Rail Accident Investigation Branch

Person struck by tram at Gravel Hill tram stop, Croydon, 10 March 2020

Important safety messages

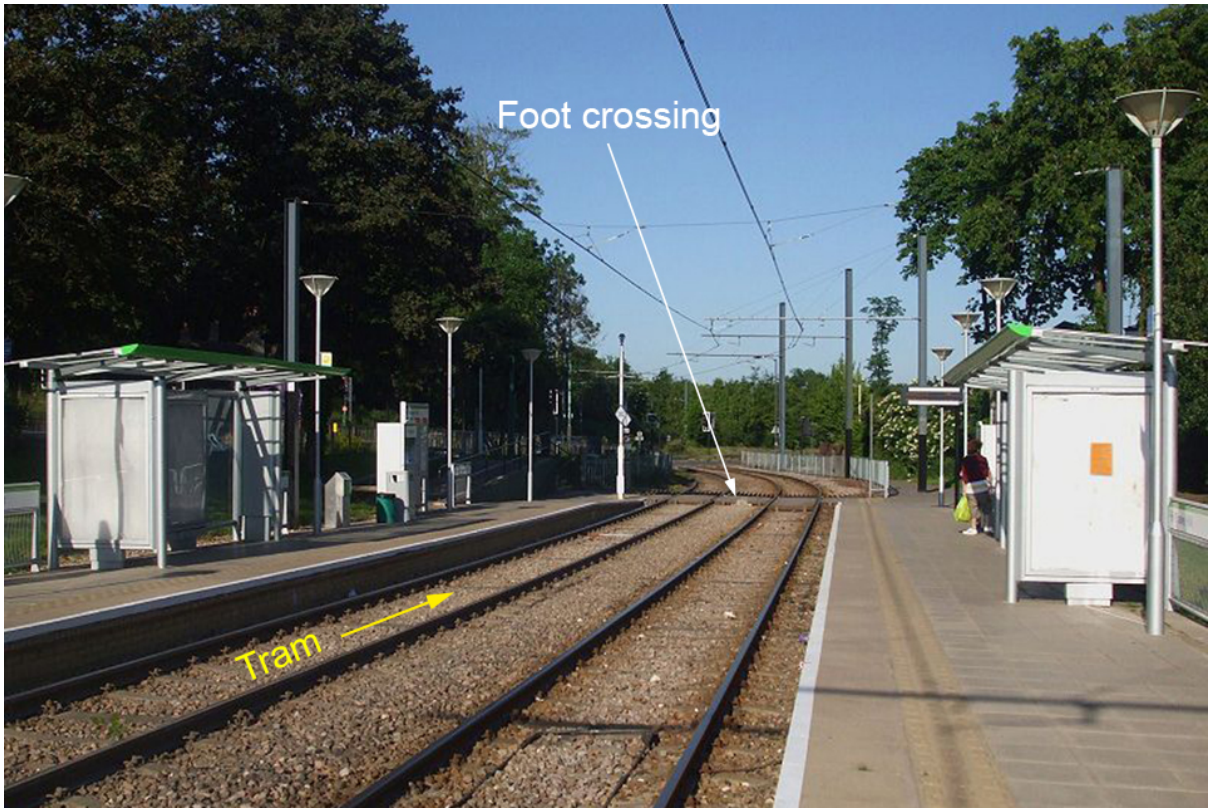
This accident demonstrates the importance of:

- effective risk assessment at tram stops by tramway designers, maintainers and operators, taking account of local factors such as foot crossings, interaction with nearby road junctions and usage patterns including large passenger flows at the beginning and end of a school day
- tram operators developing tram stop departure routines based on an understanding of the local factors identified in their risk assessments
- drivers applying appropriate departure routines when leaving tram stops and giving particular attention to pedestrian movements around any nearby crossings.

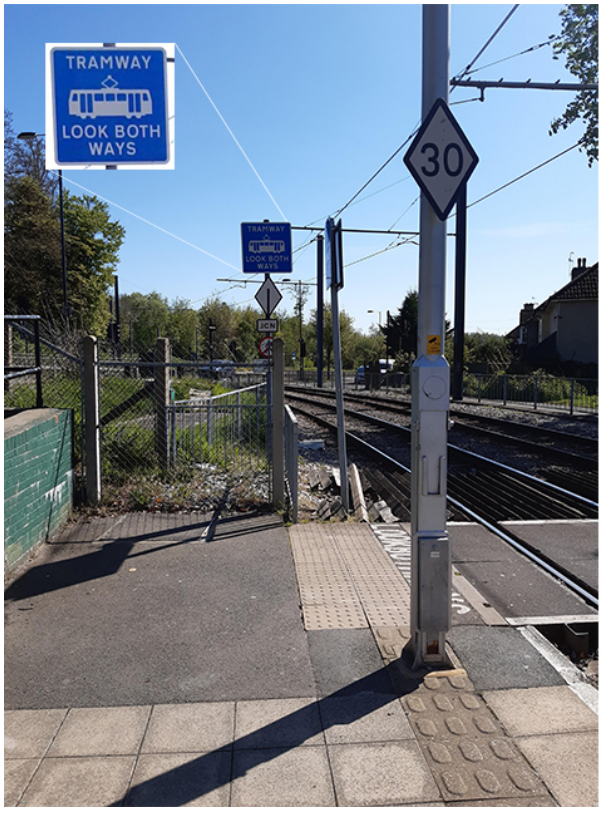
Summary of the accident

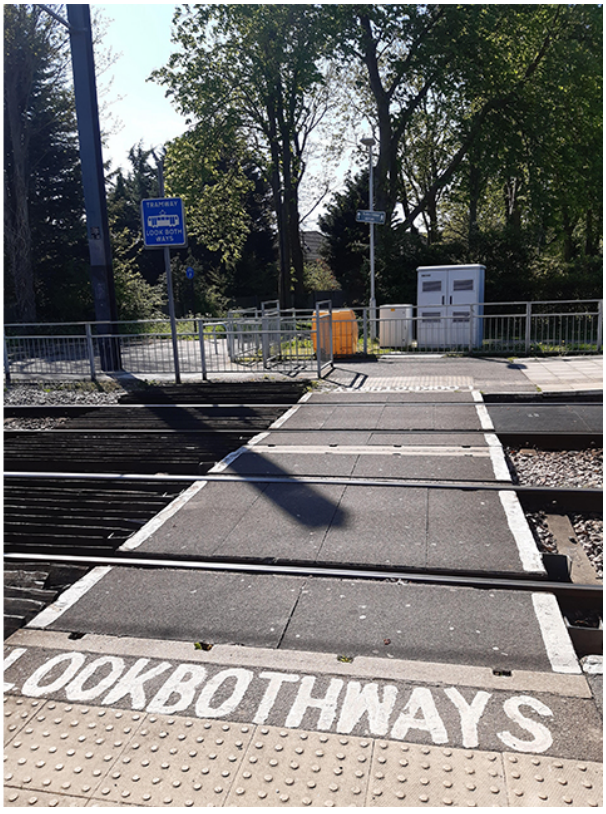
At around 08:05 hrs on Tuesday 10 March 2020, a person was struck by a tram as it was departing from Gravel Hill tram stop on the Croydon tramway. The tram was travelling towards New Addington at about 17 km/h (11 mph) when the impact occurred, and the person suffered minor injuries.

Gravel Hill tram stop comprises a platform on each side of a two-track tramway. A foot crossing links the platform ends nearest New Addington, and connects to footpaths that provide access between the tram stop and the surrounding area including two schools. A post-mounted sign and writing on the ground instruct people using the crossing to look both ways.



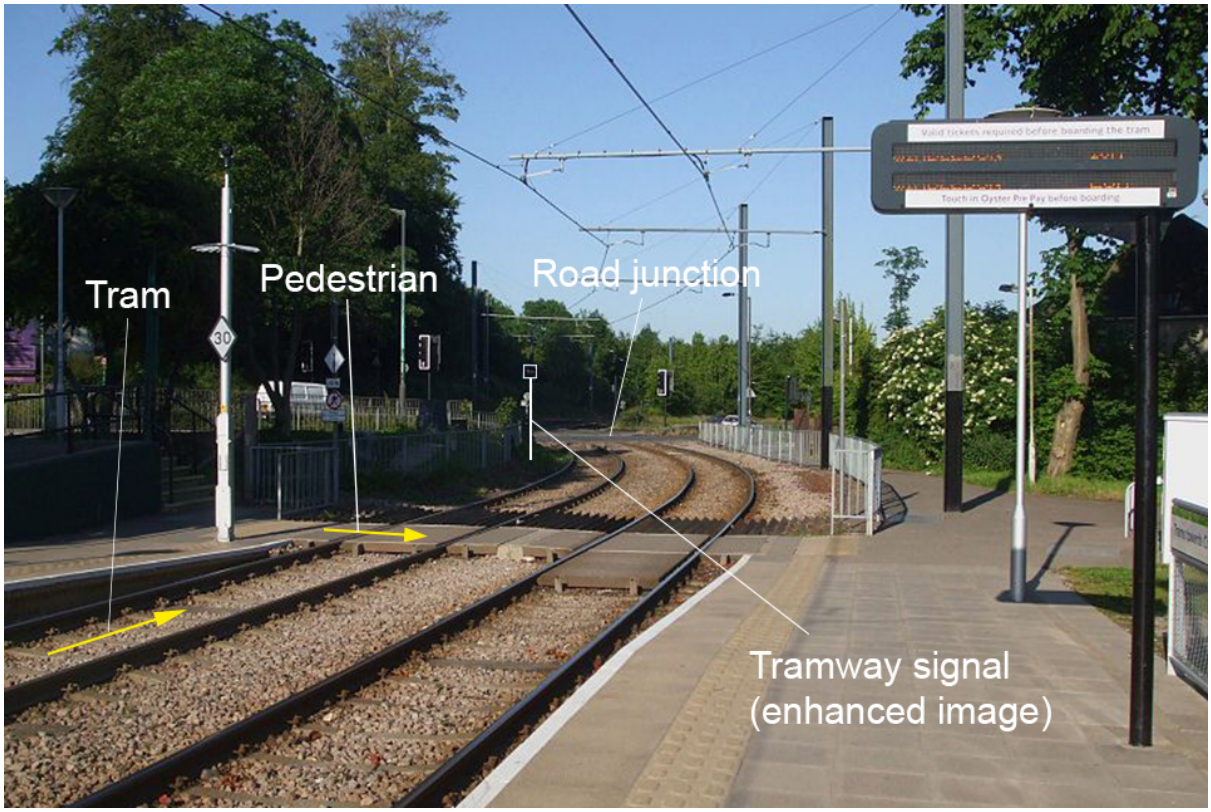
Gravel Hill tram stop looking towards road junction (photograph by Sunil060902, distributed under a CC-BY-SA 3.0 licence.)





Signage in area where injured person entered foot crossing

Beyond the tram stop, the tramway crosses a road at a junction controlled by road traffic signals and tramway signals. Trams departing from the tram stop and travelling towards New Addington go over the foot crossing, then pass the road junction tramway signal before crossing the road. For tram movements in this direction, the signal sequence to stop road vehicles and permit trams to cross the road is usually initiated by tram drivers operating a cab-mounted, ready-to-start button as the tram is about to leave the tram stop.

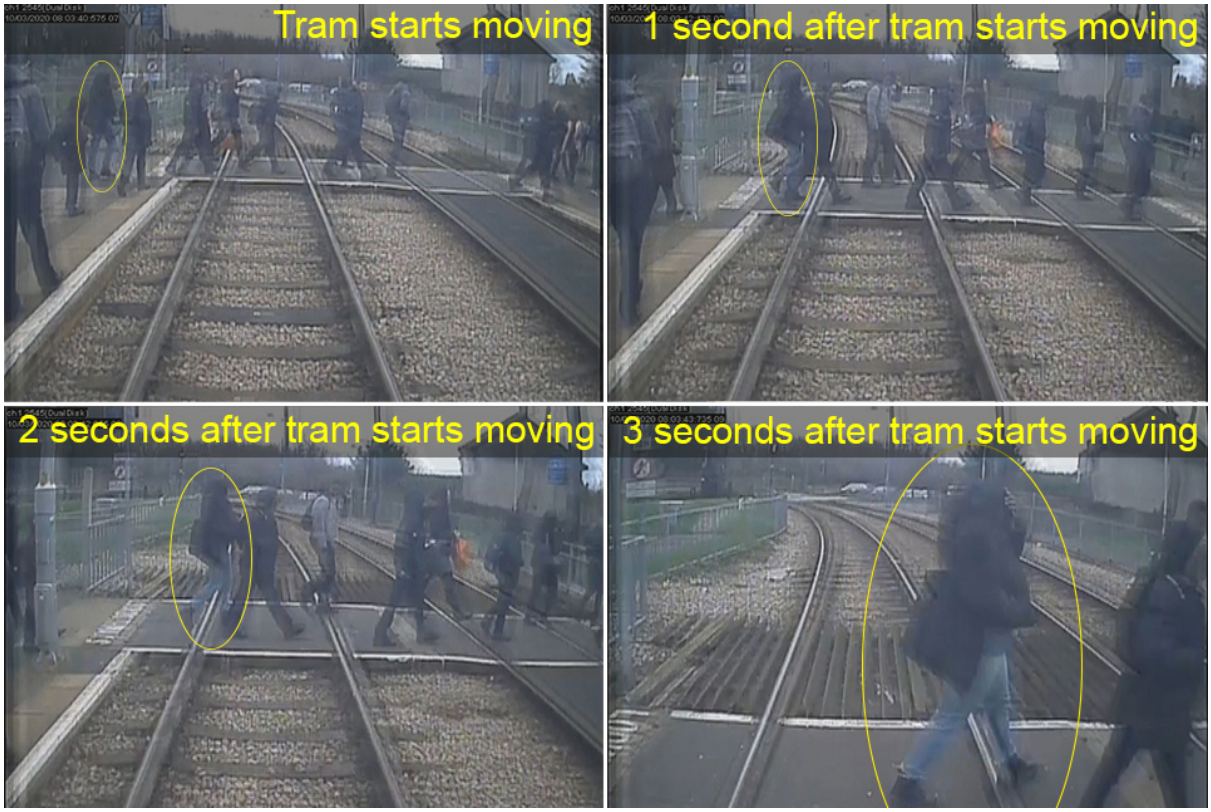


Foot crossing and road junction (photograph by Sunil060902, distributed under a CC-BY-SA 3.0 licence.)

The tram involved in the accident stopped about 10 metres from the foot crossing, the normal stopping position for trams travelling towards New Addington, and remained stationary at the tram stop for 22 seconds. During this period, a large number of passengers, including the person struck by the tram, left the tram and moved towards the foot crossing.

About 11 seconds before the tram moved off, the driver operated the ready-to-start button to initiate the road junction signal sequence. He then closed the tram doors using a button in his cab, and he has stated that he sounded the tram bell before starting the tram.

Two people, including the person struck by the tram, started to cross about one second after the tram began to move. The next person to arrive at the crossing waited for the tram to pass, as did a substantial number of people who arrived subsequently.



Positions of injured person as tram leaves tram stop (CCTV images courtesy of Tram Operations Limited)

Approximately four seconds after the tram started moving, it had reached a speed of about 17 km/h (11 mph) when it reached the foot crossing, where it struck the person a glancing blow.

Cause of the accident

The accident occurred due to a combination of the tram moving off relatively quickly, and typical pedestrian behaviour in which people routinely cross the line as trams start to move.

RAIB has compared the tram departure on this occasion with nine other tram departures in the same direction from Gravel Hill, using tram stop CCTV recordings provided by the tram operator as examples of departures at a similar time of day. The nine departures show trams taking between around 4 and 6 seconds, with a mean of around 5.5 seconds, to travel from their stopping position to the foot crossing where the person was struck. The tram involved in the incident travelled this distance in around 4 seconds.

The number of people using the foot crossing, and how close they were to approaching trams, varied significantly in these nine examples. There were three instances when pedestrians were in the path of the approaching tram until only one or two seconds before the tram arrived at the crossing.

RAIB has also compared recordings from the forward-facing CCTV cameras fitted to the tram involved in the accident with three other recordings provided by the tram operator as examples of other departures from Gravel Hill towards New Addington at a similar time of day. These three recordings show passengers moving towards the end of the platform and then onto the foot crossing. In two instances, people begin to use the crossing after the tram starts moving (three people in one instance, one person in the other). In the third example, no passengers are seen on the platform or waiting to cross when the tram starts moving. At the time of the accident, two people, including the injured person, began to use the crossing about one second after the tram started moving.

The forward-facing CCTV recordings show that some people using the foot crossing before and during the tram's departure do not obviously look towards the tram before crossing. This includes some people wearing hoods, which may prevent them seeing the tram in their peripheral vision and can restrict their hearing. It is possible that some of these people were relying on hearing an approaching tram and/or were following other people in the belief that these people had checked whether it was safe to cross.

Although the injured person stated that she saw the tram stationary at the tram stop after she began crossing, CCTV images show that the tram was already moving slowly at this time and that she was closely following a group of people. The injured person stated that she was wearing an earpiece in each ear when on the tram but had removed one and was listening to the other at a low volume while on the crossing.

The person believed that tram drivers would give way to pedestrians already on the crossing when a tram begins to move and that pedestrians should not start to cross after a tram begins to move. This understanding is consistent with other witness evidence and the behaviour of other people and trams shown on the CCTV images reviewed by RAIB.

Croydon tram drivers are taught, and are required to follow, a tram stop departure sequence that includes the following steps:

- confirm tram doors are closed
- operate ready-to-start button (to initiate road junction signal sequence)
- be observant for customers arriving late for the tram
- check along platform length using the tram's side mirror before moving off
- sound tram bell before moving off (to warn people outside the tram)
- move off only when safe to do so
- obey signal aspects
- use first notch (minimum power setting) when starting to move off
- accelerate smoothly and progressively – it does not have to be rapid progress, it has to be safe progress
- while moving off, scan ahead for obstructions and continue to use the mirrors on the side of the tram to check that no one is trapped in the tram doors
- be prepared to stop the tram in an emergency.

The tram driver stated that he sounded the tram's bell before moving off and that, after moving off, he was switching his attention between looking ahead and looking in the tram's side mirror to check that no one was trapped in the doors and being dragged along by the tram. He stated that he was aware of the person on the crossing ahead shortly before reaching the crossing, but believed she would have moved clear of the tram's path before it reached the crossing.

RAIB was unable to determine why the driver misjudged the tram's speed and/or the pedestrian's progress over the crossing. He had begun training to drive Croydon trams in October 2018 (17 months before the accident) and his employer reported it had no concerns about his performance during training, or since qualifying as a tram driver in January 2019. Witnesses reported no unusual distractions, and the driver stated that he was feeling well and not tired. In the six days before the accident, the driver had worked four early turns, including two very early turns starting before 05:00 hrs. Although consecutive very early turns are generally considered to be a potential factor contributing to cumulative fatigue, in this instance the driver had taken a rest day two days before the accident and another five days before the accident. The RAIB has therefore found no evidence to suggest that fatigue may have been a factor in this accident.

Previous similar occurrences

A pedestrian was seriously injured when struck by a tram while crossing the Croydon tramway on a foot crossing at Sandilands tram stop on 16 May 2012. The RAIB investigation (RAIB report 03/2013) also identified other accidents involving people being struck by trams at tram stop foot crossings on the Croydon tram system and included a recommendation for improvements to risk assessments at these foot crossings. The Office of Rail and Road has reported that this recommendation has been implemented.

A pedestrian crossing the tramway at Norbreck tram stop on the Blackpool tram system suffered fatal injuries when struck by a tram on 5 August 2009 (RAIB report 09/2010). The resulting RAIB recommendations included developing an effective system to monitor tram driver compliance with speed limits on the Blackpool system. The Office of Rail and Road has reported that this recommendation has been implemented.