
> c) permit the safe passage of trains
>
> d) allow access for maintenance and inspection of both track and the crossing surface system.'

Among the factors to be taken into account (section G2.2) is:

> 'e) the avoidance of tripping or slipping hazards to people or animals likely to use the crossing.'

47 Section G2.5 lists particular requirements for bridleway and footpath crossings. Among these, and relevant to the situation at Moor Lane, is the requirement that:

> 'the crossing surface shall be in keeping with, but not necessarily the same as, the surface provided on the right of way on the approaches to the crossing immediately outside the railway boundary'.

At Moor Lane the approaches outside the boundary fence are by unmade grassy paths.

48 Network Rail is required by the Railways and Other Guided Transport Systems (Safety) Regulations 2006 to maintain a safety management system which meets the requirements of the regulations. The safety management system operated by Network Rail commits it to complying with Railway Group Standards.

49 The Network Rail Operations Manual was introduced in July 2002. This document included, as part of procedure C5, the risk assessment form from RT/LS/S/012 issue 3. This form now included a space for the assessor to specify the condition of the crossing surface, and whether any action was required.

50 On 17 September 2003 a local girl, aged 10, died when she was electrocuted on the conductor rail of the up line at the river bridge close to Moor Lane crossing. She was one of a group of three children who had been playing in the vicinity of the crossing.

51 Following this accident, Network Rail repaired the anti-trespass guards at the crossing. These had been found to be in poor condition, and were considered to be ineffective in deterring unauthorised access to the line.

52 The Operations Delivery Manager for the Waterloo area carried out a risk assessment using the form from RT/LS/S/012 following the fatality in September 2003. He noted that the surface was timber, and considered that concrete troughing in the down side approach path presented a tripping hazard, but made no other comment on the crossing surface.

53 Since 2005 inspection and risk assessment have been carried out by separate teams. There is now a Network Rail standard maintenance procedure NR/PRC/MTC/MG0081 'Inspection of level crossings including work identification and prioritisation', which was introduced in January 2006. It requires the Services Delivery Manager for each area to create an inspection register and, in conjunction with the Level Crossing Risk Control Co-ordinator, to determine the maximum inspection interval for every level crossing in the area. The Area Signal Engineer is responsible for approving the register. Network Rail business process document NR/SP/SIG/19608 'Level Crossing Infrastructure (Inspection and Maintenance) Handbook' specifies that the maximum inspection interval for footpath crossings shall be six months. Inspections of Moor Lane crossing have been carried out at this frequency.

54 Network Rail specification NR/SP/OPS/100 'Provision, Risk Assessment and Review of Level Crossings', introduced in December 2006, specifies that:

> 'The All Level Crossing Risk Model (ALCRM) shall be used to assess the risk at each crossing, to be supported as necessary by expert judgement or additional risk assessment processes where appropriate.'

55 The specification does not specify the interval at which crossings are to be assessed, but the interval given in the instructions for using the ALCRM is every three years for passive crossings (those without any warning lights or barriers) such as Moor Lane. The specification no longer refers to RSPG 2E.

56 The Wessex area level crossing risk control co-ordinator and a mobile operations manager (under training) carried out a risk assessment of Moor Lane crossing on 4 May 2007, the first time this had been done at this crossing using the ALCRM. They noted that the crossing did not have a non-slip surface. The pre-printed data collection form (Network Rail Operations Manual procedure 5-23) used for the risk assessment, and intended to provide input to the ALCRM, has a question which asks 'If decking provided is the deck wide enough and has a non slip surface'. This question is intended to be answered as a whole with a yes or no. On the form for the assessment of Moor Lane, the assessors used a pen to divide the question into two parts, and ticked the 'yes' box in answer to 'Is the deck wide enough' and the 'No' box in answer to 'has a non-slip surface'. They did not make any other comment about the crossing surface, or take any action to recommend adding a non-slip surface. This contradiction does not appear to have been queried when the form was input to the computer system, with only the 'yes' answer being used.

57 An inspector from the maintenance organisation's level crossings team carried out the next six-monthly level crossing inspection, on 20 November 2007. He identified that:

- the white lines were missing from the edges of the decking in the four-foot of the down line;
- the chain link required renewal on parts of the fencing;
- the up line whistle board had graffiti on it; and
- there was rotten timber in the up side gate.

All of these matters, except for the white lines on the decking, had been attended to by the time the accident occurred on 16 April 2008.

Maintenance and renewal

58 Following the fatal accident to a child close to the crossing in September 2003 (paragraph 50), the crossing surface and anti-trespass guards were found to be in poor condition. Network Rail replaced rotten and missing timbers following this accident. The risk of slipping on the crossing was not identified in the accident investigation itself (which was carried out jointly by Network Rail and the then maintenance contractor) or in the risk assessment that the operations delivery manager for the area carried out on 25 October 2003 after the conclusion of the investigation, using the then-current procedure C5, laid down in the Network Rail Operations Manual dated July 2002.

59 During October and November 2005, both the tracks over the crossing were relaid and the ballast was renewed. The track had previously consisted of jointed *flat-bottom rails* on timber sleepers. The replacement track is laid with CWR on concrete sleepers.

60 As part of the renewal work, the crossing surface was removed and replaced. New timbers were provided between the rails and between the tracks, as a 'like-for-like' replacement of the previous surface. These timbers were laid transversely across the tracks, parallel to the line of the path over the crossing.

61 Following the accident the RAIB inspected the timber surface and found that it was in good repair.

Public complaint

62 A local resident made a complaint to HMRI about Moor Lane crossing in early 2005. An HMRI inspector met the resident at the crossing on 23 February 2005 and discussed the issues that were giving him cause for concern. These were:

- the vegetation growing around the crossing, which in the resident's view obscured the view of the crossing from the public road and meant that children playing near the crossing could not be seen;
- bags of ballast that had been deposited on the lineside near the crossing, and which had been there some time, which the resident considered could provide ammunition for children to throw stones at trains; and
- the 'limited clearance' signs fixed to the ends of the nearby river bridge, which the resident believed were an unnecessary expense.

63 The HMRI inspector explained to the resident that the first and third of these were not matters on which he considered that any action was necessary. In the first case, it was unreasonable to expect Network Rail to remove vegetation for the reasons suggested. In the third case, the signs are an important element of safety for track workers and should remain.

64 In addition to these concerns, the HMRI inspector identified that the crossing surface was particularly slippery, and lacked any non-slip coating. He sent an e-mail the same day to Network Rail's infrastructure maintenance manager for the Wessex area asking for improvements to be made to the surface, and for the bags of ballast to be removed.

65 The infrastructure maintenance manager replied to HMRI the same day promising to investigate the issues raised. On 2 March 2005, he sent a further e-mail stating that a work order had been raised to carry out re-surfacing of the crossing, and that the ballast bags would be removed at the first available opportunity.

66 Having received this undertaking from Network Rail, HMRI closed its file on the matter.

67 The infrastructure maintenance manager instructed his staff to create a work order to cover the provision of a non-slip coating on Moor Lane crossing. The service delivery manager raised a form with the necessary authorisations on it. This form was sent to the Feltham maintenance depot to be converted to a work order on the *Mincom Information Management System* (MIMS) computer system which was then being used by Network Rail for logging and managing maintenance work on track and signalling systems.

68 A work order was created on MIMS on 10 March 2005 at 08:50 hrs. At 09:30 hrs on the same day it was recorded as 'closed' on the system. The code used to close the work order indicated that it had been closed because it was considered to have been raised in error. Because of this, the work to provide a non-slip surface was not carried out. The member of Network Rail staff responsible for data entry is unable to recall this particular works order among the many thousands dealt with in the Feltham depot.

69 No action was taken by anyone in Network Rail or HMRI to follow up the work on Moor Lane crossing, or to check that it had been completed.

Previous occurrences of a similar character

70 There were 8 pedestrian fatalities at level crossings in 2007 (excluding suicides), and 8 in 2008 up to the end of October. The most recent accidents of this type that are being investigated by the RAIB occurred at West Lodge, near Haltwhistle, Northumberland, on 22 January 2008, at Tackley, Oxfordshire on 31 March 2008, and Morden Hall Park, Greater London, on 13 September 2008.

Identification of the immediate cause

71 The immediate cause of the accident was that Mrs Mansell, who had walked onto the crossing as the train was approaching, fell to the ground as she attempted to move clear, and was unable to avoid being struck by the train.

Identification of causal and contributory factors

The train

72 The data recorder fitted to the train shows that as it approached the 'whistle' board it was travelling at 59 mph (95 km/h), slightly below the speed limit for the section of line. The driver sounded the horn for 0.5 seconds when the train was about 65 m on the approach to the 'whistle' board (the train was then about 340 m from the crossing), and again, six seconds later, on seeing the women walking onto the crossing.

73 After sounding the horn for three seconds, the driver then applied the emergency brake. The train stopped in 244 m, in a total time of 18.5 seconds. This represents a deceleration of 1.43 ms^{-2} (14.5 % g), significantly in excess of the specified minimum performance requirements for train braking[1].

74 After the accident the warning horn and headlight of the train were checked by the RAIB and found to be working normally.

75 The driving, performance and condition of the train were neither causal nor contributory to the accident.

Use of the crossing

76 The women walked onto the crossing as the train approached, when it was past the 'whistle' board and probably less than 250 m (or nine seconds running time) from the crossing. The driver began to sound the train horn when the train was six seconds running time from the crossing. By the time the women reacted to this and realised that there was a train coming, there was less than five seconds left for Mrs Mansell, who was leading, to get clear of the line.

77 At a footpath crossing such as Moor Lane, the user is required to check that it is safe to cross before stepping onto the crossing. It appears from the evidence that Mrs Mansell did not do so, and that she only became aware of the approach of a train when she was already on the crossing. This was a causal factor in the accident.

[1] Railway Group Standard GM/RT 2044 Braking System Requirements and Performance for Multiple Units, Figure 3, curve A3, enhanced 30% for emergencies (section 5.4.1).

Visibility of approaching trains

78 At Moor Lane crossing, trains approaching from Staines come into view approximately one mile (or one minute and fifteen seconds running time) away. For a person approaching the crossing from the south-west side, the visibility of trains is limited by, first, the vegetation to the right of the approach path, then the disused railway embankment and abutment about 75 m away beyond the river bridge, and finally by the railings on the river bridge. By the time the approaching pedestrian has reached a position where all these things are no longer obstructing their view to the right, they are at the fence posts at the end of the approach path, about 1.5 m away from the down line, and just past the warning notice (Figure 6), from where they can see trains up to one mile away.

Figure 6: View south-east from end of approach path

79 At this point, the pedestrian must make a decision on whether it is safe to cross the railway (see paragraphs 127 to 131 for further discussion of this issue). The view that is naturally presented to the approaching pedestrian is to the north-west, of trains approaching from Wraysbury. The angle of the approach path, at 45° to the line, means that to look along the line to the right toward Staines and London a person must look over their right shoulder, or turn their body significantly to the right. A person who is not paying close attention to what they are doing may, because of the direction they are facing when walking, not make the check to the right until they have stepped onto the crossing itself.

80 The angle of the approach path, and of the crossing itself, is a contributory factor in the accident.

Audibility of approaching trains

81 The crossing at Moor Lane is in an area which is often subject to high levels of background noise. Road traffic noise from the M25 motorway is present all the time, and is greatest when the wind is from the west or north (there was a light breeze from east-north-east on the morning of the accident). There is intermittent traffic noise from the A30. The normal direction of air traffic at Heathrow involves aeroplanes taking off from the southern runway passing about one mile away from the crossing. The RAIB measured the general noise level in a light wind at 69-70 dB, and the combined noise level from the various sources can reach 74 dB. This may be compared with a level of 55-60 dB for normal conversation. The effect of this level of noise can be to drown out the sound of approaching trains until they are within a few seconds of the crossing.

82 Further muffling of the sound of trains is provided by the disused railway embankment south-east of the crossing, which screens the sound of down trains from pedestrians approaching along the footpaths from the direction of Moor Lane.

83 The trains used on the line are relatively new, having been introduced between 2002 and 2005. They are of modern design and are quieter than the trains they replaced, which dated from between 1963 and 1980.

84 Both the tracks over the crossing were relaid in 2005. Before this, trains could be heard approaching on the jointed track while still some distance away. The replacement track uses continuous welded rail on concrete sleepers. There are now no rail joints in the vicinity of Moor Lane, and consequently there is much less noise from trains running on the lines near the crossing than was the case before the track renewal.

85 The combined effect of all these factors is that, in 2008, it is less likely than it was before 2005 that a pedestrian walking towards the crossing from the south will become aware of an approaching train before they reach a point where the train can be seen. The relative quietness of the approaching train was a contributory factor in the accident. Although people using the crossing have adequate visual warning of trains, the audible warning given by the horn, and the sound of the moving train, can be useful supplementary prompts.

Use of warning horn

86 The warning horns on the class 450 trains are in accordance with current standards and, if sounded, provide a clear indication of the approach of the train from a considerable distance away. The Railway Group Standard in force at the time the train was built was GM/RT 2180 issue 3 'Visibility and Audibility Requirements for Trains'. It required the train's warning horn to be audible at least 400 m along the track with a minimum sound pressure level of 120 dB at 5 m away and 94 dB at 100 m away.

87 The person who survived the accident, Ms G, did not recall hearing a warning horn. The on-train data recorder confirmed that the horn was used appropriately by the driver as the train approached the crossing, and subsequent checks by the RAIB on the train involved in the accident confirmed that the horn was working properly. The 'whistle' boards, although not required by standards at this location because of the good sighting available from the end of the path (paragraph 78), were provided following the fatal accident in 2003 because local Network Rail staff were concerned that the visibility from the approach path to the crossing was limited.

88 During later tests at the crossing (paragraph 94), the RAIB observed that a class 450 train horn sounded at or near the positions identified from the data recorder is distinct and clearly audible. The RAIB's investigation into the fatal accident at West Lodge crossing, Haltwhistle, on 22 January 2008 (paragraph 70) found that traffic noise overwhelming the sound of the train horn was a significant factor at a crossing where a trunk road runs immediately alongside the railway. The situation at Moor Lane is different: the road traffic is several hundred metres away, and while it increases the background noise level, it does not mask the train's horn. It is therefore likely that distraction and familiarity played a dominant role in the actions of the pedestrians, and the audibility of the train horn was not a contributory factor in the accident.

The crossing surface

89 The surface of the crossing was of planed timber, neither painted nor varnished (Figure 4). The orientation of the crossing timbers parallel to the direction of the footpath was unusual. However, tests carried out by the RAIB, using walking shoe soles weighted with concrete blocks and pulled across the surface, found that the slip resistance was the same in both directions, along and across the crossing.

90 The timbers were level, flush with the rail heads, and securely fastened down, using several different methods. Those on the outside (cess side) of the rails were fastened with hexagon-headed setscrews recessed into the surface. The timbers in the four-foot of the down line were nailed to longitudinal bearers using clout nails driven well into the wood. The other timbers were secured with dome headed fasteners, which protruded about 3 mm at their centres and did not represent a significant tripping hazard although they may have increased the risk of slipping.

91 The wide flangeway by the cess rail of the up line (paragraph 39) was large enough to accept an adult's walking shoe or boot (if the wearer were to turn sideways on the crossing), and some of the other flangeways were also wider than specified in the Network Rail company standard relating to surfaces at public crossings. The flangeways on the down line, where the accident occurred, were not wide enough for the shoes worn by Mrs Mansell to become trapped in them, and this was probably not a contributory factor in the accident. It is possible that Mrs Mansell may have stumbled as she turned, if her foot came off the edge of the crossing or lodged in the flangeway. However, from the tests and re-enactments that it carried out, the RAIB concludes that the position in which she was seen to fall, and was then struck by the train, make it most likely that she slipped on the surface of the crossing while turning round.

Slip resistance

92 Immediately after the accident, when personnel from the emergency services arrived, they noted that the crossing surface was wet and slippery and was treacherous to walk on.

93 There had not been any rain overnight, and it was a bright, clear morning. Dew was lying on the timber surface.

94 The RAIB examined the surface of the crossing, and at a later date carried out tests. On both occasions there was a thin layer of mud contaminating the surface of the timber. This appeared to have been trodden onto the crossing from the approach paths on both sides. There was no evidence of any unusual activity (such as construction work) anywhere in the vicinity of the crossing, and it seems likely that the mud was a normal by-product of the everyday use of the crossing by walkers.

95 The combination of mud and dew forms a slurry with very effective lubricating properties. The RAIB's tests found that there was little change in the static friction levels between the dry and wet states. However, further qualitative tests using volunteers wearing shoes similar to those worn by Mrs Mansell showed that the dynamic friction level was significantly reduced when the crossing surface was wet, making the crossing treacherous to walk on. When two surfaces are moving relative to each other, and are converging geometrically (not parallel), any fluid between them is being squeezed into a converging space as it is dragged along by the motion of the solid surfaces, and pressure is generated within the fluid. This pressure enables the film of fluid to withstand the applied loading. This effect is known as hydrodynamic lubrication[2], and is the principle behind the most common forms of bearings in machinery. It produces dramatic reductions in the coefficient of friction between the surfaces.

96 In practice, if a person's shoe begins to slip on a smooth, wet surface, the hydrodynamic effect is likely to develop very rapidly and create a pressurised film between shoe and surface, causing the slip to develop into a slide that may be very hard to control. The mud on the timber surface will also tend to fill irregularities in the surface, further reducing its slip resistance.

97 The investigation has not been able to discover any previous research relating to the slipperiness of level crossing surfaces. The Health and Safety Executive (HSE) has carried out research into the causes of falls on road vehicles[3], and as part of this work it measured the slip potential of a number of surfaces, including timber. The HSE research found that timber has a low slip potential in clean dry conditions. Wet contamination increased the slip potential to a high level, at which pedestrians would be expected to have difficulty walking on the surface. The RAIB concludes that the combination of dew and mud on the crossing was a causal factor in the accident.

98 The non-slip material specified by Network Rail (specification RT/CE/S/039 – RT98 section 5.12) for the surfaces of paths and level crossings consists of a naturally occurring aluminium oxide aggregate in various grades with particle sizes from 0.9 to 5 mm, fixed in either an epoxy or polyurethane resin.

99 The RAIB carried out tests on another crossing on the Windsor branch, where material which appeared to match this specification had been used as a non-slip coating on the timber surfacing of the crossing and the approach path. The tests found that the surface treated with a non-slip coating had a static coefficient of fiction between 54 % and 68 % greater than the untreated timber surface at Moor Lane. This effectively prevented a slip from developing into a slide, even in wet conditions.

The MIMS system

100 In 2005 the MIMS computer system was being used by Network Rail's maintenance organisation to hold, record and prioritise details of all maintenance work on the infrastructure. It had replaced an earlier system used in the Wessex area, known as 'IMPART', in 2003, and was itself succeeded by the current system, 'Ellipse', in 2007. All of these systems performed a similar function in respect of maintenance activities, and data relating to inspection results and work orders was rolled over from one to the other when the changeovers took place.

[2] *Introduction to Tribology*, J Halling, London, 1976, p. 111

[3] HSE Research Report 437 The underlying causes of falls from vehicles associated with slip and trip hazards on steps and floors. A Scott, M Miller and K Hallas. HSL Buxton 2006.

101 Notification that maintenance work on the infrastructure is required may arise from routine inspections (patrols), management inspections, incidents, public complaints, or scheduled preventive maintenance work. The details of the work required are recorded on a Work Arising Identification Form (WAIF), which carries the signature of the person authorising the work. The WAIF is then passed to a work scheduler or data entry clerk, for the details to be input to MIMS. This process involves creating a work order on the computer, for which the system generates a unique serial number.

102 If the details of a work order are entered incorrectly, it is possible for anyone with access to the system to amend or close it. However, the amendment is recorded on the system against the login details of the person making it. The amendment history cannot be changed by a user, and the work order is stored permanently on the system.

103 In normal circumstances, a work order is closed once the work it relates to has been completed. A certificate to this effect, signed by the person completing the work, must be passed back to the depot and the details entered on the system by a scheduler or data entry clerk. It is usual for the depot staff to amend or close work orders without reference to anyone else if they make an error in the data entry process and need to re-issue a corrected work order.

104 The RAIB's inquiries have been unable to discover why the work order for applying a non-slip surface to Moor Lane crossing was closed less than an hour after being created on the MIMS system (paragraph 68). There is no evidence of any systemic fault or misuse of the system. There is no explanation recorded for the closure other than the 'RE' code (for 'raised in error') entered in the relevant field. The same user login details are recorded for the creation and closure of the work order. There is no link to any replacement work order, which might have been expected if the original work order had been closed because some parts of it had been incorrectly entered (which does not appear to have been the case).

105 Various scenarios for human error have been discussed with Network Rail staff who have been responsible for operating and managing the MIMS system. It is possible that clerical errors might have resulted in a work order being closed incorrectly, but there is no evidence of this occurring on any other occasion at Feltham, and it appears that the deletion of the Moor Lane work order was an isolated instance.

106 Network Rail has in place procedures for auditing the accuracy and completeness of MIMS/Ellipse information. At present these require the Delivery Unit planning and resource co-ordinator to make a quarterly check of a sample of work orders selected at random by each depot team from a range of dates specified by the planning and resource co-ordinator. No relevant errors have been found in the work orders audited for Feltham.

107 From September 2008, the role of the planning and resource co-ordinator was taken by the Infrastructure Services Manager (ISM). The ISM (Clapham) is required to visit each depot every three months and select and audit Ellipse data on site.

108 The infrastructure maintenance manager, who had been responsible for raising the WAIF for a non-slip surface at Moor Lane, had no reason to suppose that the instructions that he had given would not be carried out, and did not personally check that the work had been done. The Network Rail system provides no feedback on the progress of work orders to the person who originates the request for work to be done.

109 The failure of Network Rail to apply a non-slip surface to Moor Lane crossing in 2005, following a request from HMRI to do so, is a causal factor in the accident.

110 The HMRI inspector who had made the request had been given written confirmation by the IMM that a work order had been raised. He then closed his file. It is for the safety regulator to decide whether to accept assurances of action from duty holders, based on their experience of the duty holder's performance (both at local and national level), or else to check on actions taken.

Action on public complaints

111 A member of the public contacted the RAIB during the course of the investigation, and alleged that complaints about various railway installations in the Staines area had not been taken seriously by Network Rail or HMRI.

112 However, apart from the incident described in paragraphs 62 to 69, no evidence of any previous public complaints relating to Moor Lane crossing has been located.

Identification of underlying causes

Risk assessment process

113 The process for formal risk assessment of footpath crossings, as applied to Moor Lane, is described at paragraphs 41 to 57. The application of the process, on at least three occasions over the ten year period since it was introduced, did not identify the risk of slipping on the crossing surface. The Railway Group Standard (GI/RT7012) requires slipping hazards to be taken into account when selecting a type of crossing surface, but does not give any guidance on how this should be applied in practice.

114 There was no information given in any guidance provided by Railtrack or Network Rail for people carrying out crossing inspection on criteria which might prompt improvements to the surface.

115 There are five footpath crossings on the line between Staines and Windsor. At the time of the accident in April 2008, three of these had non-slip surfaces and two, including Moor Lane, did not.

116 Examination of the records relating to the other crossings has provided some information on when non-slip surfaces were provided, but the reasons why can only be surmised. It appears that one of the crossings (Rifle Range, at 21 miles 11 chains between Staines and Wraysbury) had a non-slip surface provided some time between 1992 and 1996. The crossing at Riffolds (21 miles 75 chains, between Wraysbury and Sunnymeads) was noted as having a non-slip surface in May 1997, and the crossing at Fleet (22 miles 64 chains, near Sunnymeads station) had been so equipped by February 1996. As noted in paragraph 42, an inspection of Moor Lane crossing in 1996 identified that it lacked a non-slip surface, but Railtrack did not take any action at that time.

117 All three crossings are lightly used, almost entirely for leisure purposes, and there is no other apparent reason why they should have been singled out for upgrading. The two crossings which were not given non-slip surfaces, at Moor Lane and Moor Farm (19 miles 53 chains, near Staines), are closer to large areas of housing and appear to be more used than the other three.

118 Before the creation of Railtrack in April 1994, crossing inspections were carried out by British Rail's area movements inspectors. It appears from the surviving records that the area movements inspectors communicated directly with the maintenance organisations, made requests for work to be done following their six-monthly inspections, kept their own record of what they had asked for, and followed up the results at the next inspection. There is evidence of requests for non-slip surfaces being made in this way, and of the improvements subsequently being made (paragraph 116). It is possible that these requests may have been made following an inspection in wet weather when the slippery nature of the timber surface was evident.

119 The guidance given in RSPG 2E that non-slip surfaces should be provided on timber crossings does not have retrospective application. Railtrack and Network Rail have not had any policy of generally providing such surfaces on footpath crossings, although many individual crossings do now have them.

120 Network Rail has a general duty under section 3 of the Health & Safety at Work etc Act 1974 to conduct its undertaking in a way which ensures, so far as is reasonably practicable, that persons not in its employment are not exposed to risks to their health or safety. This duty requires, among much else, that the company should assess the risk associated with its existing equipment and working practices, and implement control measures to reduce the risk so far as is reasonably practicable. In the context of footpath crossings, the risk to the public of injury or death resulting from a slip on a wet timber surface is clear. The control measure, of providing and maintaining a non-slip surface, does not appear to the RAIB to be grossly disproportionate to this risk and thus appears to pass the test of reasonable practicability.

121 It has been suggested by some staff who have been involved in the crossing risk assessment process that 'reasonably practicable' opportunities for upgrading crossings to the standard of RSPG 2E could be provided by renewal of the surface caused by major track works. However, both lines through Moor Lane were renewed during 2005, and the crossing surface appears to have been replaced to the same standard (untreated timber) as was present before the renewal, although it is apparent from photographs that the actual planking was new. If a non-slip surface had been added to the crossing at the time the surface was renewed, the additional cost would have been very small.

122 The current specification for risk assessment (NR/SP/OPS/100) does not refer to RSPG 2E. Railtrack and Network Rail have based company policy on the stated absence of retrospective effect for the RSPG. The consequent absence of any guidance on what 'reasonably practicable' means in the context of upgrading level crossings has led to acceptance of the status quo by assessors. This is an underlying cause of the accident.

Crossing the railway

123 The crossing at Moor Lane is occasionally used by people tending grazing animals on the moor, but it is mainly used for leisure purposes to gain access to the moor, which is open land with no buildings or other premises on it. There are bridges over the railway 644 yds (589 m) south-east and 320 yds (293 m) north-west of the crossing, both of which provide alternative routes on to the moor.

124 Closure of the crossing would remove the risk to pedestrians. British Rail considered a proposal to close the crossing in 1978, but reached the conclusion at that time that there was little possibility of diversion or extinguishment of the public footpath. Following the nearby fatality on 17 September 2003, Network Rail again investigated the possibility of closing the crossing. There were indications that the Staines Moormasters (who administer the use of the common lands known as Staines Moor) would have objected to the closure, and no further action was taken. The crossing's status as part of a public footpath means that if Network Rail wishes to close the crossing, it must apply to the local authority to make an order under section 118A of the Highways Act 1980. The grounds for proposing closure under this section are that it would be expedient for the safety of the public using the crossing. Users of the footpath are entitled to object to any proposal for diversion or closure of the path. If objections are received and cannot be resolved, the order must be submitted to the Secretary of State for Transport for decision, which will usually result in a public inquiry into the proposed closure. Before making the order, the council or the Secretary of State must have regard to whether it is reasonably practicable to make the crossing safe for use by the public. The crossing at Moor Lane has good visibility of approaching trains in both directions.

125 The difficulty of closing the level crossing, and its consequent continued availability to members of the public as a footpath, was an underlying cause of the accident. The legal framework relating to level crossings is currently under review by the Law Commission, and the closure process is one of the areas being considered.

Severity of consequences

126 The obstacle deflector and guard irons provided at the front of the train were effective in preventing Mrs Mansell from being run over by the train, and throwing her clear of the line. However, at the speed the train was travelling, it was not possible to survive the impact.

Other factors for consideration

The decision point

127 A person using a level crossing which is not protected by warning lights or barriers must make a decision on whether it is safe to cross the railway. To make this decision, they need reliable information about the whereabouts of any approaching trains. In the case of a footpath crossing, this information is usually visual, but may be supplemented (or in some cases overridden) by audible warnings.

128 Where the user relies on seeing approaching trains, there is a point at which the best possible view down the line is obtainable while the user is still in a place that is clear of passing trains (a position of safety). This is known as the final decision point, but its position is not formally marked by any visual indicator.

129 Users may also be influenced to make a decision to cross by the position of the warning notices which tell them to 'Stop – Look – Listen'. The notices provide an indicator of a possible place to stop and look. If they are not close to the final decision point they may mislead people into deciding, prematurely and with insufficient information, that it is safe to cross the line.

130 In the case of Moor Lane crossing the notices are very close to the fence posts at the end of the approach paths on both sides of the line which mark the final decision point. A person standing in a position where they can read the notice on the south side of the line can see only a limited distance (about 100m) towards Staines. Mrs Mansell was very familiar with the crossing and is known to have been aware of the hazards there. It is not likely that the position of the notice was a factor in the accident..

131 At one of the other footpath crossings on the Windsor branch which was visited as part of the investigation (Fleet crossing, near Sunnymeads station), one of the warning notices was positioned about 20m back from the final decision point. This seems likely to have happened when the crossing was repositioned and realigned some years ago, and the notice was not moved. Network Rail has since repositioned the notice close to the final decision point, but it is a matter of concern that the error was not previously identified by any of the regular inspections and risk assessments that were carried out at that crossing (Recommendation 4).

Anti-trespass guards

132 The guards on either side of the crossing (see paragraph 38 for description, and figure 5) are of the type referred to in guidance documents as cattle-cum-trespass guards. These are required (RSPG section 2E, paragraphs 174 to 179, and Railway Group Standards GE/RT8025 and GI/RT7012) on all crossings on lines electrified on the conductor rail system, and on other crossings where there is regular and frequent movement of cattle on the hoof, or where there is a significant risk of trespass by pedestrians.

133 The guards have two purposes:

(a) to prevent animals from straying from the crossing onto the line; and

(b) to deter pedestrians from trespassing on the railway, especially where there is a particular risk of electrocution, such as a conductor rail.

134 At a footpath crossing such as Moor Lane, the kissing gates prevent large animals from approaching the crossing, so the guards are mostly redundant for purpose (a) as regards the safety of trains. They are some use in preventing dogs that are not on leads from straying onto the line. The value of this should not be discounted, because incidents in which pedestrians are struck by trains while trying to prevent their dogs from being hurt occur regularly (there have been two fatal accidents from this cause in 2008).

135 The value of anti-trespass guards in preventing accidents to people is doubtful. They are perceived to be difficult to walk on, and so do have a deterrent value. They also serve to separate the crossing from the conductor rail ends. However, it is quite possible for a determined person to walk over the guards, and indeed it is necessary for anyone with legitimate business that involves walking along the railway to walk across the anti-trespass guards, since at many crossings (including all those on the Windsor branch) no alternative route is provided, and there are fences extending from the end of the approach paths along the length of the anti-trespass guards.

136 The guards are supposed to be fitted ‘adjacent’ (RSPG 2E paragraph 177) to the footway. In practice there may be a small gap between the footway and the end of the guard rails (Figure 5). This may create a hazard in which a person’s foot can become trapped, should they stumble or slip off the footway itself. This hazard would be eliminated if there were a substantial gap (more than 300 mm) between the crossing and the anti-trespass guard, but this is not permitted in the current guidance.

137 At Moor Lane, there were gaps between some of the rails of the guards and the crossing surface, particularly in the four-foot adjacent to the cess rail at the London end of the crossing. The forensic and witness evidence indicates that Mrs Mansell was not near this edge of the crossing, and her foot was not trapped in one of these gaps.

138 The gaps are created when the anti-trespass guards are installed. The guard units are manufactured to standard dimensions to suit crossings which are at right angles to the track, and have to be modified on site to suit skew crossings such as the one at Moor Lane. If this modification is not carried out carefully and thoroughly, there are likely to be gaps in the finished installation.

139 For these reasons it is appropriate to consider whether the current design of anti-trespass guards is suitable at footpath crossings where there is no access for large animals, and whether the risks created by the design of the guards outweigh whatever effect they have in controlling the risks from trespass.

140 At the time of the fatal accident to a child near Moor Lane in 2003, the anti-trespass guards at the crossing were in poor condition. The investigation found that there was no definite connection between the condition of the guards and the accident, which involved children playing on the river bridge. However, the occurrence of the accident caused the compliance of the guards with the relevant standard to be queried. One of the responses to the accident was to repair them.

141 On balance, the presence of anti-trespass guards is beneficial to the safety of the public because of their deterrent value. However, they do not physically prevent trespass and their presence should not be regarded as a substitute for more effective protective measures or the exercise of reasonable care by crossing users.

Conclusions

Immediate cause

142 The immediate cause of the accident was that Mrs Mansell fell to the ground on the crossing and was unable to avoid being struck by the approaching train (paragraph 71).

Causal factors

143 Causal factors were:

a. Mrs Mansell did not stop, look and listen before stepping onto the crossing (paragraph 77).

b. The surface of the crossing was slippery (paragraph 97, **Recommendation 1**).

c. Network Rail had not added a non-slip surface to the crossing, although this had been considered by Railtrack in 1996 and requested by HMRI in 2005 (paragraphs 109, 110**, Recommendation 2**).

Contributory factors

144 The following factors were considered to be contributory:

a. The angle, relative to the railway, of the south-eastern approach path and the crossing itself (paragraph 80).

b. The relative quietness of the combination of a modern train and track recently relaid with continuous welded rail (paragraph 85).

c. The level of background noise at the crossing (paragraph 81).

Underlying causes

145 The underlying causes of the accident were:

a. The risk assessment processes operated for footpath crossings by Railtrack and more recently by Network Rail did not identify the risk of slipping on a timber surface, and as a result a non-slip surface was not provided at the crossing (paragraph 122**, Recommendation 3**).

b. The difficulty of closing the level crossing, and its consequent continued availability to members of the public as a footpath (paragraph 125).

Actions reported as already taken or in progress relevant to this report

146 Over the weekend of 17/18 May 2008 Network Rail applied a non-slip surface to Moor Lane crossing, reduced the width of the flangeway gaps in the up line, and repainted the white lines along the edges of the crossing.

147 Since the accident, Network Rail has issued the Ellipse Management Handbook, covering the operation of the computer system used by its maintenance organisation. This requires all cancellations to be accompanied with a written authority from the appropriate Manager and duplicated in the comments field in Ellipse.

Recommendations

148 The following safety recommendations are made[4]:

Recommendations to address causal factors and underlying causes

1 Network Rail should assess the risk to crossing users from slippery surfaces at all footpath, bridleway and user worked crossings, and take appropriate measures, such as the provision of a non-slip surface, to reduce them so far as is reasonably practicable (paragraph 143b).

2 Network Rail should review the operation of the 'Ellipse' computer system and the associated processes for managing work orders, and ensure that appropriate controls are in place to prevent the premature or inadvertent closure of work orders (paragraph 143c).

3 Network Rail should revise document NR/SP/OPS/100 to provide better guidance for risk assessors at level crossings on what level of upgrading of the crossing to improve safety can be regarded as reasonably practicable (paragraph 145a).

Recommendation to address other matters observed during the investigation

4 Network Rail should revise the guidance it gives to staff inspecting level crossings, ensuring that the importance of the correct position and layout of the warning signs is adequately emphasised (paragraph 131).

[4] Those identified in the recommendations, have a general and ongoing obligation to comply with health and safety legislation and need to take these recommendations 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, these recommendations are 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 at www.RAIB.gov.uk.

Appendices

Appendix A - Glossary of abbreviations and acronyms

ALCRM	All level crossing risk model
AMI	Area movements inspector
DC	Direct current
EMU	Electric multiple unit
HMRI	Her Majesty's Railway Inspectorate
HSE	Health & Safety Executive
IMM	Infrastructure maintenance manager
MIMS	Mincom Information Management System
OTDR	On-train data recorder
RAIB	Rail Accident Investigation Branch
RSPG	Railway safety principles and guidance
SWT	South West Trains
WAIF	Work arising identification form

Appendix B - Glossary of terms

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

Cess	The area of the track bed outside the edge of the ballast.*
Chain	A unit of length, equivalent to 22 yards or about 20 metres. There are 80 chains in one mile.*
Conductor rail	An additional rail, used to convey and enable collection of electrical traction current at track level.*
Continuous welded rail	A rail of length greater than 37 metres (120'), produced by welding together standard rails, or track constructed from such rails.*
Down line	Line normally used by trains travelling towards Windsor.
Electric multiple unit	An electrically powered train consisting of one or more vehicles (semi-permanently coupled together) with a driving cab at both ends. Some or all of the vehicles may be equipped with powered axles.*
Flangeway	The gap between the inner edge of the running rail and the timber surface of a level crossing.
Flat bottom rail	A rail section having a flat based rail foot or flange.*
Four-foot	The area between the two running rails of a standard gauge railway.*
Mincom Information Management System	A work planning system used by Network Rail, replaced by Ellipse.*
Railway Group Standard	A document, produced by the Rail Safety & Standards Board, mandating the technical or operating standards required of a particular system, process or procedure to ensure that it interfaces correctly with other systems, process and procedures.*
Six-foot	The area between the two tracks of a double line railway.*
Up line	Line normally used by trains travelling towards London.

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Any enquiries about this publication should be sent to:

RAIB
The Wharf
Stores Road
Derby UK
DE21 4BA

Telephone: 01332 253300
Fax: 01332 253301
Email: enquiries@raib.gov.uk
Website: www.raib.gov.uk