



Rail Accident Investigation Branch

Rail Accident Report



Tram, Pedestrian Collision at Staniforth Road, Sheffield, 27 October 2005

This investigation was carried out in accordance with:

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

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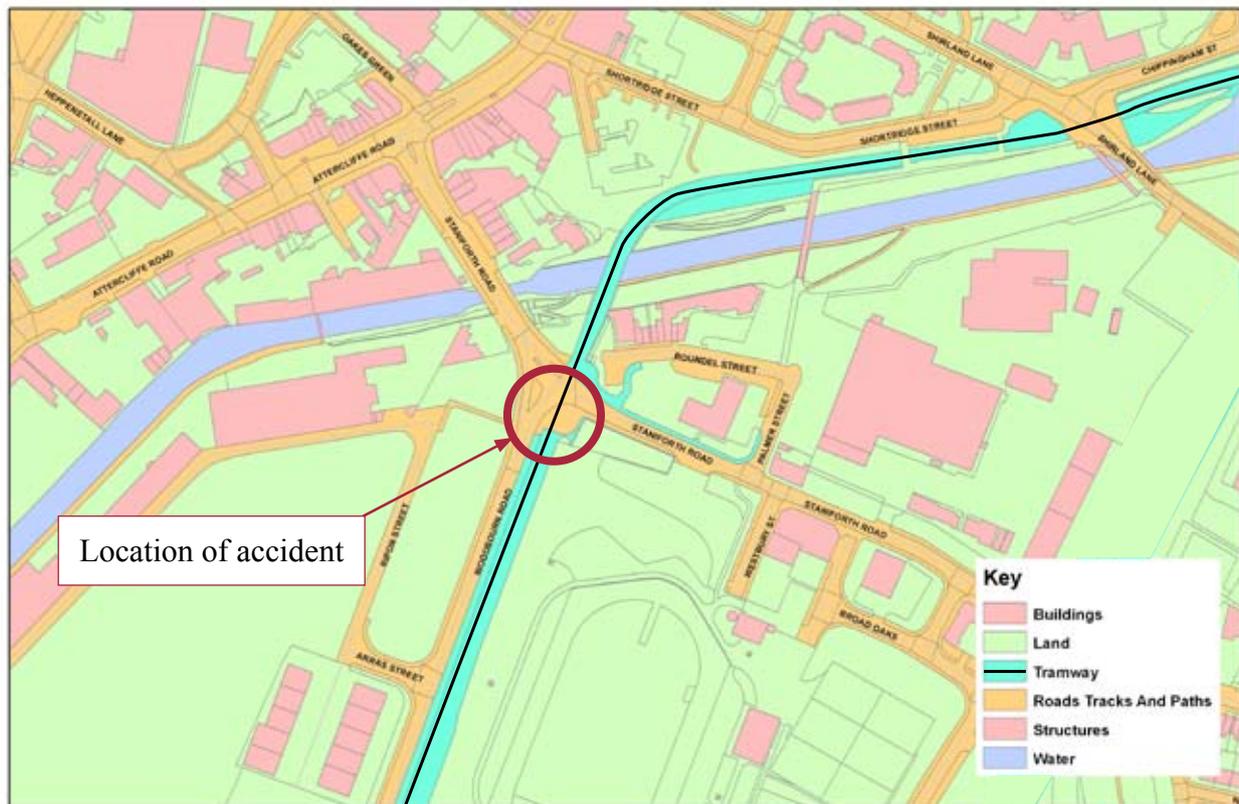
Introduction

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.
- 3 This report contains the findings of the RAIB investigation into an incident on 27 October 2005 in which a tram, operated by Stagecoach Supertram, struck a pedestrian on a crossing near the Woodbourn Road/Staniforth Road Junction.
- 4 The investigation examined the performance of the tram and tram driver and the layout of the crossing from the tramway's perspective. It does not examine the actions of the pedestrian.

Summary

- 5 Tram 112, carrying around 20 passengers and travelling north-east towards Meadowhall, Sheffield, struck and seriously injured a pedestrian on the foot/cycle crossing adjacent to the Staniforth/Woodbourn road junction. The pedestrian, who had been walking away from the City Centre along Woodbourn Road beside the tramway, stepped onto the crossing directly in front of the oncoming tram. On being struck, the pedestrian was thrown onto the road junction some distance from the tramlines. The tram continued across the foot/cycle crossing and the road junction before coming to a stop. No one on the tram was injured.
- 6 The immediate cause of the accident was the pedestrian stepping on to the crossing directly in front of the oncoming tram.
- 7 The design and positioning of the parapet fence separating the foot and cycleways from the tramway on the approach to the crossing may have been a contributory factor.
- 8 Three recommendations are made to improve tramway safety.



Extract from OS map of central Sheffield showing location of accident

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The Investigation

Background

- 9 The South Yorkshire Supertram, which opened in 1994, is operated and maintained on behalf of the South Yorkshire Passenger Transport Executive by Stagecoach Supertram who hold a 30 year concession.
- 10 The tram, number 112, is one of 25 units that make up the Supertram fleet. It was built by Siemens and supplied as part of the new tramway system. It is a 4 bogie, double articulated unit, 34.8 metres long, weighing 52.2 tonnes, with a maximum speed of 50 mph. Electric power is drawn from an overhead wire. Subsequent examination and testing did not identify any factors associated with the vehicle that were relevant to the accident.
- 11 The tram is fitted with CCTV cameras which record the interior and forward and back facing exterior views. The forward facing camera shows the views and actions of the pedestrian.
- 12 The line to Meadowhall is made up of two tracks running south-west/north-east. They are designated as “outbound” running towards Meadowhall and “inbound” towards the City Centre. Trams travelling “outbound” leave the Woodbourn Road tramstop and run parallel to Woodbourn Road on the left. This is shown in Appendix B Figure 1. Between the carriageway and the tramway is a wide pavement forming both a footway and a cycleway.
- 13 Staniforth Road crosses Woodbourn Road and the tramway on the level. There are separate pedestrian crossings of the tramway immediately to the north-east and south-west of Staniforth Road. The incident took place on the south-west crossing.
- 14 “Outbound” trams climb a slight gradient away from the Woodbourn Road tramstop and then run down a shorter, steeper gradient onto the foot/cycle crossing and the crossing of Staniforth Road beyond. The tracks and the parallel Woodbourn Road are broadly straight.
- 15 The tramway speed limit is 30 mph reducing to 25 mph for the crossing of Staniforth Road. The 25 mph speed limit sign is mounted between the foot/cycle crossing and the road crossing. Tramway rules require drivers to have reduced speed by the time the front of the tram has reached the sign.
- 16 The level of the tramway and the road are the same over most of this area, however, the tramway dips below the road level once the tramway starts running down towards the crossing. This leads to a vertical drop of varying height up to around 1 metre between the pavement and the tramway. For this reason fencing has been provided between the tramway and pavement over the last 45 metres before the crossing.
- 17 The fencing has three distinct sections as shown in Appendix B Figure 2 and described below:
 - The 4.5 metres of fence adjacent to the crossing is of a type normally associated with a pedestrian crossing. It provides little impediment to visibility.
 - The next three fence panels are of a parapet design, 1.4 metres high, designed to restrain pedestrians, cyclists and motor vehicles. The design comprises substantial vertical posts with horizontal bars and mesh to aid through visibility.
 - The remainder of the fence is of a parapet design comprising substantial vertical posts and closely spaced vertical bars that when viewed from the angle of a tram approaching the crossing, block the tram driver’s view of the pavement.

- 18 The parapet fence partly obstructs the tram driver's view of pedestrians, particularly when they are in the last few metres before reaching the crossing when the pavement slopes downwards to meet the level of the tramway at the crossing.
- 19 The crossing has fixed warning signs and tactile paving to warn pedestrians and cyclists of the tramway. There are no signals, warning lights or audible warnings for pedestrians and cyclists.
- 20 Current pedestrian tramway crossing good practice is described in Health and Safety Executive (HSE) Railway Safety Principles and Guidance (RSPG) Part 2 Section G and considers pedestrian sightlines, signage, visual and audible warnings. However the junction design pre-dates RSPG.
- 21 The road crossing is controlled by road traffic signals and tramway signals that normally give trams priority.
- 22 There have been no previous tram/pedestrian collisions at this crossing. There have been 5 tram/road vehicle collisions in the last eight years, all due to road vehicles passing red lights.

Facts about the accident

- 23 On the afternoon of the incident, the weather was dry and sunny.
- 24 The tram driver involved in this incident has been employed by Stagecoach Supertram since April 2003, trained as a driver between January and March 2004 and has been employed as a full time driver since March 2004. He had not been involved in any previous accidents. At the time of the incident, he had just commenced his shift. The records relating to his recent shifts, training, assessment and ongoing monitoring were examined as part of the investigation. No factors relevant to this accident were identified.
- 25 At around 14.08 hrs, the tram driver boarded the tram at Nunnery Square tram stop and started an "outbound" run. He slowed, but did not stop at Woodbourn Road tram stop, as there were no passengers waiting to board or alight. He then accelerated, reaching 32 mph for a short time, before applying the brake, bringing the speed down to 27 mph and then coasting. By this time, the tram had reached the downhill section and having already noted that the signal was clear, the driver was concentrating on the road crossing ahead. As the tram was coasting on the downhill gradient, its speed rose to 28 mph. The line speed at this location is 30 mph.
- 26 As the tram approached the foot/cycle crossing, the pedestrian turned right towards the crossing and was first noticed by the tram driver beyond the end of the fencing. At around that time, the driver started braking. He then sounded the horn and increased the brake rate to full service brake within around a second. The tram slowed and collided with the pedestrian around 2.5 seconds after he had become visible to the tram driver beyond the end of the fence. See Appendix C for information on speed, braking, audible warnings and distance travelled through the stop.
- 27 The driver brought the tram to a stop 64 metres beyond the point of the collision using the full service brake. He then made an emergency call by radio to summon assistance at 14.10 hrs.

Analysis

- 28 Examination of the front facing CCTV footage shows that whilst the tram is some distance from the crossing, two pedestrians can be seen walking alongside the fence towards the Staniforth Road Junction. As the tram and pedestrians get closer to the crossing, it becomes more difficult to see the pedestrians to the extent that they become almost completely obscured behind the fence. They then reappear adjacent to the crossing as the tram approaches, both looking to their left away from the tram. At the last moment, they turn and face the tram, the woman stops clear and the man continues directly into the tram's path. He is struck whilst standing over the left hand rail. The tram was around 30 metres (2.5 seconds travelling time) from the point of impact when the pedestrians reappeared beyond the end of the fencing. As the tram was travelling at 28 mph, the driver would not have been able to perceive the pedestrian was going to walk onto the crossing, react and brake the tram to a stop before impact. Therefore, the immediate cause of the incident is the pedestrian stepping onto the crossing directly in front of the tram.
- 29 The application of the brake by the tram driver at around the same time as the pedestrians came into view was most likely a response to his rising speed rather than to the presence of the pedestrians. As such, the initial brake rate was low. On perceiving the risk, the driver sounded the horn and increased the brake rate to full service brake. The tram began to slow and struck the pedestrian a short time later at a speed of around 26 mph. This is shown on the diagram in Appendix C.
- 30 The driver sounded the horn and increased the brake rate within around one second of the pedestrians coming into view beyond the end of the fencing. This indicates that he quickly perceived the risk and reacted for which he should be commended.
- 31 The driver did not use the hazard brake which would have reduced the tram's speed more quickly than the service brake.
- 32 In this case, because the pedestrian was thrown to the side, rather than in front of or under the tram, the effects of not using the hazard brake were limited to those associated with changes in impact speed and time. It is estimated that the impact would have occurred less than 0.15 seconds later and between 3 and 6 mph slower, had the hazard brake been used. Such a short time difference would not have prevented the collision. The combined effect of the time and speed difference on the outcome are difficult to quantify, however, it is unlikely to have led to a significant change. This is not considered to be a significant factor in this incident.
- 33 The reason the driver did not apply the hazard brake could not be firmly established either from records or through interview questions and answers. There is a notch in the power brake controller between the full service and hazard brake positions, but testing indicates that this was not unusually stiff compared to those on other trams. The use of the hazard brake had been practiced as part of the driver's practical training and evidence, including downloaded tram data, suggests that tram drivers would normally use the hazard brake a few times every week. It is therefore not immediately obvious why the hazard brake was not used in this instance. However, the driver concerned had very little time after sighting the pedestrians to perceive the potential hazard, react to it and apply the brake prior to impact and not applying the hazard brake may be a result of that.

34 The design and positioning of the fence separating the tramway from the pavement affected the driver's view of the pedestrians. It is a Supertram requirement to sound an audible warning if the driver believes it is necessary to draw the attention of pedestrians and road users to the presence of a tram. Rule book section D paragraph 9.1 refers. Driver training and assessment records that were examined suggest that the tram driver is generally cautious and uses audible warnings in an appropriate manner. It is therefore quite possible that had he had better sight of the pedestrians as they approached the crossing, he would have used the bell or horn earlier than he in fact did, and given the pedestrian more warning of the danger. Assuming that the pedestrian would have then reacted differently and not walked in front of the tram, the accident would have been avoided. Such a scenario is not a certainty but is reasonably likely. As such, the effect of the fence on the driver's view of the pedestrians may have been a contributory factor in this incident. The recommendations in this report relate to restricted visibility of pedestrians at or near to tram crossings.

Conclusions

- 35 The immediate cause of the accident was the pedestrian stepping directly in front of the oncoming tram.
- 36 The design and positioning of the parapet fence separating the foot and cycleways from the tramway on the approach to the crossing may have been a contributory factor.

Actions already taken or in progress

- 37 Stagecoach Supertram, South Yorkshire Police and Sheffield City Council have started discussions on the replacement of the fence adjacent to the crossing.
- 38 Stagecoach Supertram have introduced a compulsory audible warning by all trams at this location as an interim measure.
- 39 Stagecoach Supertram have carried out an assessment of the entire route and have identified a number of locations where similar conditions exist. They have begun to fully assess all the identified locations and, where necessary, will introduce measures to reduce the chance of a similar event occurring.

Recommendations

40 Following an organisation's consideration of the recommendations below and decisions regarding implementation, then, that organisation will be responsible for establishing the necessary implementation priority and timescale taking into account their health and safety responsibilities and the safety risk profile and safety priorities within their organisation.

- 1 Stagecoach Supertram should either replace the fence with a design that provides the tram driver with better visibility of pedestrians as they approach the crossing, introduce compulsory audible warnings and/or take other appropriate measures so as to reduce the likelihood of such an event reoccurring (paragraph 34).

Until this has been done, the interim use of compulsory audible warnings (see paragraph 38) should be maintained.

- 2 Stagecoach Supertram should examine the risks generated by other crossings where the tram driver's view of the pedestrian's final approach is restricted and improve the driver's sightlines, introduce compulsory audible warnings and/or take other appropriate measures to reduce the likelihood of such an event reoccurring (paragraph 34).
- 3 HMRI should amend Railway Safety Principles and Guidance Part 2 Section G to ensure that the design of pedestrian crossings should consider not only "insufficient visibility of an approaching tram", but also tram drivers' insufficient visibility of approaching pedestrians (paragraphs 20 and 34). **

** A way of achieving this is to amend the script of paragraph 73 of the current Railway Safety Principles and Guidance Part 2 Section G, and move this paragraph from the sub-section entitled "Pedestrian crossings with signals linked to approaching trams", to the section entitled "Pedestrian footways and crossings".

Appendices

Glossary of abbreviations and acronyms

Appendix A

CCTV

Closed-circuit television

HMRI

Her Majesty's Rail Inspectorate

HSE

Health & Safety Executive

RSPG

Railway Safety Principles and Guidance

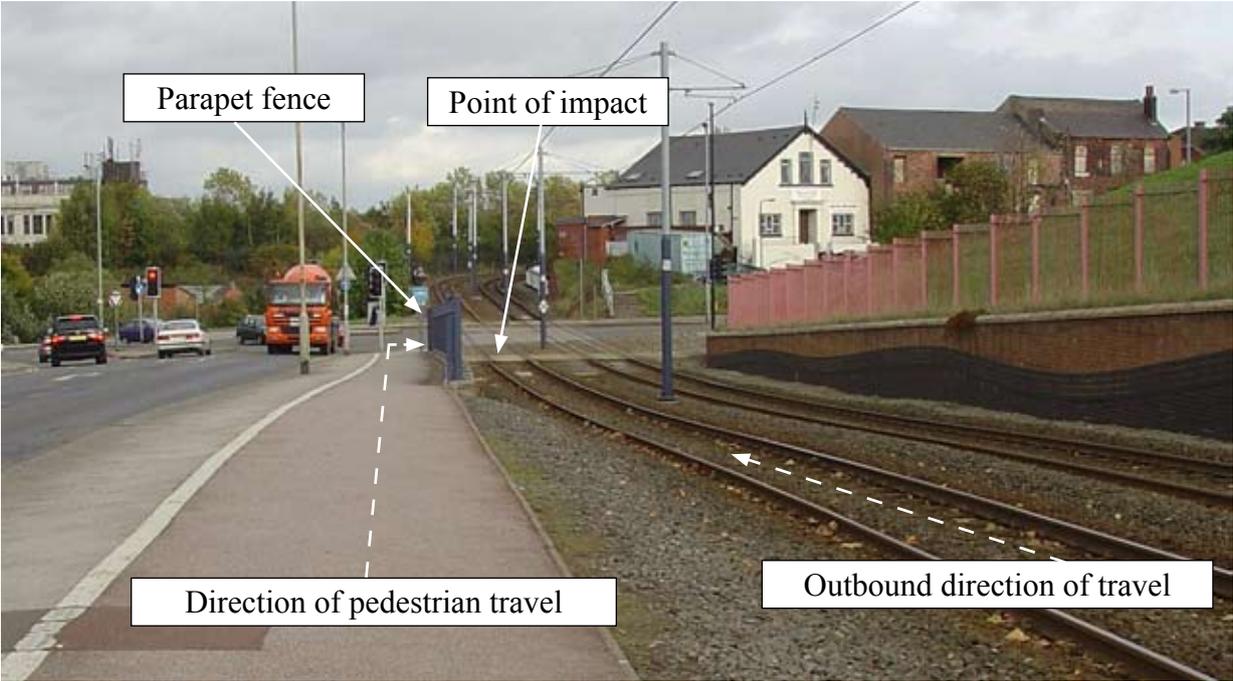


Figure 1: Site layout



Figure 2: Parapet fence

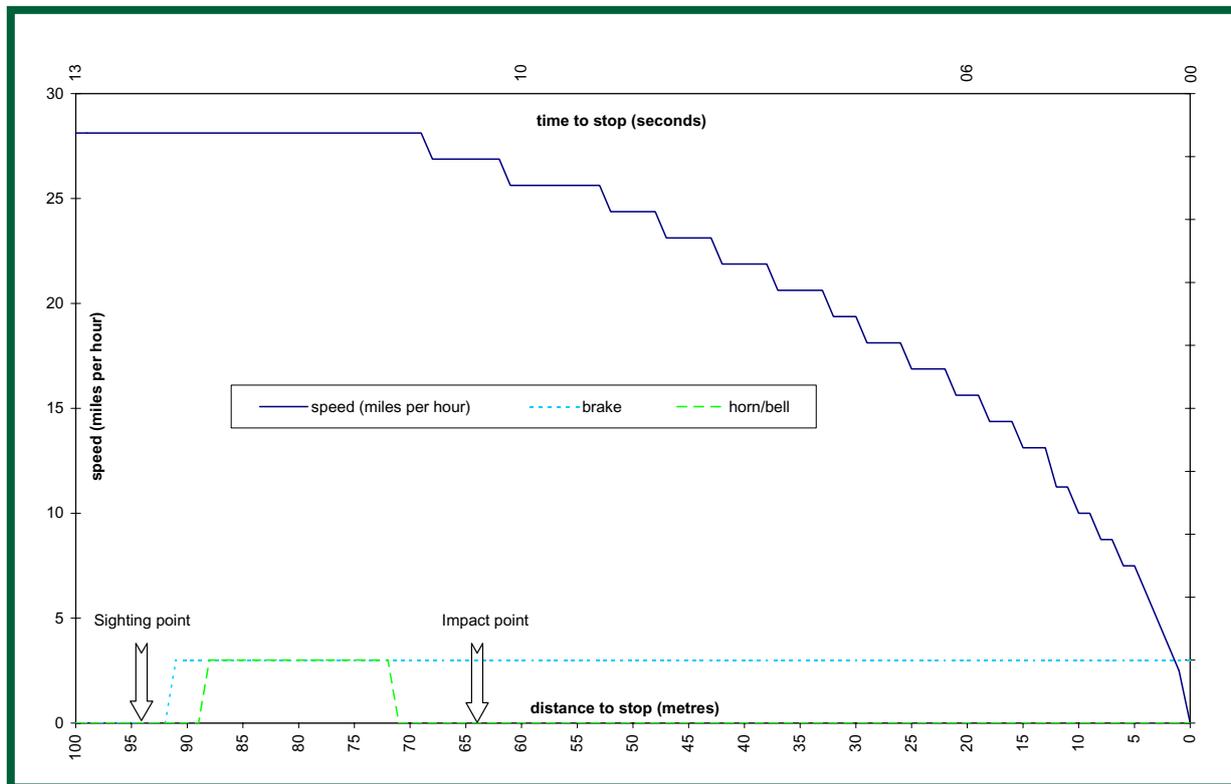


Figure 3: Graph of tram braking and use of horn / bell (NOTE: The distance scale is linear, the time scale is not)

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