



Rail Accident Investigation Branch

Rail Accident Report



**Near-miss on Victory level crossing, near
Taunton, Somerset
19 December 2009**

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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Near-miss on Victory level crossing, near Taunton, Somerset, 19 December 2009

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Summary

During the evening of 19 December 2009, a wheelchair user suffered a near-miss with a train on Victory level crossing, near Taunton in Somerset. One of the front wheels of his wheelchair became embedded in an area of ballast at the edge of the crossing, with part of the wheelchair obstructing the down line.

Shortly after this happened, a train approached on the down line and the wheelchair user was forced to pull himself out of the wheelchair, which was subsequently struck by the train. The wheelchair user suffered minor injuries in the incident.

The RAIB has made four recommendations to Network Rail concerning level crossing surfaces, level crossing inspections, minimising the hazards to users of small-wheeled vehicles on level crossings and the management of safety-related work at level crossings.

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 The terms 'up' and 'down' in this report are relative to the direction of travel; the down line runs from Taunton to Exeter. The terms left and right are also relative to the direction of travel.
- 4 Appendices at the rear of this report contain the following:
 - 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.

The Incident

- 5 At around 18:40 hrs on 19 December 2009 an unaccompanied wheelchair user was traversing Victory level crossing, located approximately 3 miles west of Taunton, in Somerset, travelling from the north side of the crossing to the south side (figure 1). As he approached the south side of the crossing, the front right-hand wheel of his wheelchair became trapped in an area of *ballast* located in the south-west corner of the crossing (figure 2). While he was attempting to free the wheel, the level crossing audible warning tone sounded to warn of an approaching train. Unable to free the wheel, the wheelchair user took hold of a nearby fence and pulled himself free from the wheelchair. Moments later the train passed over the level crossing and struck the back wheel of the wheelchair.

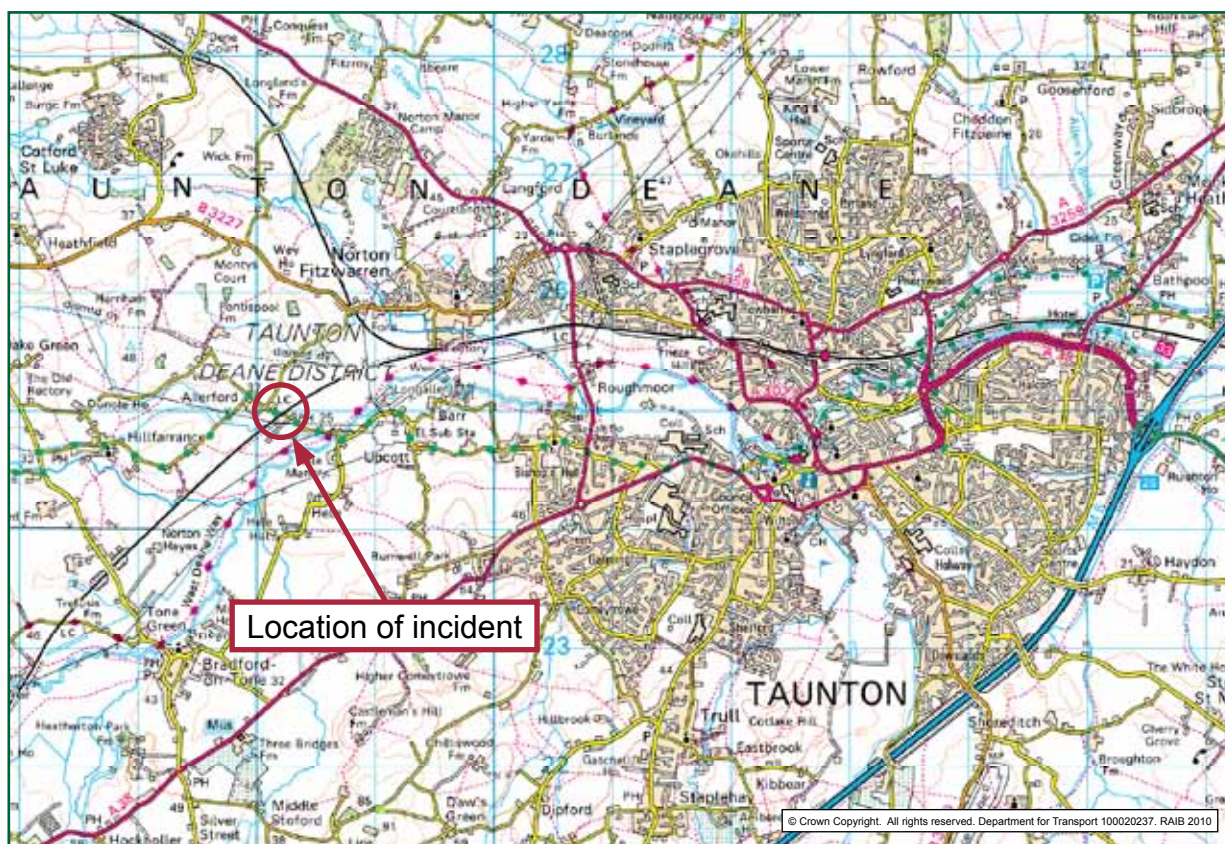


Figure 1: Extract from Ordnance Survey map showing location of incident

- 6 The wheelchair user was not struck by the train but suffered bruising to his leg when he fell to the ground after pulling himself from the wheelchair. He was left shaken by the incident. A passer-by used a telephone at the level crossing to speak to the signaller. The signaller stopped trains from approaching the level crossing and called the ambulance service. The Rail Accident Investigation Branch and the British Transport Police were also notified and commenced investigations into the incident.

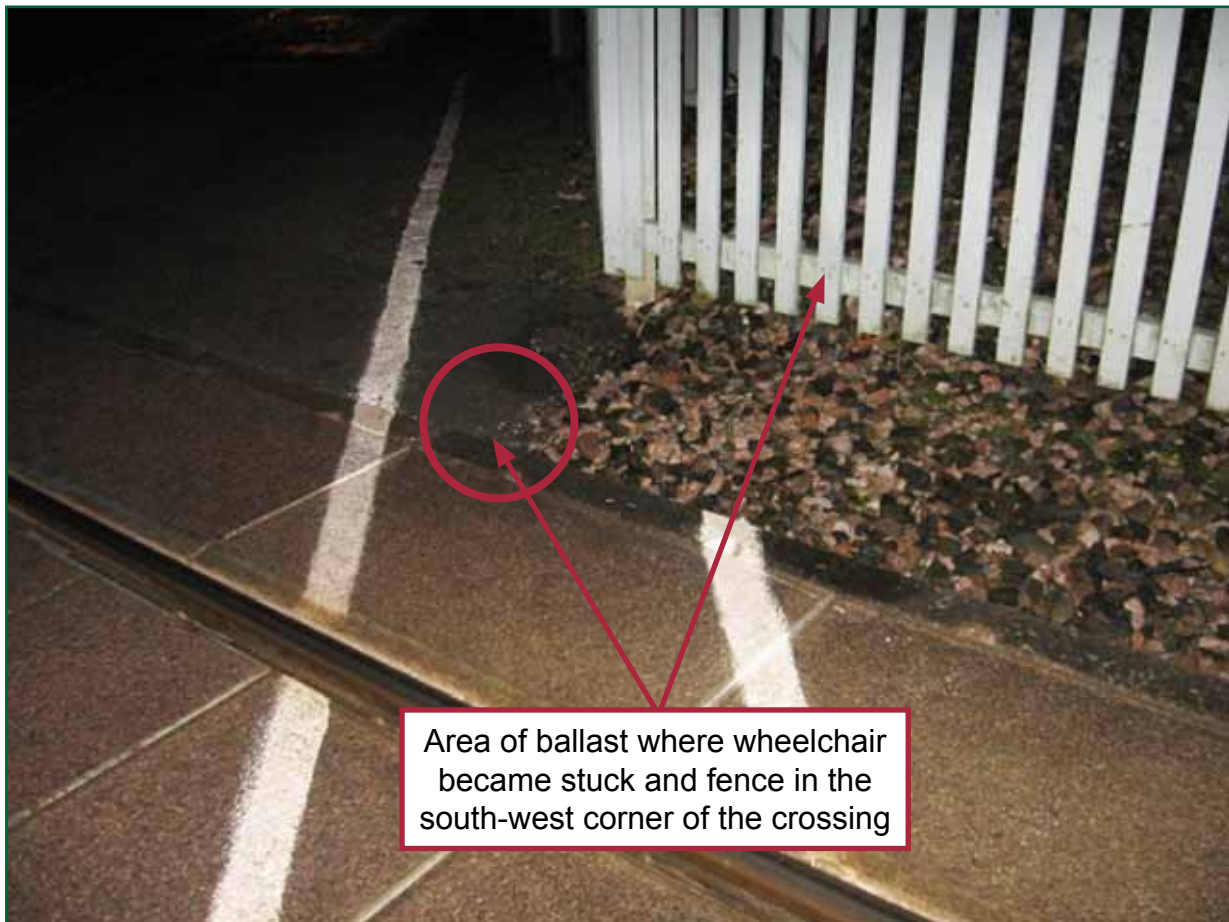


Figure 2: Area of ballast and fence in south-west corner of the crossing (photograph courtesy of Network Rail)

Organisations involved

- 7 Network Rail owns and maintains Victory level crossing and employs the local *off-track gang* responsible for ongoing maintenance activities at the crossing, and the level crossing inspectors responsible for the inspection of the level crossing.
- 8 High Output Track Renewals (HOTR) is a department within Network Rail that managed a project between 2006 and 2009 to renew the rails between Taunton and Exeter.
- 9 Dean and Dyball (now Birse Rail but referred to as Dean and Dyball within this report) were contracted by Network Rail to carry out work to the surface of Victory level crossing in March 2007. As part of this work, Dean and Dyball arranged for a sub-contractor to lay *asphalt* and paint white lines on the crossing.
- 10 Arriva CrossCountry operated the train that struck the wheelchair on Victory level crossing and employs the driver of that train.
- 11 An inspector from the Office of Rail Regulation carried out an inspection at Victory level crossing in February 2008.

Location

- 12 Victory level crossing is located on the line between Taunton and Exeter and is approximately 3 miles west of Taunton. The road over the level crossing is a minor road in a rural location linking the villages of Allerford, Hele and Upcott.
- 13 The level crossing crosses the railway at an angle of 55° (figure 3). Around 98 trains pass over the crossing each day, of which the vast majority are passenger trains that approach the crossing at or near to the maximum permitted line speed of 100 mph (160 km/h in both directions).

External circumstances

- 14 It was dark and dry at the time of the incident.

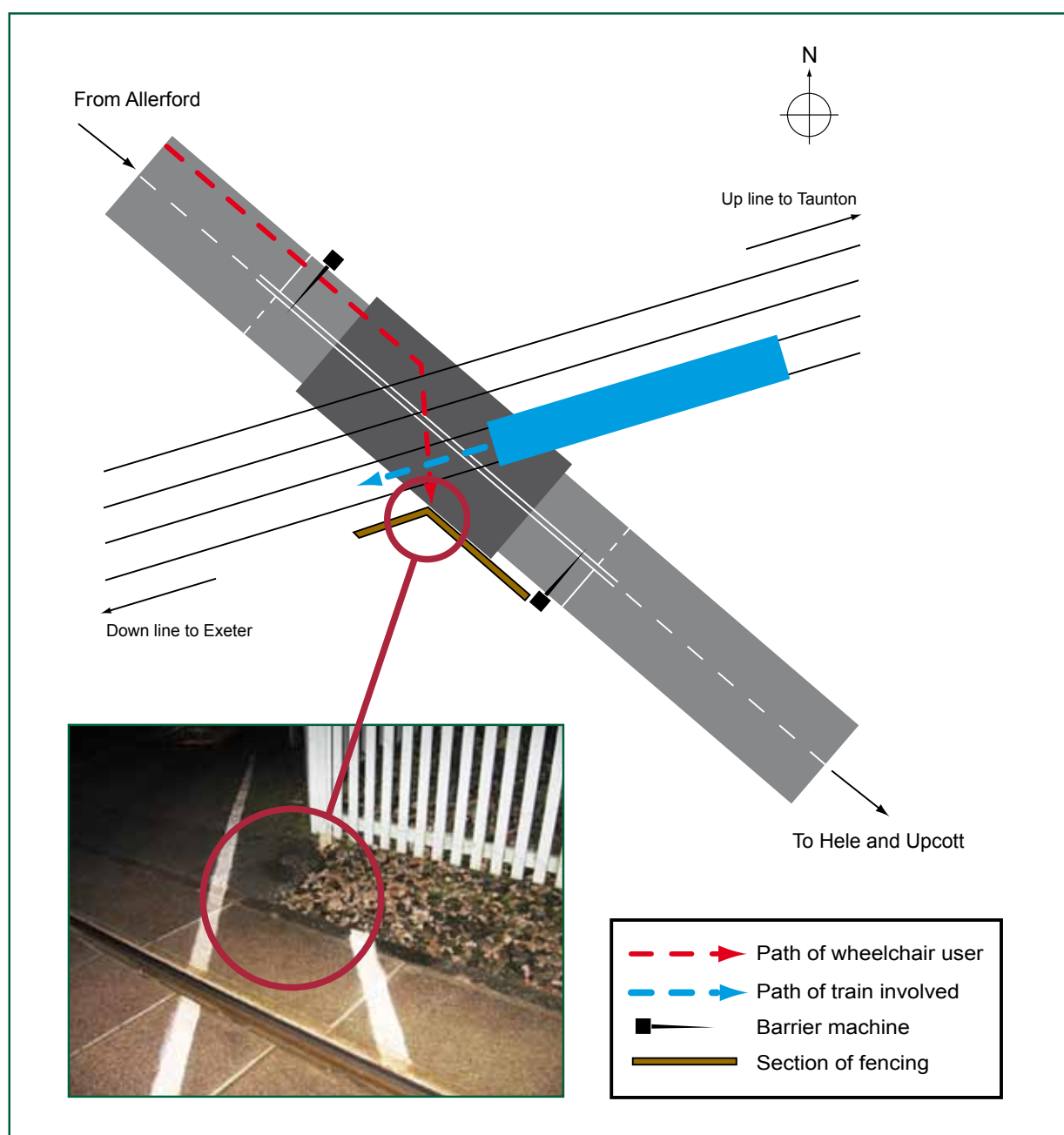


Figure 3: Track layout (not to scale)

Train involved

- 15 The train that struck the wheelchair was the 08:20 hrs Aberdeen to Penzance service. The train was a class 221 'Super Voyager' diesel electric multiple unit.
- 16 The RAIB has found no evidence that the driving of the train, its design or condition, were factors in this incident.

Equipment and infrastructure involved

- 17 The overall design requirements to be met by Victory level crossing are laid down in a *level crossing order*.
- 18 Victory level crossing is an *automatic half barrier* level crossing, which is activated by approaching trains striking a *treadle* located around 1800 metres on the approach to the crossing. The configuration equipment at the crossing initiates the following sequence of events once an approaching train has struck the treadle:
 - Steady amber road traffic lights are illuminated and an audible warning tone sounds.
 - After three seconds the amber lights extinguish and two red lights flash alternately. The audible warning tone continues to sound.
 - Four to six seconds later the half barriers descend.
 - The fastest train (paragraph 13) will reach the crossing at least 27 seconds after striking the treadle.
 - When the crossing is clear the barriers begin to rise, the audible warning tone stops and the red lights are extinguished (unless another train, in the meantime, has activated the crossing controls).
- 19 The RAIB checked the operation of Victory level crossing and found that it complied with its design specification.
- 20 The level crossing surface comprises pre-fabricated rubber panels. The railway lines pass through gaps between panels. The flanges of rail vehicle wheels pass through gaps between the rails and adjacent panels, referred to as *flangeway gaps*. Network Rail standard NR/SP/SIG/19608 (later re-numbered to NR/L2/SIG/19608 and referred to as such in the remainder of this report) states that the flangeway gap shall not be less than 55 mm wide to allow for the safe passage of train wheels (figure 6). If the flangeway gap is too small the wheels of passing trains could contact the edge of the crossing surface and damage it creating a derailment risk and a hazard to crossing users.
- 21 At Victory level crossing the flangeway gaps were measured to vary between 55 and 62 mm.
- 22 Edge beams (figure 4) are installed on the north and south sides of the crossing to secure the outer crossing panels and to provide an edge for the asphalt section that is used to fill the gap between the crossing panels and the road approaches.
- 23 A footway for pedestrians is marked out over the level crossing surface to provide a walking area clear of the road carriageway. Cattle-cum-trespass guards (figure 4) are installed along the east and west sides of the crossing panels to deter animals and trespassers from gaining access to the railway lines.

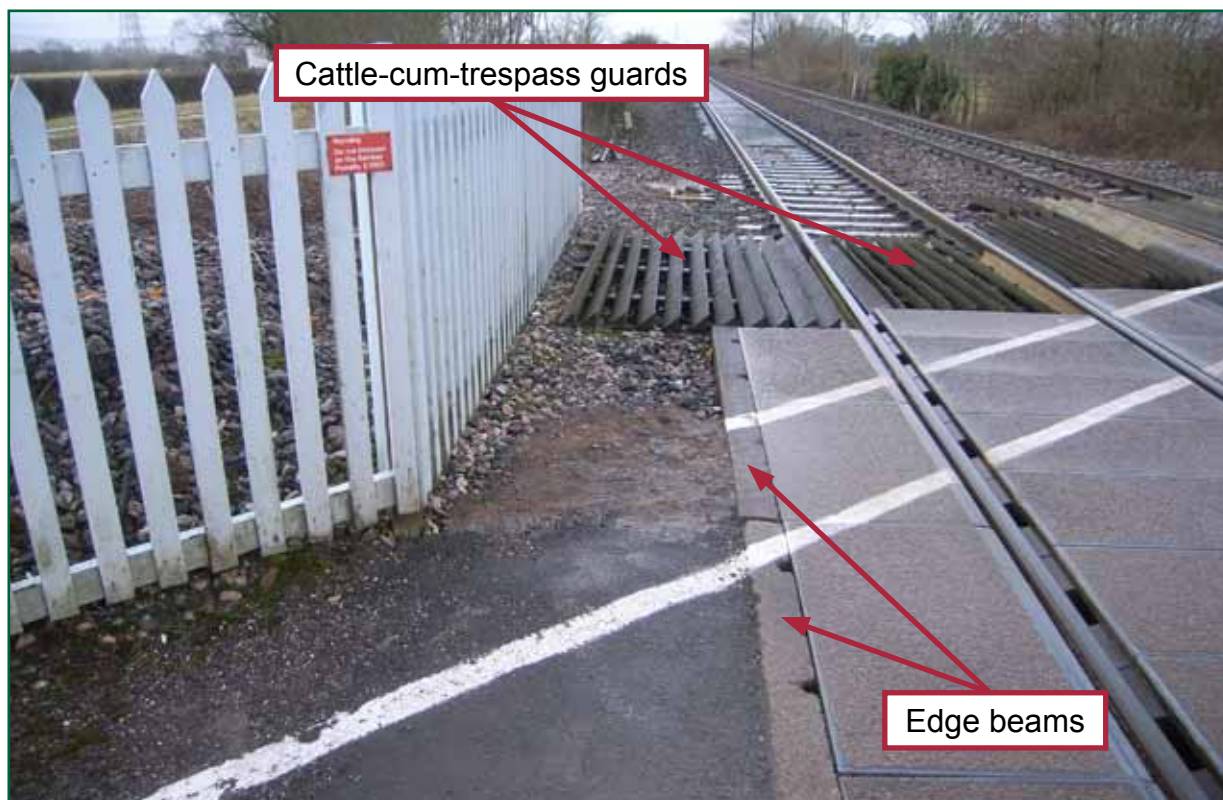


Figure 4: Position of edge beams and cattle-cum-trespass guards

- 24 There is no lighting and no footpath on either road approach to the level crossing, and no lighting on the level crossing itself.
- 25 The wheelchair that was struck by the train was a specialist light-weight wheelchair of titanium construction. The front wheels are free to swivel through 360°. The front wheels are smaller than a typical National Health Service (NHS) wheelchair, and are approximately 23 mm wide (figure 5). Typically, the front wheels of a NHS wheelchair are approximately 27 mm wide and are also free to swivel through 360°.

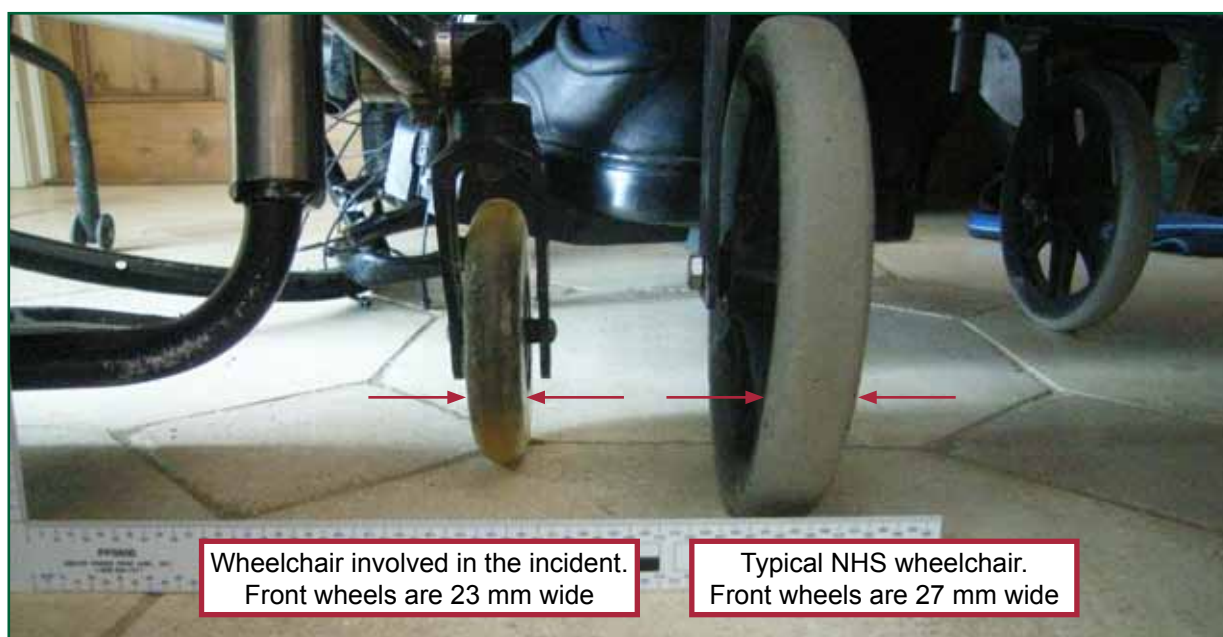


Figure 5: Wheels of wheelchair involved in incident (left) and standard NHS wheelchair (right)

Events preceding the incident

- 26 At around 18:30 hrs on 19 December 2009, an unaccompanied wheelchair user left his house located around 175 metres from the north side of Victory level crossing. His destination was on the same road, but south of the level crossing. The wheelchair user was a regular user of the level crossing.
- 27 He approached Victory level crossing on the left-hand side of the road (in the normal direction of road traffic). As he made his way over the crossing, the wheelchair user reported that he had negotiated the four flangeway gaps (two for the up line and two for the down line) by lifting the front wheels slightly and moving the wheelchair forward on its rear wheels, before setting the front wheels down again. In order to minimise the risk of the front wheels of the wheelchair becoming trapped in the flangeway gaps, he reported that he had elected to cross over them at right angles. Since the crossing was skewed in relation to the railway lines this approach meant that the wheelchair moved progressively towards the south-west corner of the level crossing.

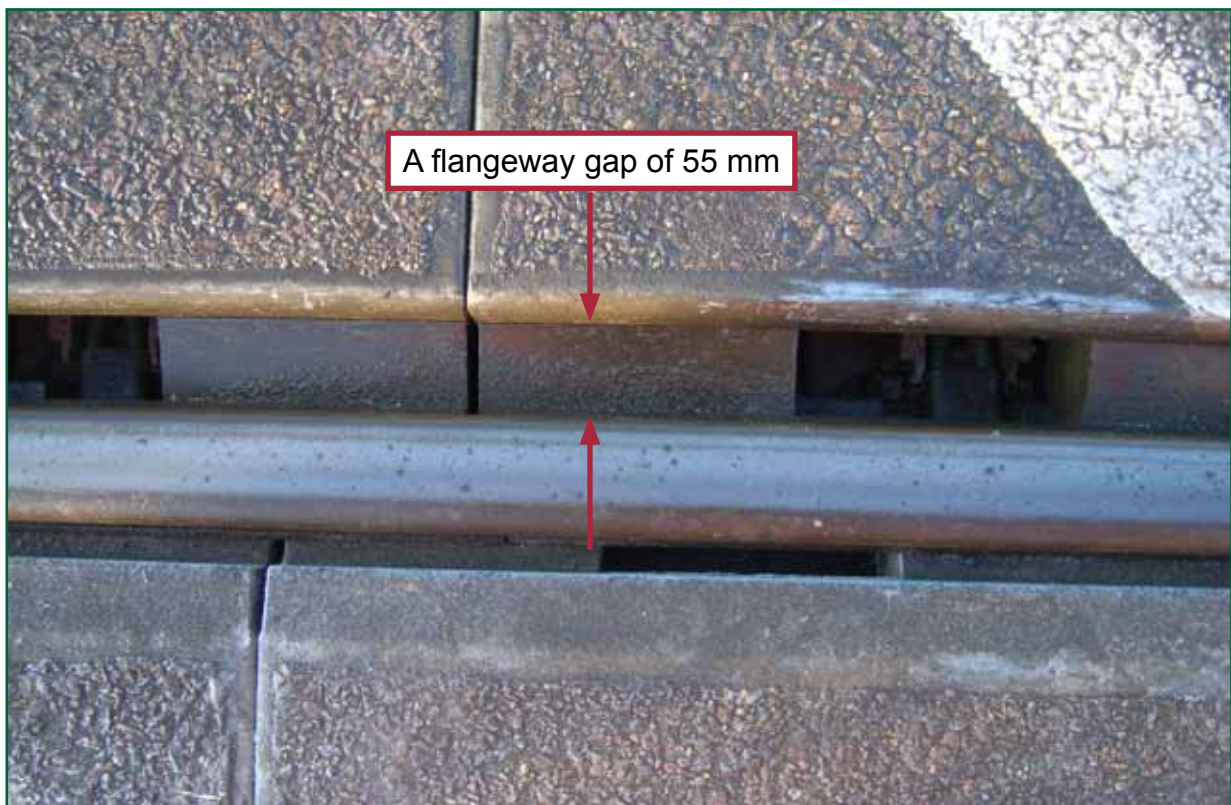


Figure 6: Example of the flangeway gap at Victory level crossing

Events during the incident

- 28 The wheelchair user reported that as he traversed the final flangeway gap on the down line one of the front wheels dropped off the level crossing surface panel into an area of ballast in the south-west corner. Almost immediately, the audible warning tone began to sound indicating that a train was approaching the level crossing. The wheelchair user reported that shortly afterwards he had looked to his left and saw the headlights of a train approaching on the down line. Looking behind, he saw that the rear wheels of his wheelchair were very close to the nearest rail on the down line.

- 29 Concerned that he may be struck by the approaching train, and still unable to free the front wheel of his wheelchair, the wheelchair user decided to lean forward and pull himself free from his chair by holding on to a nearby fence (figure 2).
- 30 Soon after he had released himself from the chair, the train passed over the level crossing and struck the rear wheel of the wheelchair.

Consequences of the incident

- 31 The wheelchair suffered significant damage (figure 7). The wheelchair user suffered some bruising to his right leg when he pulled himself from the wheelchair and was left shocked by the incident.



Figure 7: The damaged wheelchair

Events following the incident

- 32 A passer-by found the wheelchair user lying close to the fence alongside the down line and used the crossing telephone to call the signaller.
- 33 The signaller operated railway signals to protect the level crossing, although at the time there were no other trains in the area. The signaller requested an ambulance and reported the incident to Network Rail control.

- 34 The signaller identified the train that struck the wheelchair as the 08:20 hrs Aberdeen to Penzance service. The signaller contacted the driver promptly. The train driver recalled feeling a slight bump but had not seen anything unusual when the train passed over Victory level crossing.
- 35 The wheelchair user was escorted back home following treatment by paramedics.
- 36 Workers from the local Network Rail off-track gang attended Victory level crossing later that night and laid concrete over the area of ballast where the wheelchair user had become trapped, to provide a temporary level surface (figure 8).

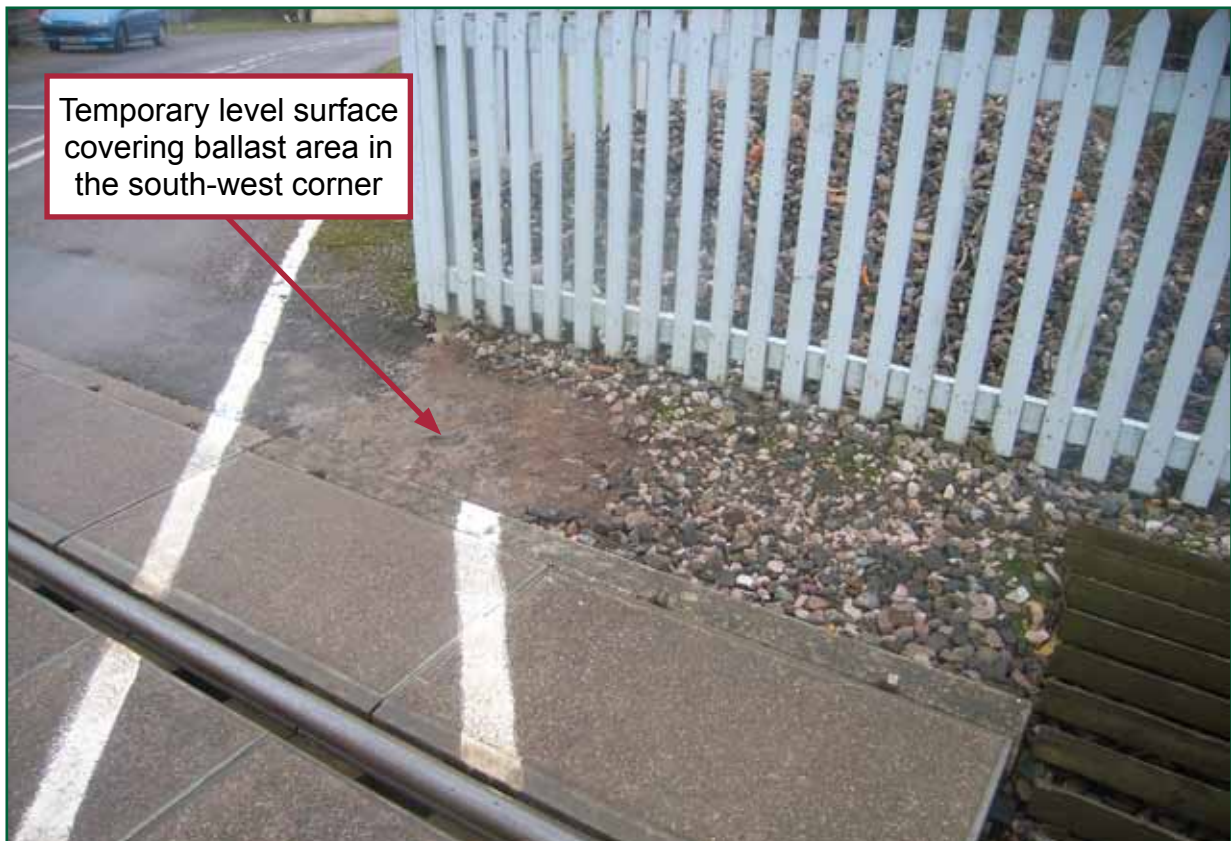


Figure 8: Interim work carried by Network Rail following the incident to provide a level surface

The Investigation

Sources of evidence

37 The following sources of evidence were used:

- witness interviews;
- site photographs and measurements;
- Network Rail level crossing information;
- Network Rail company standards;
- Railway Group Standards;
- records supplied by the Office of the Rail Regulator, Birse Rail (formally Dean and Dyball) and Network Rail;
- a review of previous reported occurrences of near-miss incidents involving wheelchair users on level crossings; and
- a review of international studies on level crossing safety for wheelchair users.

Key Facts and Analysis

Identification of the immediate cause¹

- 38 **One of the front wheels of the wheelchair became stuck in an area of ballast in the south-west corner of the crossing.**
- 39 Since March 2007, the crossing surface included an area of ballast approximately 1 metre wide and 2.4 metres long at the south-west corner (figures 2 and 3). The wheelchair user had used the crossing on most days since then. On this occasion, the course taken by the wheelchair user directed him towards it and he either misjudged his position or was distracted and his front wheels encountered the ballast.

Identification of causal² and underlying³ factors

The relaying of Victory level crossing in March 2007

- 40 **When the down line through Victory level crossing was re-laid in March 2007, the asphalt strip on the south side of the crossing was not replaced along the full length of the crossing. A section of ballast was left in the south-west corner. The non-application of asphalt to the full length of the south side of the crossing is a causal factor in this incident.**
- 41 In 2006, Network Rail began a project to renew the rails between Taunton and Exeter. The project was managed within Network Rail by the HOCR department and involved sub-contracted parties both internal and external to Network Rail. The sub-contracted arrangements also involved further sub-contracts and a complex arrangement of roles and responsibilities.
- 42 The first phase of the project began in 2007 and involved renewing the rails on the down line. This work required the removal and replacement of Victory level crossing to allow the HOCR relaying train room to operate.
- 43 Photographic evidence from August 2006 shows the condition of the crossing before this work took place. It indicates that the asphalt that filled the gap between the level crossing surface and the road highway originally extended beyond the corner fence post towards the end of the edge beam on the south side (figure 9).
- 44 The work at Victory level crossing was scheduled to take place in stages between 10 March 2007 and 18 March 2007, with the first task being removal of level crossing components on 10 March 2007. The road over the crossing was closed between 10 March and 18 March 2007.

¹ The condition, event or behaviour that directly resulted in the occurrence.

² Any condition, event or behaviour that was necessary for the occurrence. Avoiding or eliminating any one of these factors would have prevented it happening.

³ Any factors associated with the overall management systems, organisational arrangements or the regulatory structure.

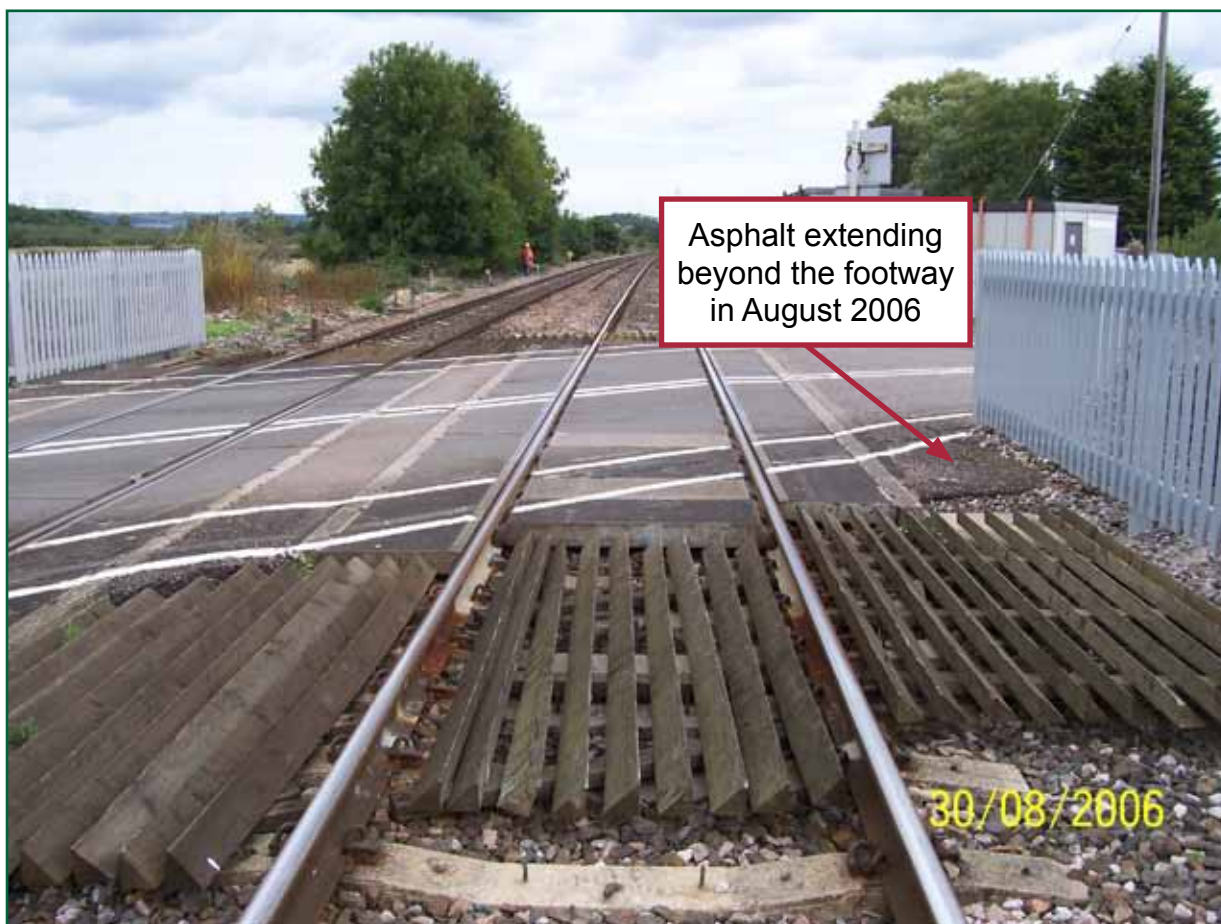


Figure 9: The asphalt section in August 2006 (photograph courtesy of Network Rail)

- 45 Before the work at Victory level crossing took place, a site visit was arranged to assess its scope. The site visit was attended by representatives from Dean and Dyball, the sub-contractor who was to carry out the asphaltting and white line painting, and the local Network Rail off-track gang. The work was assessed as being a direct like-for-like replacement of the asphalt and road studs (also known as cat's eyes) and repainting of the white line road and footway markings over the level crossing. Evidence indicates that at the site visit neither the *ground plan* (paragraph 58) nor level crossing order (paragraph 59) were referred to. This was normal practice locally when a like-for-like replacement of a crossing (or part of a crossing) was being made.
- 46 Overnight on Saturday/Sunday 10/11 March 2007, the existing asphalt surface between the edge beams and the road approach on the south side of the crossing was removed. The work was carried out by the sub-contractor. Representatives from Dean and Dyball and the Network Rail off-track gang were also present.
- 47 The following week, on the night of 17/18 March 2007, the local Network Rail off-track gang fitted new crossing panels to recreate the down side section of the level crossing. The down line edge beams were also re-installed. A sub-contractor laid asphalt to the level of the crossing surface and adjoining road approach. Photographs taken by the HOCR department during the work (figure 10) indicate that the asphalt installed at this stage did not extend beyond the left-hand side of the carriageway (in the direction of travel) on the south side of the crossing and did not correspond with what had been present previously. A short section of ballast remained at the south-west corner of the crossing (figure 2).



Figure 10: The asphalt section following the work in March 2007 (photograph courtesy of Network Rail)

- 48 The Network Rail off-track gang had completed two long shifts on 17 and 18 March 2007 and had left site before Dean and Dyball and the sub-contractor finished the asphaltting. Network Rail's representative on site from the HOCR department was not fully conversant with the requirements for level crossings: the off-track gang had been contracted for this purpose. Therefore, when the level crossing was handed back on the morning of 18 March 2007, nobody on site was competent to judge whether the asphalt at the interface with the crossing surface had been restored to its original length and no site plan was available as a reference source.
- 49 Both Dean and Dyball and the sub-contractor stated that their practice would be to re-apply asphalt to the original dimensions on a 'like-for-like' basis. Neither company could recall why this was not done on the morning of 18 March 2007. The RAIB considered that there were two possible explanations:
- there was insufficient time for the asphalt to be laid to the original length; or
 - the individuals undertaking the asphaltting work were not aware of its original length.

Time Pressure

- 50 Dean and Dyball and the sub-contractor were expecting to commence work to re-instate the asphalt and road studs from around midnight on 17 March 2007. However, the work did not begin until around 04:30 hrs to 05:00 hrs because the re-railing activity was running late. However, the *possession* still had to be handed back at 08:15 hrs on 18 March 2007.

- 51 The sub-contractor informed Dean and Dyball that there was insufficient time to carry out all the required works. This information was passed onto Network Rail's representative on site from the HOTR team. The sub-contractor and Dean and Dyball took the decision that only a *base course* of asphalt would be laid, extending the width of the road approach. This would ensure that as a minimum, the level crossing surface was level at its interface with the road approach on the down side, thus enabling the road to be re-opened. No road or footway white lines were painted on the new panels.
- 52 The RAIB has evidence that it would have taken about another 20 minutes to lay enough asphalt to have restored the base course to its original length.
- 53 Dean and Dyball submitted a re-quote for the unfinished works. The re-quote did not include any base course asphalt which would have been required if it had been their intention to extend the length of the asphalt back to its original position. The RAIB therefore considers that the contractors believed that they had already provided sufficient asphalt on the south side of the crossing and did not intend to extend the length of the asphalt on a subsequent visit. Although they may have been under time pressure, it was not the reason why the area of ballast was left in the south-west corner of the crossing.

Knowledge of original length of asphalt

- 54 There were two possible ways in which the contractors might have known exactly how much asphalt to apply to the south side of the Victory level crossing during the night of 17/18 March 2007:
- use of photographs showing the extent to which asphalt was present before its removal during the weekend of 10/11 March 2007; or
 - availability and use of standards, the ground plan or level crossing order, clearly defining how the crossing should interface with adjacent areas.

Use of photographs

- 55 Dean & Dyball and the sub-contractor stated that during the preparatory site visit (paragraph 45) they would have taken photographs of the crossing in its original state. These photographs would then be included in the briefing pack given to the team undertaking the work on 17/18 March, which would assist them in restoring the crossing to its original condition.
- 56 Dean & Dyball were unable to provide the RAIB with a copy of the briefing pack that they stated was given to the individuals who carried out the work at Victory level crossing on 17/18 March 2007. Given that the asphalt was not laid to its original length, either the briefing pack did not include relevant photographs, or the individuals on site did not refer to them.

Standards and other documentation on level crossing arrangements

- 57 **Level crossing standards and documents (table 1) did not clearly describe the arrangements for providing the asphalt surface at the interface between the level crossing and surrounding areas. This was an underlying factor.**
- 58 All Automatic Half Barrier level crossings have a ground plan and level crossing order associated with them. The ground plan provides information on the dimensions of the markings over the level crossing for the stop lines, carriageway centre lines and the pedestrian footway. The position of the cattle-cum-trespass guards is also indicated.

- 59 The level crossing order is a legal document made by (or on behalf of) the Secretary of State for Transport under the Level Crossings Act 1983. The level crossing order states the requirements at the level crossing including the method of operation and control of the level crossing and the markings that need to be provided.
- 60 There are other documents associated with level crossing surfaces. Table 1 provides information from the key documents regarding the interface between the crossing surface and the road approach.

Document	Narrative	Status of document
Level Crossing Order (for Victory level crossing)	The ground at the two edges of the carriageway over the crossing shall be made up to the level of the carriageway for a distance of not less than 1 metre beyond each edge.	Legally binding document. Dated 2 June 1987.
The Ground Plan (for Victory level crossing)	The diagram indicates that the carriageway over the crossing shall be 6.1 metres wide with an area made up to the level of the carriageway 1 metre wide either side of the carriageway.	Legally binding document. Dated December 1987.
Railway Group Standard GI/RT7012	Factors to be taken into account (level crossing surface)hazards to cyclists and occupants of prams, baby buggies, pushchairs and wheelchairs caused by flangeway gaps and discontinuities in the surface.	Standard that is binding on Network Rail. Issue 1, dated August 2004 was applicable at the time of the incident at Victory level crossing. GI/RT7012 was subsequently withdrawn in April 2010 and Network Rail introduced NR/L2/SIG/30017, Requirements for level crossings in its place for the factors described in the previous column.
Railway Safety Principles and Guidance- part 2 section E- Guidance on level crossings	The footway should be made up to the level of the carriageway and maintained in a good and even condition.	Guidance issued by the Office of Rail Regulation. Dated 1996.
Network Rail standard NR/L2/SIG/19608-appendix E	The inspection of the surface system shall include the interface between the surface system and the adjacent road or pathway.	Network Rail's internal company standard Issue 1, April 2004 to issue 4, December 2008.
Network Rail company standard NR/SP/TRK/040 issue 1	A crossing is deemed to be in normal operating conditions if the acute angle between road and railway centre lines is between 60° and 90°.	Network Rail's internal company standard. Issue 1, December 1997.

Table 1: Extracts from level crossing documents on level crossing surface provision

- 61 In summary, there is a requirement within the various documents described in table 1 that the area at the edges of the crossing should be made up to the level of the carriageway and maintained in a good and even condition. However, it is not clear over what distance the asphalt length should extend (eg the width of the highway, between cattle-cum-trespass guards, the length of the edge beams, etc).

- 62 The absence of such standards meant that there was no uniform method applied to the installation of crossings.

Level crossing inspection and assessment

- 63 **After the work undertaken on 17/18 March 2007, the crossing was left in a suboptimal condition with an uneven interface in the south-west corner between the crossing surface, asphalt and ballast. The uneven interface was not identified during a number of crossing inspections that took place between March 2007 and December 2009 and no remedial action was taken. This was a causal factor in the incident.**

Level crossing inspection and maintenance

- 64 **Victory level crossing is inspected at six-weekly intervals by two level crossing inspectors working for Network Rail's local off-track gang. The checklists used during the inspection do not highlight the possible hazard to wheelchair users and persons pushing small-wheeled items from uneven surfaces or changes in surface type. The absence of this item from the checklist is an underlying factor in this incident.**
- 65 Inspections at AHB level crossings are undertaken in accordance with the requirements of Network Rail standard NR/L2/SIG/19608 'Level Crossing Infrastructure: Inspection and Maintenance'. At the time that work was undertaken at Victory level crossing in March 2007, issue 2 of the standard applied. By the time of the incident in December 2009, issue 4 of the standard was current. The difference between issues 2 and 4 reflected changes within Network Rail's organisational structure. Issue 4 also gives guidance on the inspection of level crossing surfaces although it is primarily concerned with decking systems for which a checklist is included.
- 66 A series of checklists from NR/L2/SIG/19608 are used by Network Rail level crossing inspectors. From June 2009, there were 28 separate checklists and a table within NR/L2/SIG/19608 stated which of them was to be used for each type of level crossing. For AHB crossings such as Victory, table 6 indicates that six check lists are to be used covering areas such as road signage and telephones. One of them, LXi28, addresses level crossing surfaces.
- 67 Checklist LXi28 directs the crossing inspector to assess eight areas. Of those eight areas, the most relevant is that which directs inspectors to look for tripping hazards between crossing panels, rails, edge beams and the road and footway surfaces. None of the completed inspection forms reviewed by the RAIB for Victory level crossing identified the area of ballast in the south-west corner as being a tripping hazard. However, the checklist does not specifically ask the inspector to consider the hazards to users with wheeled items (pushchairs, wheelchairs, bicycles), as was required by Railway Group Standard GI/RT7012 and is required by Network Rail Company Standard NR/L2/SIG/30017 (see table 1).

Level crossing risk assessment

- 68 Network Rail procedures mandate that regular risk assessments are carried out at all level crossings. Part of the process requires that site visits are carried out by either Mobile Operations Managers or Operations Risk Control Co-ordinators to collect information about the crossing and to enter this on a form. Some of this data (eg figures taken from the road traffic census) is then input to the All Level Crossing Risk Model in order to provide a quantified assessment of the risk present at that level crossing.
- 69 The site visits and subsequent risk assessments were initially carried out every three years although the frequency has recently been changed to once every 18 months. Each of these site visits is required to include a census of the type and number of users.
- 70 The data gathered during a site visit includes the frequency/type/speed of approaching trains, frequency/type/familiarity of crossing users and physical aspects relating to the crossing such as crossing surface, type and number of railway lines.
- 71 The RAIB has reviewed the forms that were completed during the risk assessment visits to Victory level crossing. The forms did not guide the user to look for pedestrian issues with the level crossing surface, therefore the person using the form would be unlikely to identify any issues with uneven or inconsistent crossing surfaces unless they were an obvious safety issue (such as insecure crossing panels or significant damage to the road surface). This omission meant that opportunities to identify the inconsistent surface in the south-west area of the crossing during the 18 month cycle of risk assessments was missed.

Inspection by the Office of Rail Regulation

- 72 An inspector from the Office of Rail Regulation (ORR) undertook an inspection at Victory level crossing on 6 February 2008 as part of the ORR's 2007/2008 *delivery plan*. At that time the white lines had still not been painted on the down side of the crossing (paragraph 51). The ORR inspector issued an instruction to Network Rail to apply white lines at the crossing, but made no comment regarding the area of ballast in the south-west corner of the crossing.

Previous RAIB investigations where inspections were an issue

- 73 The RAIB has identified deficient level crossing inspections, or the non-implementation of inspection findings, as a factor in a number of previous investigations⁴. These include:
- derailment of a train at Croxton level crossing, 12 September 2006 (report No. 11/2008).
 - fatal accident at Tackley footpath crossing, 31 March 2008 (report No. 09/2009).
 - fatal accident at Moor Lane footpath crossing, near Staines, 16 April 2008 (report No. 27/2008)⁵.
 - fatal accident at Fairfield footpath crossing, near Bedwyn, 06 May 2009 (report No. 08/2010).

⁴ All RAIB investigation reports are available at www.raib.gov.uk.

⁵ This accident involved a slippery walking surface on a pedestrian crossing. The need for a non-slip surface had been identified but was not actioned.

- 74 Network Rail has notified the ORR that it is taking actions to enhance guidance to staff carrying out inspections at level crossings to address some of the issues raised in the above reports.

Using the crossing during the hours of darkness

75 At the time of the incident it was dark and the area of ballast on the edge of the crossing was not easy to see in these conditions. This was a causal factor in the incident.

- 76 No lighting is provided on the road approaches to the level crossing and the level crossing itself is not lit. There is no requirement to provide lighting at a level crossing when neither of the road approaches is lit, and the arrangements complied with Railway Group Standard GI/RT7012 (which was current at the time) and the ORR publication 'Railway Safety Principles and Guidance - part 2 section E' in this respect.
- 77 The wheelchair involved in the incident was not fitted with any lighting to aid the user's vision.

The angle of the crossing

78 Victory level crossing intersects the railway at an angle of around 55°. The front wheels of the wheelchair were free to swivel through 360° and could drop into the flangeway gap when approached at an angle. The need for the wheelchair user to cross the flangeway gaps at right angles meant that he was unable to follow a straight path along the left side of the crossing. The skewed nature of the crossing and the need for the wheelchair user to cross at right angles to the railway was a causal factor in the incident.

- 79 The road over Victory level crossing intersects the railway lines at an acute angle of 55°. Network Rail internal company standard NR/SP/TRK/040 issue 1, states that a crossing is deemed to be in normal operating conditions if the acute angle between road and railway centre lines is between 60° and 90° (table 1). According to this standard, Victory level crossing is just outside of normal operating conditions and is therefore considered to be at a skewed angle.
- 80 The wheelchair user normally approached the level crossing on the left-hand side of the road. In order to cross over the flangeway gaps and to prevent the small front wheels of the wheelchair dropping into them, he approached each rail at right angles and lifted the front wheels off the ground slightly, moving the chair forward on its rear wheels. This action progressively moved the wheelchair user towards the right-hand side of the crossing and closer to the area of ballast.
- 81 Following two fatal accidents in Australia in 2001 involving wheelchair users at level crossings, the Victoria Government formed a taskforce to understand the issues experienced by people with a disability at railway level crossings. A report⁶ into the findings of the taskforce was published in June 2003 by Sinclair Knight Merz Pty Limited.
- 82 The flangeway gap was amongst the problems identified by the taskforce. A range of potential solutions were identified by the taskforce although none of them had been fully developed or tested in an operating environment. The report included a recommendation to 'monitor advances in flangeway gap filler technology and implement where appropriate'.

⁶ Disability Access at Rail Crossings available at: <http://www.transport.vic.gov.au/DOI/Internet/transport.nsf/AllDocs/7C03E88476B8A6AECA256BA30020546C?OpenDocument>.

- 83 Work is currently underway in the United States of America to develop suitable materials to use as flangeway gap fillers for level crossings. The materials are intended to fill the gaps under light loads and to compress or retract when a train wheel passes over them. Work began in March 2010 on the development of the technology and will be followed by design, testing and durability assessments. The project is expected to be completed in around two years' time.
- 84 On Britain's mainline railways, flangeway gap fillers are not currently used. Section G2.2 of Network Rail Company Standard NR/L2/SIG/30017 states that deformable flangeway fillers should not be used unless there are calculations to prove that they do not increase the risk of derailment. This clause was also included in Railway Group Standard GI/RT7012, which preceded NR/L2/SIG/30017, and was current at the time that down line was re-laid through Victory level crossing in 2007.

Previous occurrences of a similar character

- 85 The wheelchair user had, on a previous occasion, become trapped on the crossing when one of the small front wheels of his wheelchair became caught in a flangeway gap. On this occasion a passer-by was able to assist and help him over the crossing. No trains approached during this time. The incident was not reported to the signaller or to anyone within Network Rail.
- 86 A narrative search of the rail industry Safety Management Information System (SMIS) database found 21 reported incidents involving wheelchair users on level crossings between 1998 and 2009. None of these occurred on AHB level crossings similar to Victory level crossing.
- 87 Of the 21 reported incidents, four related to the crossing surface:
- two involved wheelchair wheels getting stuck in gaps on the crossing;
 - one incident involved a wheelchair user who had become stuck in some ballast on a crossing, although the report does not indicate where the ballast was in relation to the crossing surface; and
 - one incident where a wheelchair user had difficulty crossing over one of the rails and injured their head when the wheelchair tipped backwards and they fell out.

Additional observation⁷

- 88 While the omission in laying asphalt to the full width of the crossing was not apparent to those visiting it in the months following the work undertaken in March 2007, the non-application of road and footway markings in the form of white lines on the down side of the crossing was much more obvious.
- 89 It was not until February 2008, nearly a year after the crossing was replaced, that the white lines were applied to the crossing surface. During those eleven months Network Rail level crossing inspectors raised the issue through their normal six-weekly inspection defect reporting process (paragraphs 65 - 67).

⁷ An element discovered as part of the investigation that did not have a direct or indirect effect on the outcome of the accident/incident but does deserve scrutiny.

- 90 An inspector from the ORR carried out an inspection at Victory level crossing on 6 February 2008 (paragraph 72). Following the inspection, he wrote to Network Rail raising concerns that the absence of these markings constituted a failure to comply with the level crossing order. The white lines were painted by the local off-track gang on 28 February 2008 and an inspector from the ORR subsequently reviewed photographs of the crossing to satisfy himself that the work had been completed.
- 91 Network Rail company standard NR/L2/SIG/19608 states that erased or indistinct road markings at level crossings should be rectified within seven weeks. However, the information from the level crossing inspection forms that highlighted the missing white lines over the crossing was not entered into *Ellipse*, Network Rail's database for managing maintenance activities, because the issue was being pursued separately by the local off-track manager.
- 92 The manager of the local off-track gang wanted Dean and Dyball to complete the work for which they had been originally contracted. He said that to facilitate this, he had contacted Network Rail's commercial department, who would have been responsible for contracting Dean and Dyball to complete the work. For their part, Dean and Dyball submitted an 'abortive costs' invoice to Network Rail because they had not been able to complete all the work required. They believed they had also sent Network Rail a new quotation for the work they had not been able to complete (paragraph 53). However, Network Rail's commercial department were not able to locate the re-quote submission.
- 93 Communication between the local off-track gang manager, Dean and Dyball and the commercial department of Network Rail consisted mainly of telephone calls (for which no records were kept) and e-mails. Many of the e-mails were no longer available, having been deleted by the individual concerned because of the need to avoid exceeding limits on the storage capacity for e-mails on his computer. Several documents, including invoices and purchase orders, were incomplete, reference numbers were incorrect and some of the people directly involved in the ongoing issues at Victory level crossing after March 2007 had changed jobs or left the company. For these reasons, it has not been possible to establish, with certainty, why the work at Victory level crossing was not completed in a timely manner. However, Network Rail's management processes were not effective in restoring Victory level crossing to a compliant condition following the work carried out in March 2007.

Conclusions

Immediate cause

94 One of the front wheels of the wheelchair became stuck in an area of ballast in the south-west corner of the crossing (**paragraph 38**).

Causal factors

95 The causal factors were:

- a. the non-application of asphalt to the full length of the south side of the crossing during the renewal work undertaken in March 2007 (**paragraph 40, see Recommendation 1**);
- b. the uneven interface created by the non-application of asphalt to the full length of the south side of the crossing was not identified during a number of crossing inspections and risk assessments that took place between March 2007 and December 2009 (**paragraph 63, see Recommendation 2**);
- c. it was dark at the time of the incident, which made it difficult for the wheelchair user to see the area of ballast in the south-west corner of the crossing (**paragraph 75, no recommendation is made**); and
- d. the skewed angle between the railway and the road, which meant that the wheelchair user was not able to follow a straight path at the side of the level crossing because of the need to avoid the front wheels of the wheelchair dropping into the flangeway gaps (**paragraph 78, see Recommendation 3**).

Underlying factors

96 The underlying factors were:

- a. there was a lack of guidance within level crossing standards and documentation on the arrangements for providing asphalt at the interface between the level crossing and surrounding areas (**paragraph 57, see Recommendation 1**); and
- b. Network Rail's level crossing inspection standards and checklists did not highlight the risk to small wheels, such as those on wheelchairs and children's pushchairs, from changes in crossing surface material (**paragraph 64, see Recommendation 2**).

Additional observation⁸

97 Network Rail's management processes were not effective in restoring Victory level crossing to a compliant condition following the work carried out in March 2007 (**paragraph 93, see Recommendation 4**).

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

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

- 98 Network Rail is planning to reposition the fence on the south-west corner of Victory level crossing and will provide a full length asphalt surface between the cattle-cum-trespass guards and each edge of the crossing.
- 99 As an interim solution, Network Rail has applied a concrete surface to the area in the south-west corner of the crossing that was formerly filled with ballast.
- 100 The Rail Safety and Standards Board⁹, on behalf of the Road-Rail Interface Safety Group, is carrying out research (research project T650) into improving safety and accessibility at level crossings for disabled users. Research project T650 aims to identify, review and rank facilities which disabled pedestrians may find difficult to use on the approaches to level crossings on public roads in Great Britain. Improvements have already been identified in the following areas:
- barriers;
 - lights and signals,
 - signs;
 - audible warnings; and
 - pavements, footways and tactile surfaces.
- 101 The objective of the research is to evaluate these improvements and others which may become apparent.
- 102 The Law Commission¹⁰ and Scottish Law Commission¹¹ published a consultation paper in July 2010 regarding their joint review of level crossing law. Part three of the consultation paper deals with disability and accessibility at level crossings. In its conclusions the paper indicates that any changes to make level crossings more accessible for disabled pedestrians are likely to focus on practical matters that are outside the scope of a law reform project. The consultation paper suggests that RSSB research project T650 (paragraph 100) may be a suitable forum for discussions on these practical matters.

⁹ Rail Safety and Standards Board at: <http://www.rssb.co.uk>.

¹⁰ The Law Commission at: <http://www.lawcom.gov.uk>.

¹¹ The Scottish Law Commission at: <http://www.scotlawcom.gov.uk>.

Recommendations

103 The following recommendations are made¹²:

Recommendations to address causal factors

- 1 *The purpose of this recommendation is to make it clear to those installing, replacing and inspecting level crossings the required physical arrangements at the interface between the crossing and the road.*

Network Rail should enhance its level crossing standards to include detail on the design of the interface between the crossing surface and the road. This should include a specification of the length of material relative to the crossing surface that is required to provide a consistent and safe crossing surface for all level crossing users. When developing a new standard, or amending an existing standard, account should be taken of other crossing features such as cattle guards (paragraphs 95a and 96a).

- 2 *The purpose of this recommendation is to assist level crossing inspectors in the identification of hazards within the usable crossing surface that present hazards to small wheels and to better reflect the requirements of Network Rail Company Standard NR/L2/SIG/30017.*

Network Rail should enhance its level crossing inspection standards and checklist forms, and the data collection forms used in the level crossing risk assessment process, to highlight the potential hazards from inconsistent crossing surfaces to small wheels such as those on wheelchairs and children's pushchairs and arrange suitable training/briefing for staff using the forms (paragraphs 95b and 96b).

continued

¹² 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 ORR 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.

- 3 *The purpose of this recommendation is to evaluate the effectiveness and safety benefits of possible solutions for assisting users of level crossings who may have difficulty negotiating flangeway gaps.*

Network Rail should, taking account of research in this country and developments overseas (paragraph 83), review methods for minimising the hazards from the flangeway gap at level crossings, particularly those that are skewed relative to the roadway or path, to users with small-wheeled equipment, such as wheelchairs and pushchairs, with a view to evaluating the costs and benefits of options for improving the safety of users of level crossings (paragraph 95d).

Recommendation to address an observation

- 4 *The purpose of this recommendation is for Network Rail to review and improve its arrangements for commissioning follow-up activities when safety-related work at level crossings has not been completed in accordance with an agreed specification.*

Network Rail should conduct a review of the adequacy of its arrangements for addressing the timely correction of deficiencies when safety-related work at level crossings has not been completed in accordance with an agreed specification. Any reasonably practicable measures identified during this review should be implemented (paragraph 97).

Appendices

Appendix A - Glossary of abbreviations and acronyms

AHB	Automatic Half Barrier
HOTR	High Output Track Renewals
NHS	National Health Service
RAIB	Rail Accident Investigation Branch

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.

Asphalt	A composite material commonly used in the construction of roads. It consists of asphalt and aggregate mixed together and laid in compacted layers.
Automatic Half Barrier	An automatic level crossing fitted with half barriers, traffic lights on the highway and a telephone to the relevant signal box.*
Ballast	Crushed stone that is normally used to support railway sleepers both vertically and laterally.
Base course	The layer of asphalt that provides load bearing and stability.
Delivery Plan	An ORR document outlining specific aims and objectives that are to be achieved during a defined time period.
Ellipse (database)	Network Rail system to manage track maintenance activities.
Flangeway gap	The gap between a rail and an adjacent structure through which a rail wheel passes.
Ground Plan	A document that includes information on the dimensions of a level crossing including road and footway measurements.
Level Crossing Order	An order made under the Level Crossings Act 1983 specifying in detail the method of operation and control of a level crossing.
Off-track gang	A gang of persons whose work involves maintenance of railway infrastructure other than the track itself.
Possession	A period of time during which one or more tracks are blocked to trains to permit work to be carried out safely on or near the line.*
Treadle	An electrical switch with an actuating lever operated by the wheel flanges of passing rail vehicles. They are used particularly to activate an automatic level crossing.*

Appendix C - Key standards current at the time

Network Rail company standards NR/SP/SIG/19608 issue 2, February 2006 and NR/L2/SIG/19608 issue 4, December 2009	Level Crossing Infrastructure: Inspection and Maintenance
Network Rail company standard NR/SP/TRK/040 issue 1, December 1997	Level Crossing Surface systems
Network Rail company standard NR/L2/SIG/30017, issue 1 September 2009	Requirements for level crossings
Railway Safety Principles and Guidance part 2 section E	Guidance on Level Crossings
Railway Group Standard GI/RT7012, issue 1 August 2004	Requirements for Level Crossings

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