



Rail Accident Investigation Branch

# Rail Accident Report



**Passenger trapped and dragged under a train at  
West Wickham  
10 April 2015**

Report 03/2016  
February 2016

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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## Preface

The purpose of a Rail Accident Investigation Branch (RAIB) investigation is to improve railway safety by preventing future railway accidents or by mitigating their consequences. It is not the purpose of such an investigation to establish blame or liability. Accordingly, it is inappropriate that RAIB reports should be used to assign fault or blame, or determine liability, since neither the investigation nor the reporting process has been undertaken for that purpose.

The RAIB's findings are based on its own evaluation of the evidence that was available at the time of the investigation and are intended to explain what happened, and why, in a fair and unbiased manner.

Where the RAIB has described a factor as being linked to cause and the term is unqualified, this means that the RAIB has satisfied itself that the evidence supports both the presence of the factor and its direct relevance to the causation of the accident. However, where the RAIB is less confident about the existence of a factor, or its role in the causation of the accident, the RAIB will qualify its findings by use of the words 'probable' or 'possible', as appropriate. Where there is more than one potential explanation the RAIB may describe one factor as being 'more' or 'less' likely than the other.

In some cases factors are described as 'underlying'. Such factors are also relevant to the causation of the accident but are associated with the underlying management arrangements or organisational issues (such as working culture). Where necessary, the words 'probable' or 'possible' can also be used to qualify 'underlying factor'.

Use of the word 'probable' means that, although it is considered highly likely that the factor applied, some small element of uncertainty remains. Use of the word 'possible' means that, although there is some evidence that supports this factor, there remains a more significant degree of uncertainty.

An 'observation' is a safety issue discovered as part of the investigation that is not considered to be causal or underlying to the event being investigated, but does deserve scrutiny because of a perceived potential for safety learning.

The above terms are intended to assist readers' interpretation of the report, and to provide suitable explanations where uncertainty remains. The report should therefore be interpreted as the view of the RAIB, expressed with the sole purpose of improving railway safety.

The RAIB's investigation (including its scope, methods, conclusions and recommendations) is independent of any inquest or fatal accident inquiry, and all other investigations, including those carried out by the safety authority, police or railway industry.

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# Passenger trapped and dragged under a train at West Wickham, 10 April 2015

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## Summary

At around 11:35 hrs on 10 April 2015, a passenger was dragged along the platform at West Wickham station, south London, when the 11:00 hrs Southeastern service from London Cannon Street to Hayes (Kent) departed while her backpack strap was trapped in the doors of the train. As the train moved off, she fell onto the platform and then through the gap between the platform and train, suffering life-changing injuries.

The backpack strap became trapped when the train doors closed unexpectedly and quickly while she was alighting. Testing showed that this potentially unsafe situation could only occur when a passenger pressed a door-open button, illuminated to show it was available for use, within a period of less than one second beginning shortly after the train driver initiated the door closure sequence.

The RAIB identified this door behaviour, which was not known to the owner or operator, and issued an urgent safety advice. In response to this, the railway industry undertook a review which identified 21 other types of train that permit passenger doors to be opened for a short period after door closure is initiated by train crew. The industry is now seeking ways to deal with this risk.

The train was being driven by a trainee driver under the supervision of an instructor driver. The service was driver only operation, which meant that before leaving West Wickham station, and after all train doors were closed, drivers were required to check that it was safe to depart by viewing CCTV monitors located on the platform. Two of these monitor images showed that a passenger appeared to be trapped but, although visible from the driving cab, neither driver was aware of this. Although the RAIB has not been able to establish why the trapped passenger was not seen before the train departed, a number of possible explanations have been identified.

The RAIB has identified five Learning points relating to: releasing train doors long enough to allow passengers to get on and off trains safely; effective checking of train doors before trains depart (and not relying on the door interlock light); design of door controls; and use of train driving simulators to raise drivers' awareness of circumstances when it is not safe to depart from a station.

Two recommendations have been made by the RAIB. The first, addressed to operators and owners of trains with power operated doors, is intended to identify and correct all train door control systems exhibiting the unsafe characteristics found during this investigation. The second, addressed to RSSB, seeks changes to guidance documents so that, where practicable, staff dispatching trains watch the train doors while they are closing, in addition to checking the doors after they are closed.

## Introduction

### Key definitions

- 1 Metric units are used in this report, except when it is normal railway practice to give speeds and locations in imperial units. Where appropriate the equivalent metric value is also given.
- 2 The report contains abbreviations and technical terms (shown in *italics* the first time they appear in the report). These are explained in appendices A and B. Sources of evidence used in the investigation are listed in appendix C.



## The accident

### Summary of the accident

- 3 At around 11:35 hrs on 10 April 2015, a passenger was dragged along the platform at West Wickham station by a departing train after a strap on her backpack was trapped in the train's doors when they closed. As the train moved off, the passenger lost her footing and became separated from her trapped backpack. She fell onto the platform before falling into the gap between the platform and train, suffering life-changing injuries.
- 4 The train was the 11:00 hrs Southeastern service from London Cannon Street to Hayes (Kent) and was being driven by a trainee driver under the supervision of an instructor driver. Neither driver saw the passenger or her trapped backpack before they drove the train away from the platform.

### Context

#### Location

- 5 West Wickham station lies around 4.3 miles (7 km) east of Croydon in the London borough of Bromley (figure 1). It is around 12.5 miles (20 km) measured along the route from London Cannon Street to Hayes in Kent (figure 2). The station has two platforms and the accident occurred on platform 2 (figure 3).

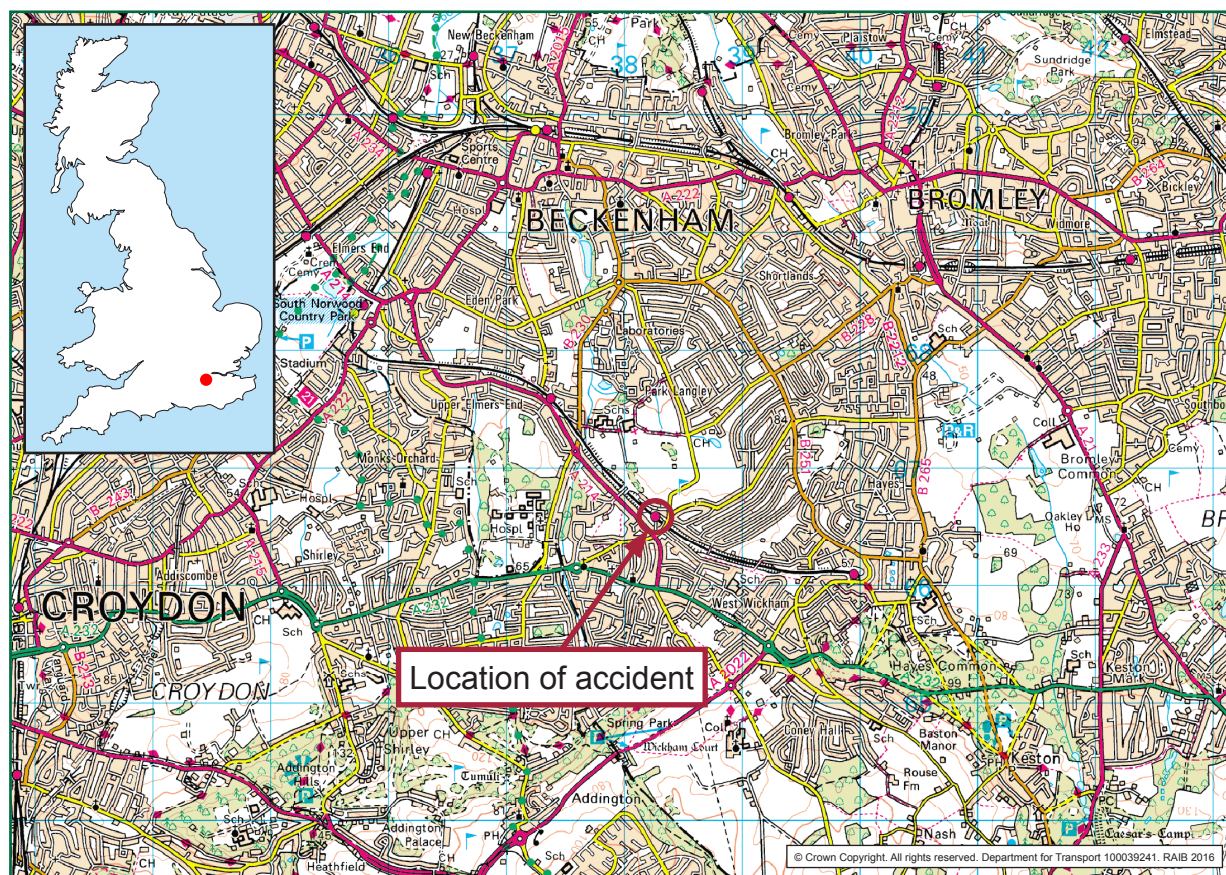


Figure 1: Extract from Ordnance Survey map showing location of accident

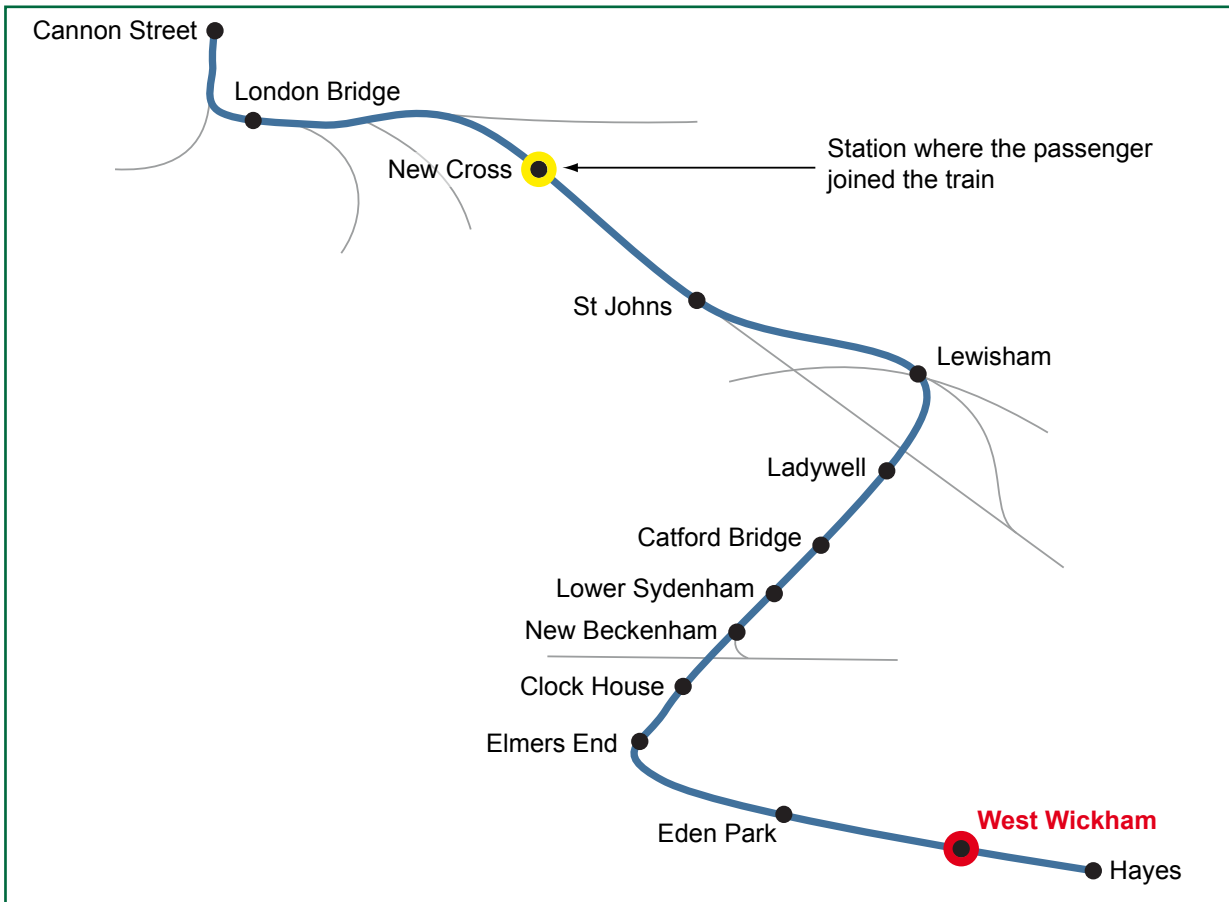


Figure 2: Route taken by the train



Figure 3: Platform 2 at West Wickham station

- 6 Trains that serve West Wickham station are dispatched using Driver Only Operation (DOO). There are no staff provided on the platforms to assist with dispatch, and a guard is not provided on the train. The driver is responsible for making sure it is safe for the train to depart. Closed circuit television (CCTV) cameras linked to monitors on the platform allow drivers to view their train so that they can see when it is safe to close the train's doors, and when it is safe to start the train.
- 7 The electric trains operating on the route through West Wickham are powered by 750 volts DC supplied from an electrified rail located next to the tracks (known as the *third rail*). In platforms, the third rail is located furthest from the platform edge.

### Organisations involved

- 8 Southeastern (the trading name of London & South Eastern Railway Limited) operated and maintained the train involved in the accident, and employed both the trainee driver and instructor driver. It is also the *infrastructure manager* of West Wickham station, which it leases from Network Rail.
- 9 Network Rail owns, inspects, and maintains the DOO CCTV equipment used at West Wickham. Network Rail is also responsible for the inspection and maintenance of the platforms and tracks at this location.
- 10 RSSB<sup>1</sup> maintains the railway rule book on behalf of the GB rail industry. RSSB was involved in some elements of the training of the trainee driver involved in the accident, but there is no evidence that these elements were a factor in the accident.
- 11 European Rail Finance Limited, part of the Eversholt Rail Group, owned the train involved in the accident.
- 12 All these organisations freely co-operated with the investigation.

### Train involved

- 13 The train involved in the accident was formed of two four-vehicle class 465 units (figure 4), often referred to as 'Networker' trains<sup>2</sup>. The leading unit was number 465184 and the rear unit was number 465047. The passenger involved in the accident was travelling in the fourth vehicle of the eight-vehicle train (ie the rear vehicle of the leading unit) which was vehicle number 65880.
- 14 Unit 465184 was built by ASEA Brown Boveri (ABB) at York, with both the build date, and the date entered service, recorded in the *rolling stock library* as 24 June 1994.
- 15 Unit 465047 was built by British Rail Engineering Ltd (BREL) at York with both the build date and the date entered service recorded on the rolling stock library as 2 December 1993.
- 16 Class 465 trains have power-operated, bi-parting sliding plug doors at two positions on each vehicle body side. These doors can be operated by passengers using push-buttons located at the passenger doorways (figure 5). The passenger doors cannot be opened using these push-buttons until the train driver has *released* the doors using controls in the driving cab. When the doors have been released for operation by the train driver, the passenger push-buttons illuminate, and become available for use by passengers.

<sup>1</sup> the company is registered as Rail Safety & Standards Board Ltd, but trades as RSSB

<sup>2</sup> Networker trains include classes 165, 166, 365, 465 and 466.



Figure 4: A class 465 train



Figure 5: Passenger bi-parting doors and passenger door-open push-buttons

- 17 The door closing cycle is initiated when the train driver operates the door close controls in the driving cab. An audible warning (known as a hustle alarm) sounds at each open door for a period of three seconds, after which any open doors begin to close. Until the doors have fully closed, the passenger push-buttons remain illuminated and active, and a passenger can operate the door-open push-button as described in paragraphs 43 to 46.

#### Rail equipment/systems involved

- 18 Two banks of DOO monitors are provided at the eastern end of platform 2 at West Wickham station. The monitor bank relevant to the accident is provided for trains comprising up to eight vehicles, and is located around 70 metres from the end of the platform (figure 6).



Figure 6: The eight vehicle monitor bank at West Wickham platform 2

- 19 The eight-vehicle monitor bank houses five *thin-film transistor* (TFT) type monitor screens, each measuring 15 inches (381 mm) diagonally. Each screen is linked to a single CCTV camera. The monitor bank provides train drivers with a colour view of the side of the train and all the passenger doorways (figure 7).

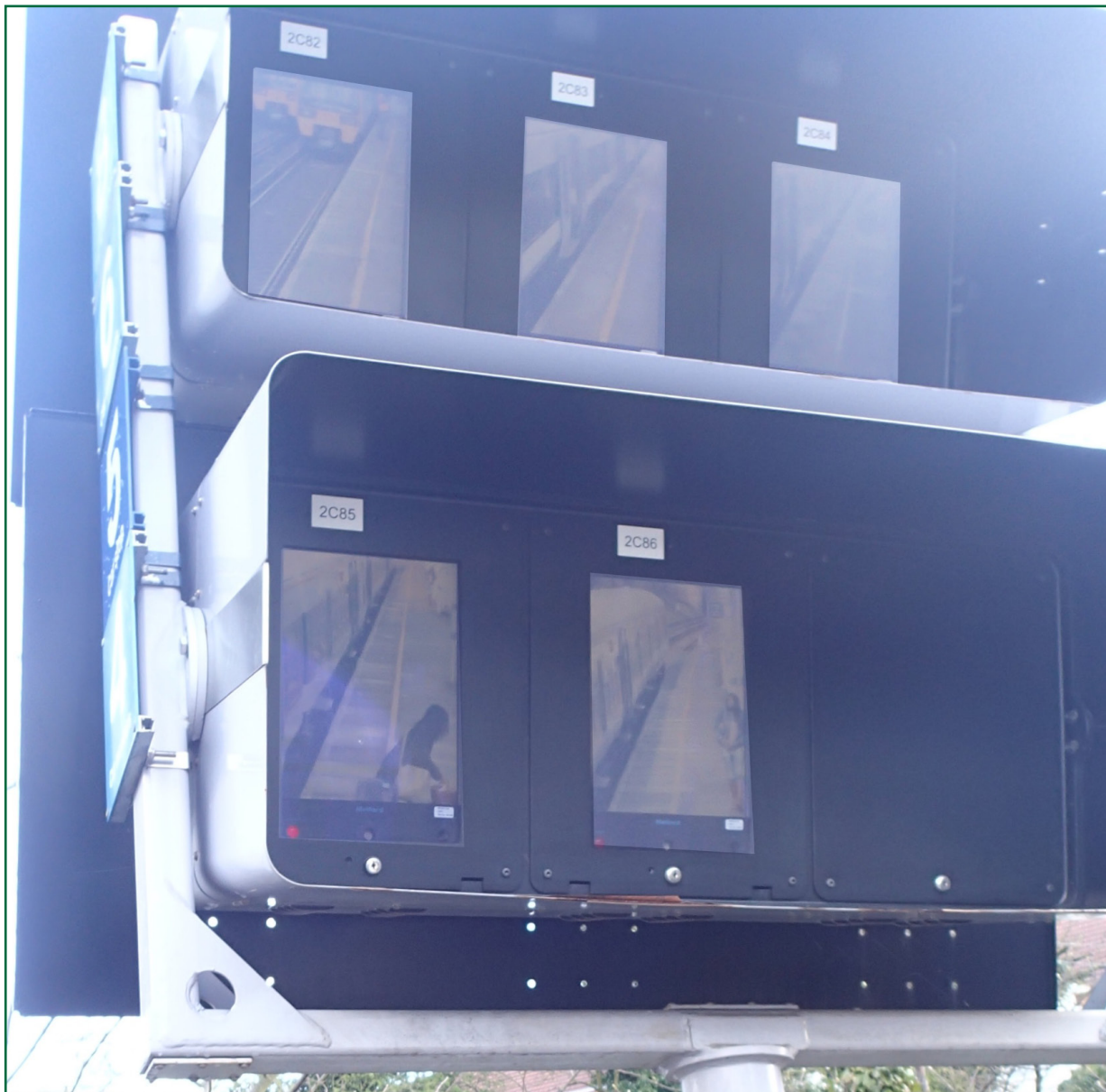


Figure 7: View of a train displayed at the eight-vehicle monitor bank at West Wickham platform 2 (note: the monitor bank images are clearer when seen with the naked eye)

- 20 The DOO monitors and CCTV equipment on platform 2 were installed in July 2011. They are maintained at three monthly intervals and the last maintenance inspection before the accident was completed on 10 February 2015. At this time, the DOO monitors were cleaned, and the CCTV camera angles checked.
- 21 On the day of the accident, no train drivers had reported any problems with the images displayed at the eight-vehicle monitor bank. The RAIB has found no evidence that the performance of the monitors at West Wickham was a factor in the accident.

### People involved

- 22 The instructor driver qualified as a train driver in February 2001. He had been an instructor driver since September 2004, and was up-to-date with his driving competency assessments.

- 23 The trainee driver began training in the rules and regulations of train driving in September 2014. On 1 March 2015, he began practical training. This involved driving passenger trains in service under the supervision of an instructor driver.
- 24 The injured passenger was an able-bodied 27 year-old who was familiar with train travel, although she was not familiar with this particular journey.

#### External circumstances

- 25 It was a clear, dry morning; weather conditions were not a factor in the accident.
- 26 The train was lightly loaded with passengers and, on arriving at West Wickham, there were no passengers waiting to board it.

## The sequence of events

### Events preceding the accident

- 27 The train departed from London Cannon Street on time. The passenger boarded the train at New Cross station and sat on the left-hand side of the third row of seats, at the rear of the fourth vehicle of the train. The journey to West Wickham took around 26 minutes.
- 28 About 2 seconds after the train stopped at West Wickham station, the passenger stood up and began to gather her belongings. About 1 second later, the trainee driver released the passenger doors and, almost immediately, a man opened the rear set of doors on the third vehicle of the train, stepped onto the platform and moved away from the train.
- 29 Around 10 seconds after the train stopped, the trainee driver pressed the 'doors close' push-button to initiate the door closing cycle. Around this time, the passenger was walking through the train towards the doors at the rear of the fourth vehicle carrying her backpack over her right shoulder. The left strap of her backpack was hanging loose.
- 30 Although another door on the train had been opened (the rear doors of the third vehicle), no doors had been opened in the fourth vehicle. When the passenger reached the doors at the rear of this vehicle, no audible warning was sounding at the doorway, and the door-open push-buttons were illuminated.

### Events during the accident

- 31 The passenger pressed the door-open button on the right-hand side of the doors and, as the doors opened, the passenger stepped off the train while attempting to put her left arm through the left strap of her backpack. As she was doing this, the doors closed quickly and unexpectedly, trapping the backpack. The *obstacle detection system* detected the trapped backpack and the doors briefly moved apart, releasing it. The passenger then pulled her backpack through the doors, but these closed quickly behind her and trapped part of the left shoulder strap of the backpack.
- 32 In the driver's cab, the *door interlock light* illuminated when the doors reached the closed position. Two seconds later, the trainee driver applied power to start the train. During this time the passenger continued trying to free the trapped backpack strap. Four seconds after the trainee driver applied power, the train began to move.
- 33 The passenger shouted for help as she was pulled along by the departing train. The man who had alighted from the train turned, saw what was happening and tried to get the attention of anyone on the train by waving. As the train speed increased, the passenger lost her footing, fell to the platform and then fell into the gap between the platform and the train.
- 34 Neither driver saw the passenger on the DOO monitors during the period of about nine seconds between her first stepping out of the door and the train starting to move.



### Events following the accident

- 35 The train continued its journey to Hayes, the next stop, where it was due to terminate. Passengers on the opposite platform at West Wickham reported the accident to a member of ticket office staff who arranged for the electrical supply to the third rail to be switched off, called the emergency services and reported the accident to the Network Rail and Southeastern joint control centre.
- 36 Staff at the Network Rail and Southeastern joint control centre saw the injured passenger at West Wickham by remotely accessing platform CCTV images (a different CCTV system to the DOO CCTV system). They immediately arranged for trains to be stopped. Meanwhile, the man who had got off the train involved in the accident, comforted the injured passenger until the emergency services arrived. Neither driver was aware of the accident until they were told by the signaller after the train arrived at Hayes. The backpack was removed from between the doors to allow the train to reach Slade Green depot where it was examined by the RAIB.

## Key facts and analysis

### Background information

#### DOO train dispatch process

- 37 The railway rule book GE/RT8000, module SS1 'Station duties and train dispatch' requires, in section 3, that train drivers should comply with the following procedure when dispatching their own trains, without assistance from platform staff, under DOO conditions:
- Check that the platform *starting signal*, if there is one, is showing a proceed aspect.
  - Make sure all passengers are clear of the train doors.
  - Check the whole length of the train to make sure that it is safe to close the doors, using the monitor or mirror, if provided.
  - After the doors have closed, check the door interlock light is illuminated.
  - Carry out the train safety check which should make sure that:
    - the train doors are properly closed;
    - nobody is trapped in the doors, for example by clothing; and
    - it is safe to start the train.
  - Only start the train if it is safe to do so.
- 38 If train drivers are unable to carry out the train safety check from the driving cab because of defective DOO equipment or poor visibility, they must position themselves on the platform to carry out the train safety check.

### Identification of the immediate cause

**39 A strap on the passenger's backpack was trapped by the train doors as they closed so that, as the train departed from the platform, she was dragged until she fell onto the platform and then into the gap between the platform and train.**

- 40 This sequence of events described in paragraphs 28 to 33 is based on recordings from CCTV cameras located on platform 2 of West Wickham station, CCTV cameras located in the passenger compartment of the vehicle from which the passenger alighted, and the on-train data recorder (OTDR) fitted to train 465184.

## Identification of causal factors

- 41 The accident occurred due to a combination of the following causal factors:
- The train doors closed unexpectedly and quickly as the passenger stepped off the train (paragraphs 42 to 54).
  - The train doors were not released long enough to allow the passenger to get up, gather her belongings, and get off the train (paragraphs 55 to 61).
  - The door obstruction detection system did not detect the trapped backpack strap. As a consequence, the driver was able to take power and drive the train out of the station (paragraphs 62 to 70).
  - The passenger was not able to pull the trapped backpack from the doors and her arm may have remained within the strap of the backpack while she was dragged (paragraphs 71 to 77).
  - Although shown on the DOO monitors, neither driver was aware of the trapped passenger when the train doors were closing, or afterwards (paragraphs 78 to 86).
  - The gap between the platform and train was large enough for the passenger to fall through (paragraphs 96 to 101).

Each of these factors is now considered in turn.

### Door operation

#### **42 The train doors closed unexpectedly and quickly as the passenger stepped off the train.**

- 43 As the passenger approached the doors, they were closed and the door-open push-buttons were illuminated. No audible warning was sounding at the doorway. Consequently, there was no indication to the passenger at that time that the driver had already initiated the door closing cycle. When she pressed the door-open push-button, the doors responded as she expected and began to open.
- 44 As the passenger passed through the opening doors, they suddenly began to close, initially closing onto the backpack. The obstacle detection system fitted to the doors detected the backpack and the doors moved slightly apart, allowing the passenger to pull her backpack through the doors. The doors then closed quickly, trapping a strap between the door *edge seals*.
- 45 RAIB testing of the doors involved in the accident showed that, if fully open when the train driver initiated the door closing cycle, the doors took around five seconds to fully close. For the first three seconds, an audible warning sounded near open doors. The doors then began to close, taking around two seconds to do so. While the doors were closing, the audible alarm ceased to sound.
- 46 The testing also showed that the door-open buttons adjacent to closed doors remained illuminated during the closure cycle. If a door-open button was pressed during the first two seconds of the cycle, the doors reached the fully open position, but then closed almost immediately. Pressing the door-open button between about 2.0 seconds and 2.5 seconds after initiation of closure resulted in the doors partially opening, to a width sufficient for a person to pass through, and then suddenly closing. Beyond 2.5 seconds, the doors may open, but not enough for a person to pass through (figure 8).

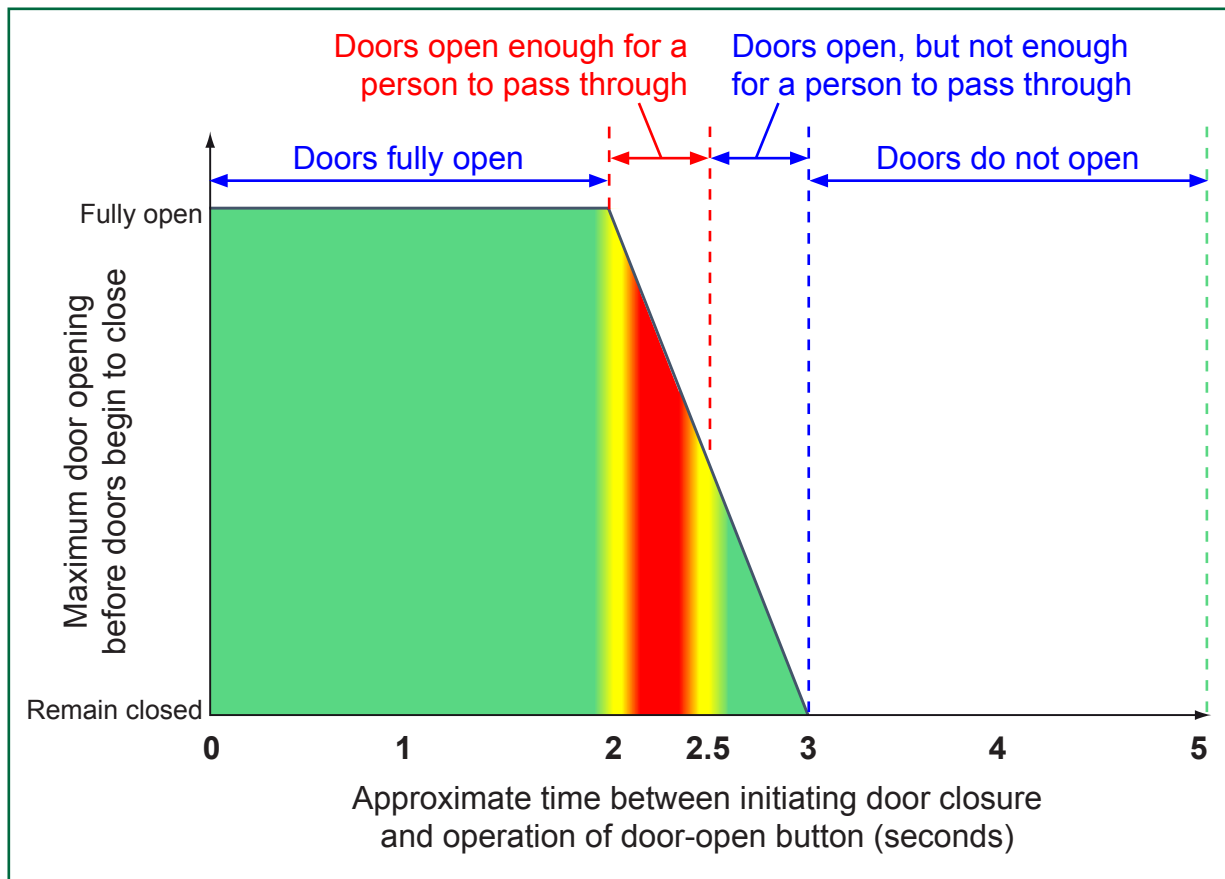


Figure 8: Amount doors open if passenger presses open button after driver initiates door closure

- 47 Testing also showed that, compared to the normal door closure speed, the door closing speed was significantly faster if the doors had only partially opened. During normal door closing the average door closing speed of fully-open doors was 0.44 m/sec. The closing speed increased to around 0.62 m/sec if the doors began closing from a partially open position with a gap of about 0.7 m between the door leaves. The faster door closing speed reduced the total time the doors were open as the passenger got off the train.
- 48 The testing (appendix D) identified that the *peak door closing force* was significantly higher for doors that had been only partially opened when closure started than for doors which had been fully opened. The peak closing force of doors that had been fully opened was around 222 N and increased to around 635 N if doors had only partially opened, with a gap of about 0.7 m between the door leaves, when closure started. When the class 465 trains were designed and built, no maximum peak force value was prescribed. Current railway group standard GM/RT2473, 'Power operated doors on passenger carrying rail vehicles', mandates a maximum peak closing force of 300 N. The doors involved were compliant with this requirement if fully open when closure started, but not if closure started with a 0.7 m gap between the door leaves. No recommendation is made in respect of door closure forces because excessive forces were only measured when doors closed from a partially open position. Closure from this position should be prevented by the implementation of recommendation 1 (paragraph 135).

- 49 Before the accident at West Wickham, neither Southeastern nor Eversholt Rail had identified that the door control arrangements could result in a potentially unsafe situation, where the doors could open wide enough for a person to pass between, but then close quickly and with significant force, resulting in the potential to trap and/or injure passengers. The RAIB recognised that this was a potential problem with other trains, and issued an urgent safety advice, which led to the rail industry identifying similar problems on other types of train (appendix E).
- 50 Class 465 trains were originally built as three subclasses during the early 1990s. Class 465/0 and 465/1 trains were built by BREL (and successor organisation ABB). Class 465/2 trains were built by GEC Alstom (previously Metro-Cammell) with the majority of these subsequently refurbished and renumbered class 465/9.
- 51 All three original subclasses were required to comply with British Rail technical specification TNE/465/89/S/001. This required the hustle alarm to sound at all open doors for a period adjustable by authorised staff and not exceeding four seconds. After this period, all open doors on the train were required to close and then lock. After being released by the driver (normally after stopping at a station), the specification required that the passenger door-open push-buttons should remain illuminated and operational until they were disabled on completion of the hustle alarm period. Testing showed that the push-buttons at the door used by the passenger when alighting from the class 465/1 unit complied with this part of the specification.
- 52 The specification did not contain a requirement that the door-open push-buttons be disabled once the door closure sequence was initiated. Subsequent testing showed that both class 465/0 and class 465/1 trains (ie those built by BREL/ABB) exhibited the sudden closure problem described in paragraph 46, but the problem did not occur in the class 465/2 units built by GEC Alstom (previously Metro-Cammell). The door control system on this subclass disables the passenger door-open buttons at the point door closure is initiated by the train driver.
- 53 Testing also showed that the hustle alarm, intended to warn passengers that the doors were about to close, was likely to be ineffective on the train involved in the accident, and similar trains, when passengers operate the door-open push-button after the driver has initiated door closure. In normal door operation, the alarm sounded near open doors for 3 seconds before the doors began to close (paragraph 45). However, it would have sounded (although partly masked by noise from the door operating mechanism) while the door was opening if, as at West Wickham, the door-open push-button was pressed after the door closure cycle was initiated. The alarm was then silent during closing.
- 54 The passenger could not recall hearing the hustle alarm sound as the doors opened at her doorway at West Wickham station. Although she was wearing in-ear earphones, she said she was listening to a podcast at low volume so she would be able to hear any on-train announcements, and be aware of her surroundings.

Door release period

- 55 **The train doors were not released long enough to allow the passenger to get up, gather her belongings, and get off the train.**
- 56 The doors would not have closed as the passenger stepped off the train if the passenger had been given a longer period to reach the doors after the train stopped at the station. The OTDR fitted to the incident train recorded that closure of the train's doors was initiated about 10 seconds after the train stopped. CCTV images show that the passenger remained in her seat for about 2 seconds after the train stopped and then took about 10 seconds to stand up, gather her belongings, reach the doorway and then press the door-open button about 2 seconds after the driver had initiated the door closure sequence.
- 57 It is not possible to eliminate all circumstances in which passengers arrive at a doorway after the door closure sequence has been initiated. The train safety check (paragraph 37) and door detection systems (paragraphs 62 to 70) are therefore intended to mitigate the associated risks due to people and objects becoming trapped in the doors. However, if previous experience leads people to believe that train doors may be closed relatively quickly, there is a risk of accidents inside trains due to people hurrying to ensure that they reach the doors before they close.
- 58 Although the time taken for the passenger to reach the door was affected by the 2 seconds she remained in her seat after the train stopped, RAIB tests using the incident train showed that the time taken before initiating door closure was less than the time required for some passengers to reach the doorway. The testing showed that, from the seats furthest from the passenger doors, it took around 8 seconds for an able-bodied passenger in an empty vehicle to reach the doorway. This indicates that the 10 seconds taken between stopping at West Wickham and initiating door closure is less than the time required by people with reduced mobility, those needing to gather belongings and people assisting or carrying young children. Longer periods would also be required for passengers needing to pass through a crowded train.
- 59 Guidance issued by Southeastern to its drivers states that, when deciding the time to initiate door closure, they should allow extra time for vulnerable passengers. The guidance does not specifically mention allowing enough time for people with reduced mobility, needing to gather belongings and/or accompanying children. Drivers will not always know when vulnerable passengers are on their train, and will not necessarily know the station at which they intend to alight.
- 60 The incident train was running on time, and the trainee driver had time available to release the train doors for longer, without causing delay to the train service. Southeastern has stated that the timetable allows 60 seconds for a train to call at West Wickham and similar stations. Neither driver reported that they felt under any time pressure during the journey, or when at West Wickham.

61 Analysis of data from five similar services (paragraph 93) showed that door closure on the incident service was sometimes initiated earlier than on all other services included in the sample (figure 9). Four of the nine closure sequences on the incident service were initiated less than 15 seconds after the train stopped, including the 10 second period at West Wickham, and a shorter period at one other station. A period of at least 15 seconds was allowed at all stops made by all other trains in the sample. The RAIB has not established the particular circumstances associated with each station stop included in figure 9 (eg whether drivers could see passengers disembarking for a considerable time period, and instances when drivers were waiting for their booked departure time). However, comparison with RAIB testing (paragraph 58), shows that at some stations the incident train driver did not allow sufficient time for mobility impaired people to disembark safely. This leads to Learning point 1 (paragraph 135).

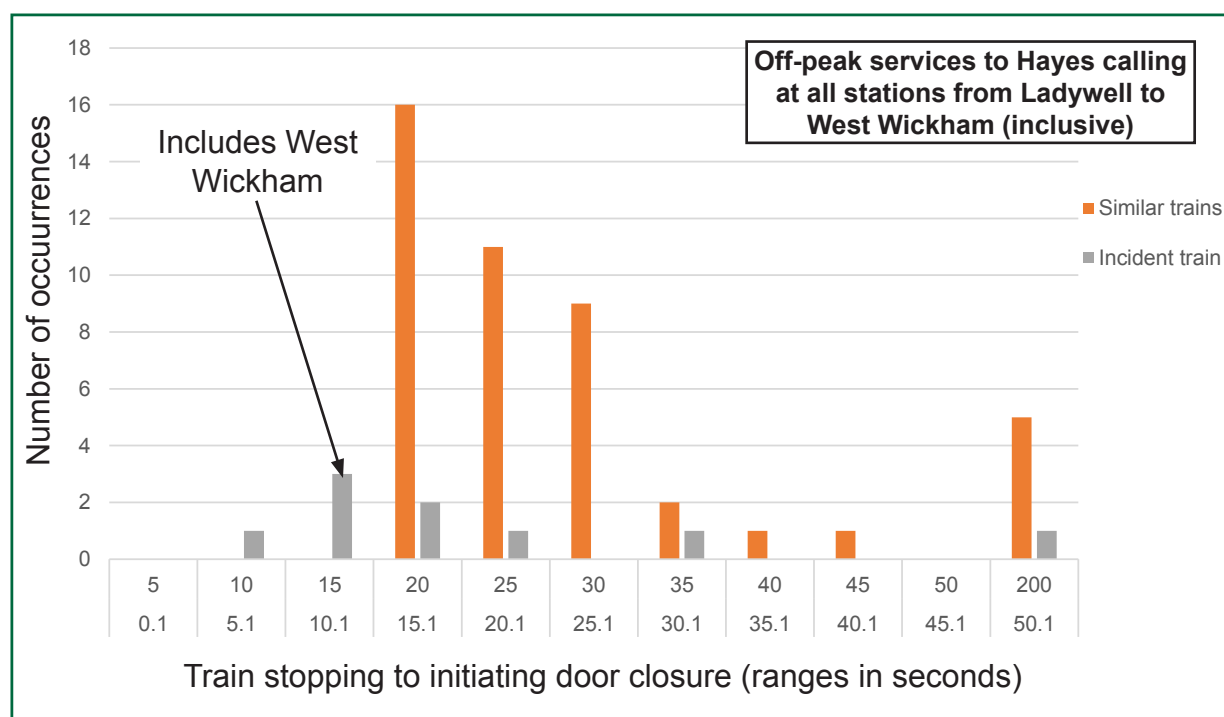


Figure 9: Time interval between train stopping and driver initiating door closure sequence

### Obstruction detection

62 **The door obstruction detection system did not detect the trapped backpack strap. As a consequence, the driver was able to take power and drive the train out of the station.**

63 Class 465 trains are fitted with an obstacle detection system linked to an *interlock circuit* which prevents the train motors operating if a large or moderately sized object is detected between door leaves. A door interlock light is illuminated in the driving cab if all doors are closed and locked with no objects detected as trapped by the train doors.

- 64 The doors initially closed onto the passenger's backpack. The obstacle detection system sensed the presence of this obstacle and caused the doors to slightly reopen, allowing the passenger to continue leaving the train. The doors then continued closing and trapped one of the thin straps forming part of the backpack's left shoulder strap. The obstacle detection system did not detect this thin strap and, after the doors closed and locked, the train door interlock light in the driving cab illuminated.
- 65 The current railway group standard concerning obstacle detection, GM/RT2473 'Power operated doors on passenger carrying rail vehicles', prescribes the minimum design and maintenance requirements for passenger doors. This standard requires that doors shall not close and lock if a specified test object 30 mm or thicker is detected by the closing doors. The standard also states that an obstacle 10 mm thick trapped in the door should be detected and either 'the door shall not be indicated closed and locked' or the obstacle can be 'withdrawn... with a force not higher than 150 N'.
- 66 The class 465 fleet was designed and built to a specification that pre-dated the requirements of current railway group standard GM/RT2473. However, the specification for the class 465 doors included requirements for obstacle detection and withdrawal of small objects as described in British Railways standard GO/OTS300 'Power operated external doors on passenger carrying rail vehicles'.
- 67 Standard GO/OTS300 and Southeastern maintenance instructions for its fleet of class 465 trains require the door closing forces to be reduced, or the door to automatically reopen, if a test object of dimensions 25 mm - thinner than the current requirement of 30 mm in standard GM/RT2473 - is placed between the closing door edges. Post-accident testing of the accident doors by the RAIB showed that they complied with this requirement.
- 68 Standard GO/OTS300 required that when using a test object of smaller dimensions than 25 mm, the test object should be 'easily' withdrawn. The maintenance instructions for Southeastern's fleet of class 465 requires a test object of 15 mm - thinner than specified by GO/OTS300 but thicker than the 10 mm required by standard GM/RT2473 - to be either obstacle detected, or if the doors close and lock, the test object can be 'withdrawn via local deformation of the doors seals'
- 69 Post-accident testing found that a 15 mm test piece could be withdrawn from between the doors using a force of around 200 N. This is greater than the maximum force of 150 N permitted for more recent trains that are required to comply with standard GM/RT2473. The RAIB found similar results when testing the doors on another type of Networker train (a class 365 involved in a *trap-and-drag* incident at Huntingdon on 15 February 2006<sup>3</sup>) that was built before standard GM/RT2473 introduced a maximum withdrawal force.
- 70 Neither current, nor historical standards, require train door systems to detect thin items such as the backpack strap involved in this accident.

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<sup>3</sup> [RAIB report 11/2007](#) 'Huntingdon train door incident, 15 February 2006'.



### Removing trapped objects

- 71 **The passenger was not able to pull the trapped backpack from the doors, and her arm may have remained in the strap<sup>4</sup> while she was dragged.**
- 72 CCTV footage from the platform and the train shows the passenger trying to pull her trapped backpack from between the closed doors. The images show that the bag was outside the train, but the strap was trapped and she was not able to generate enough force to free it, even when she was seen leaning away from the train (without pushing off the side of the train). The RAIB used the backpack that was involved in the accident in a series of tests to determine the likely reasons why the passenger was not able to pull the thin backpack shoulder strap free. The tests indicate that either the backpack shoulder strap became twisted and trapped against the inside of the closed doors, or a buckle on the strap became trapped flat against the inside of the closed doors (figures 10 and 11).

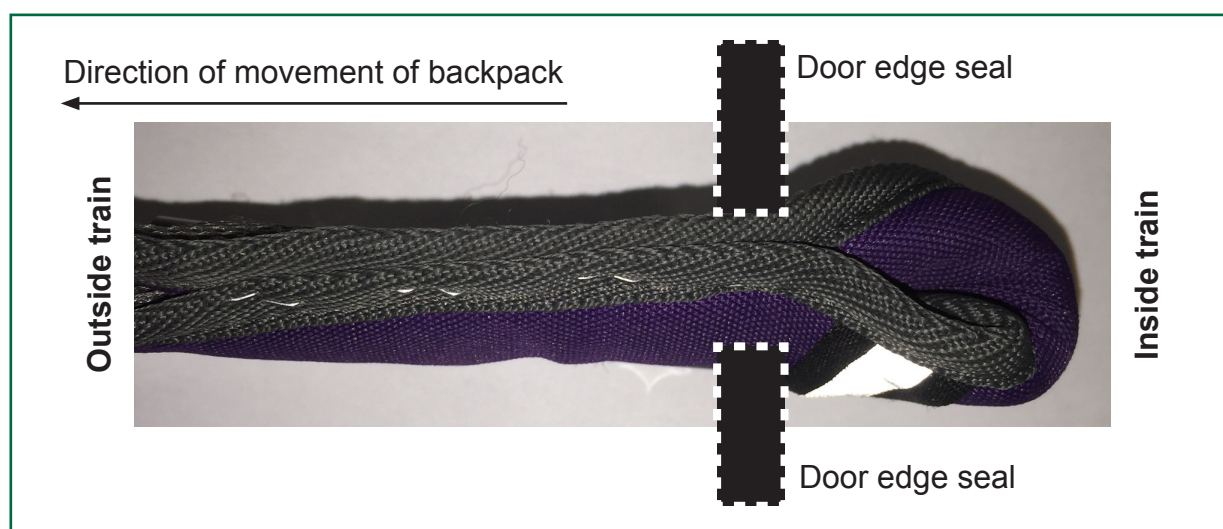


Figure 10: Twisted strap trapped on the inside of the closed doors

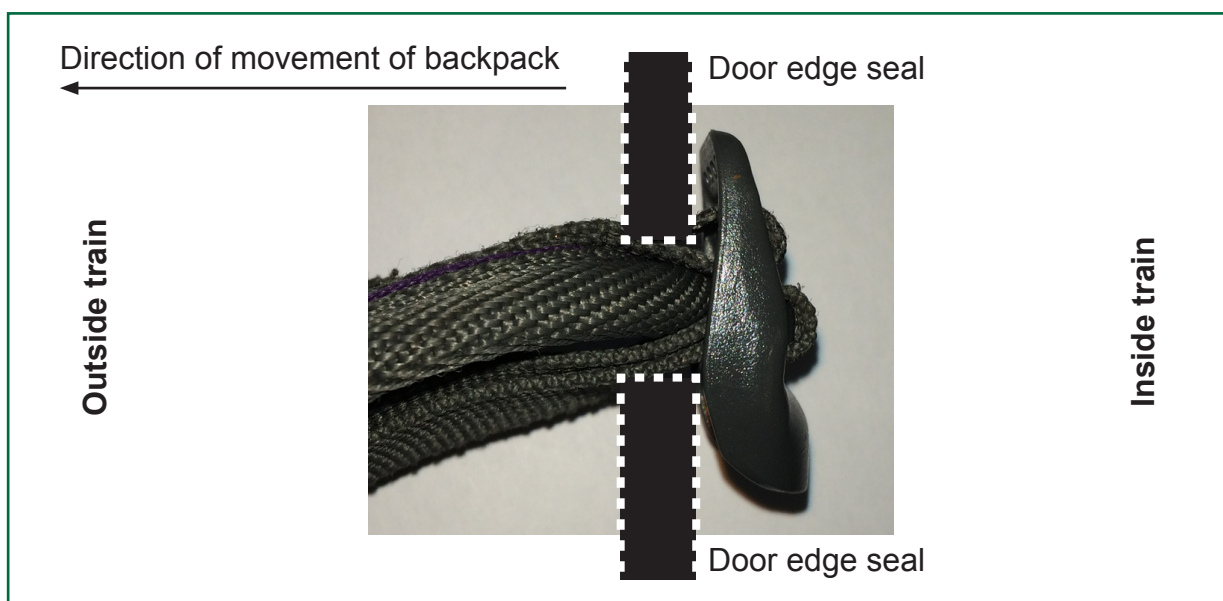


Figure 11: Buckle lying flat against the inside of the doors

<sup>4</sup> CCTV evidence was inconclusive in trying to determine the relationship between the passenger's arm and the backpack strap.

- 73 Testing conducted with a person of similar build to the passenger showed it was probable that the passenger could have pulled with a force of up to about 240 N when leaning away from the train and without pushing off the train body side. Testing of the incident train (appendix D) showed that this was more than the pull-out force of approximately 90 N that was required to remove an untwisted strap trapped between the closed doors. However, if the strap was twisted, the pull-out force required to remove it from between the doors was approximately 280 N. With one of the buckles on the backpack shoulder strap trapped flat against the inside of the closed doors, it was not possible to remove the strap until the buckle broke, at a force of 516 N. All these forces relate to pulling directly away from the side of the train (ie pulling at 90° to the side of the door), the direction the passenger was pulling before the train started to move.
- 74 Testing also showed that the force needed to release the backpack would have increased after the train started moving since the passenger was no longer pulling at 90° to the side of the train. It is therefore probable that the passenger was unable to pull the backpack from the train because the strap was either twisted and trapped against the inside face of the closed doors (figure 9), or was restrained by the strap buckle trapped against the inside face of the closed doors (figure 10). The RAIB has been unable to determine which parts of the strap were trapped inside the train because this was not recorded before the backpack was removed (paragraph 36).
- 75 The pull-out values, except for the untwisted strap, are greater than those found during Southeastern's routine maintenance (paragraph 68). This is because the test object used for maintenance tests is smooth and is fairly easy to withdraw when compared, for example, to a twisted strap. Neither British Railways standard GO/OTS300, nor railway group standard GM/RT2473, specify the type of material, or the roughness, of the obstacle to be used when evaluating the obstacle detection system (paragraph 65).
- 76 The design of the door seals is not considered to be a factor in this accident<sup>5</sup> because testing has shown that the passenger could probably have pulled the backpack through the closed doors unless the strap was either sufficiently twisted or the buckle was flat against the back of the door seals (paragraph 73).
- 77 The passenger attempted to pull the trapped strap from between the doors, rather than attempting to free herself from the backpack, because she was caught by surprise and did not expect the train to move off while she was trapped. She stated that she believed the doors would open if a person was trapped.

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<sup>5</sup> The RAIB has investigated accidents at Huntingdon ([RAIB report 11/2007](#)) and King's Cross ([RAIB report 09/2012](#)), where the design of the door seals on class 365 'Networker' type trains was a factor in trapping accidents.

### Awareness of the passenger

- 78 **Although shown on the DOO monitors, neither driver was aware of the trapped passenger when the train doors were closing, or afterwards.**
- 79 The RAIB established that the train stopped in the correct position with the DOO monitors visible from the driving cab. The monitors were functioning correctly and a person standing at the location where the passenger got off the train would have been visible on two of the five monitor screens, with the view of her in the top right-hand screen being less discernible than in the bottom left-hand screen (figure 12). DOO train drivers departing from West Wickham are required to use these monitors to complete a train safety check after all doors are closed, and before the train departs (paragraph 37). This check should always be carried out after the door interlock light is illuminated and is intended to make sure that the train is safe to start (eg there is no one trapped in the doors).
- 80 Both drivers stated that they understood the importance of the train safety check, and were aware of the risks to passengers during train dispatch.

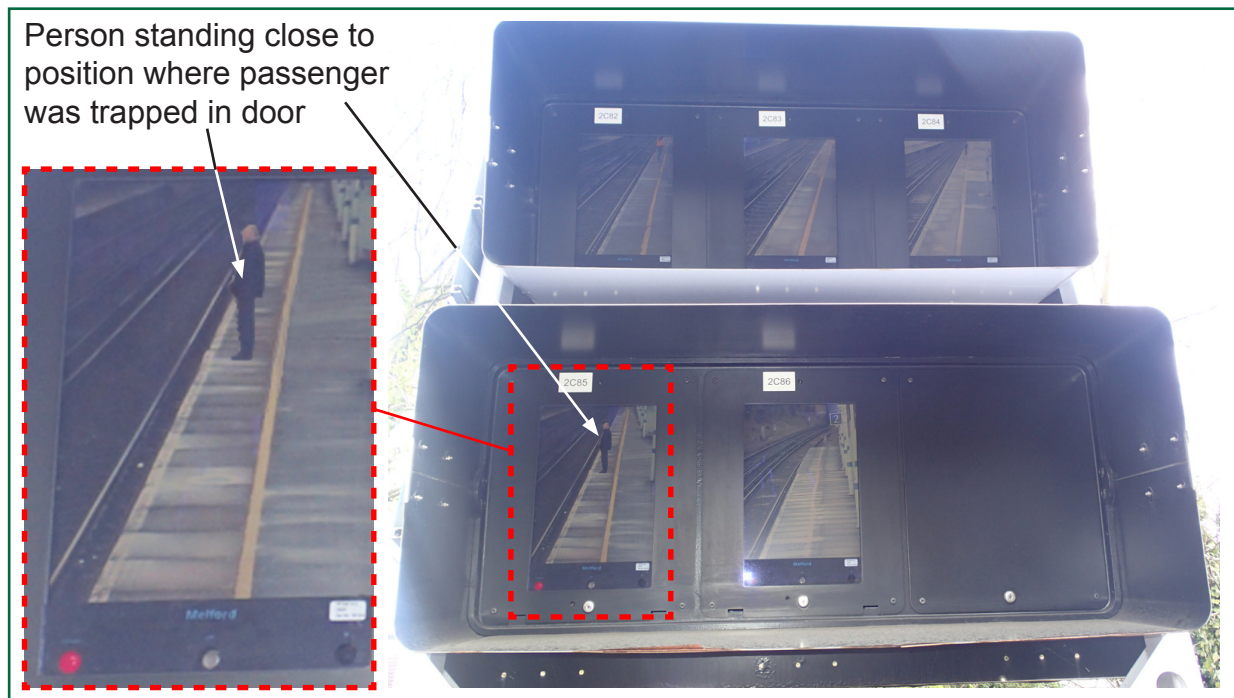


Figure 12: Location of passenger on the DOO monitor images (position of person superimposed on to image)

- 81 Following the accident, neither driver could recall anything unusual about the stop at West Wickham. The instructor driver stated that the trainee had experienced many hundreds of train dispatches using DOO monitors, including around 75 dispatches without incident on the day of the accident. In circumstances like these, it is common for people to lack a recollection of details relating to a particular event unless something unusual occurs<sup>6</sup>, and neither driver could recall any details of their stop at West Wickham on the day of the accident.

<sup>6</sup> Hunt RR, 'The subtlety of distinctiveness: What von Restorff really did', 1995. Available at: <http://link.springer.com>.

- 82 The instructor driver stated that the trainee had experienced around 80 hours of driving under instruction. The instructor completed daily and weekly reports which recorded positive comments about the trainee's progress<sup>7</sup>.
- 83 A train driver is responsible for the safe working of the train. Where an instructor driver is supervising a trainee driver, the instructor driver is ultimately responsible for the safe operation of the train. However, as trainee drivers progress, an instructor driver may permit the trainee to take on some responsibilities with reduced supervision and without the instructor driver undertaking a comprehensive check of all the trainee's actions.
- 84 The instructor driver considered that the trainee had reached the stage in his training where he was competent to make some safety judgements during the train dispatch process. This included deciding whether it was safe to start the train when there were few people on the train and the platform. To check that the trainee driver was correctly following the train dispatch procedure in these circumstances, the instructor asked the trainee to tell him what he was doing using a 'running commentary'. For example, by saying that the train was stopped at the correct position, saying when he was going to close the doors, and saying when it was safe for the train to depart. Both drivers stated that they believed train dispatch from West Wickham would have been carried out in this manner.
- 85 Southeastern operating procedure SE/WI/OPS/032 'Trainee and experienced train drivers - training and initial assessment' notes that trainee drivers should not be assessed as competent to start trains (which includes carrying out train dispatch) until the trainee has completed at least 40 to 50 driving hours and started a train on at least 10 occasions. This is the amount of time Southeastern estimates a trainee would need to gain sufficient practical experience of the DOO dispatch process. The trainee involved in the accident at West Wickham had accumulated around 80 driving hours at the time of the accident and had exceeded the requirement of starting the train from a platform on more than 10 occasions. Southeastern allows its instructor drivers to decide when trainee drivers are permitted to do particular tasks with lessening supervision based on the competence requirements of its operating procedure SE/WI/OPS/032.
- 86 The railway rule book requires drivers to undertake the train safety check after illumination of the door interlock light but before operating the power controller (paragraph 37). The railway rule book does not require drivers to monitor doors while they are closing or after operating the power controller.

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<sup>7</sup> The instructor driver has stated that where appropriate he would record critical comments about the progress of trainee drivers, but had not had cause to make such comments about the trainee driver.

87 Table 1 shows the key events<sup>8</sup> between door closure being initiated by the trainee driver and the train starting to move.

Time since door closure initiated	Event
0 secs	door closure initiated
2 secs	incident door begins to open, and passenger begins to step out of the train
3 secs	open door on third vehicle, and incident door begin to close (paragraph 30)
5 secs	all doors are closed and locked
7 secs	trainee driver selects power to move the train
11 secs	train begins to move

Table 1: Timeline of key events between initiation of door closure and train moving

The passenger stepped off the train about 2 seconds after door closure was initiated, and was then visible on the monitors (paragraph 79) for 9 seconds until the train started to move.

- 88 The RAIB has not been able to establish why, although visible on the monitors, the trainee driver and instructor driver did not see the passenger trying to free her trapped backpack. Neither driver could recall details of the stop at West Wickham (paragraph 81). The following paragraphs discuss possible reasons why the drivers did not see the passenger.
- 89 Witness evidence suggests that the trainee driver was aware of the railway rule book requirements for DOO train dispatch, and of the importance of not starting the train unless he was sure it was safe to do so. He stated that he would look at the DOO monitors 'all the time' during the dispatch procedure by scanning the monitors using a top-left to bottom-right technique – known as the 'Z' scan technique. The RAIB considers it unlikely that the trainee driver was scanning the monitors 'all the time' in an effective manner during the train dispatch process at West Wickham as this included the period of around 9 seconds when the passenger would have been continuously visible in two of the five DOO monitors.
- 90 The trainee driver was not aware of the passenger before the train started to move. The possible explanations for this lack of awareness are:
- He did not carry out a full train safety check after the doors were closed, and before operating the power controller, because the illuminated door interlock light gave him reassurance that it was safe to start the train; and/or
  - He had not noticed the trapped passenger while monitoring the doors as they were closing (or between door closure and the doors beginning to close) and so believed a further check of this door was unnecessary; and/or

<sup>8</sup> Time intervals during the accident are derived from OTDR data and recordings of the station security CCTV. The DOO monitors display images from cameras that are not recorded. Time intervals are rounded to the nearest second.

- He did not notice the passenger on the DOO monitors because he did not use an effective scanning technique, such as the 'Z' scan technique, and so did not look at the relevant monitor image; and/or he scanned the monitors quickly, and did not notice the passenger, a phenomenon associated with 'looked but failed to see'<sup>9</sup> events; and/or
  - His attention was focused on the passenger who got off the train when it first arrived at West Wickham, or the door used by that passenger (paragraph 79).
- 91 Both drivers had experienced many hundreds of successful DOO train dispatches in the previous weeks, and had completed around 75 DOO dispatches on the day of the accident. This, together with the absence of passengers waiting at West Wickham and the very lightly loaded train, may have reduced their expectation of a passenger accident during train dispatch. This could have led to the trainee driver scanning the monitors relatively quickly and not spotting the passenger.
- 92 The instructor driver stated that he would have verified that the trainee driver had completed the train safety check before they departed from West Wickham by saying 'is all clear' and the trainee driver responding 'yes' (paragraph 84). Although the instructor driver considered the trainee driver capable of undertaking this task, he stated that he would normally glance at monitor screens visible to him from his seated position, although not all of the monitors at West Wickham would have been visible to the instructor driver. The instructor driver has stated he did not see the trapped passenger at West Wickham. A reconstruction has shown that the instructor driver's view of the monitors may have been restricted because:
- the instructor was seated on the side of the cab furthest from the monitors;
  - the stopping position of the train meant that from the instructor's seated position, only part of the bottom left-hand monitor screen (paragraph 79) was visible through the cab window; and
  - the instructor's view of the cab window was partially obstructed by the trainee who was on the side of the cab nearest the monitors.
- 93 The OTDR fitted to the incident train recorded that the period of time between the door interlock light illuminating in the driving cab, and the trainee driver operating the train's power controller, was around 2 seconds. The railway rule book requires that the train safety check must be completed after the doors have closed and the door interlock light has illuminated (paragraph 37). Although a relatively short period of time, OTDR data from five other off-peak services from London Cannon Street to Hayes (ie services similar to that involved in the accident) show that the period of 2 seconds was not unusual at West Wickham and similar stations (figure 13). About 13% of stops included a similar period, 36% of stops include a lesser period of about 1 second and about 51% of stops include a period of 3 or more seconds.

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<sup>9</sup> The Department for Transport: A review of the 'looked but failed to see' accident causation factor: <http://www.dft.gov.uk/rmd/project.asp?intProjectID=10121>.

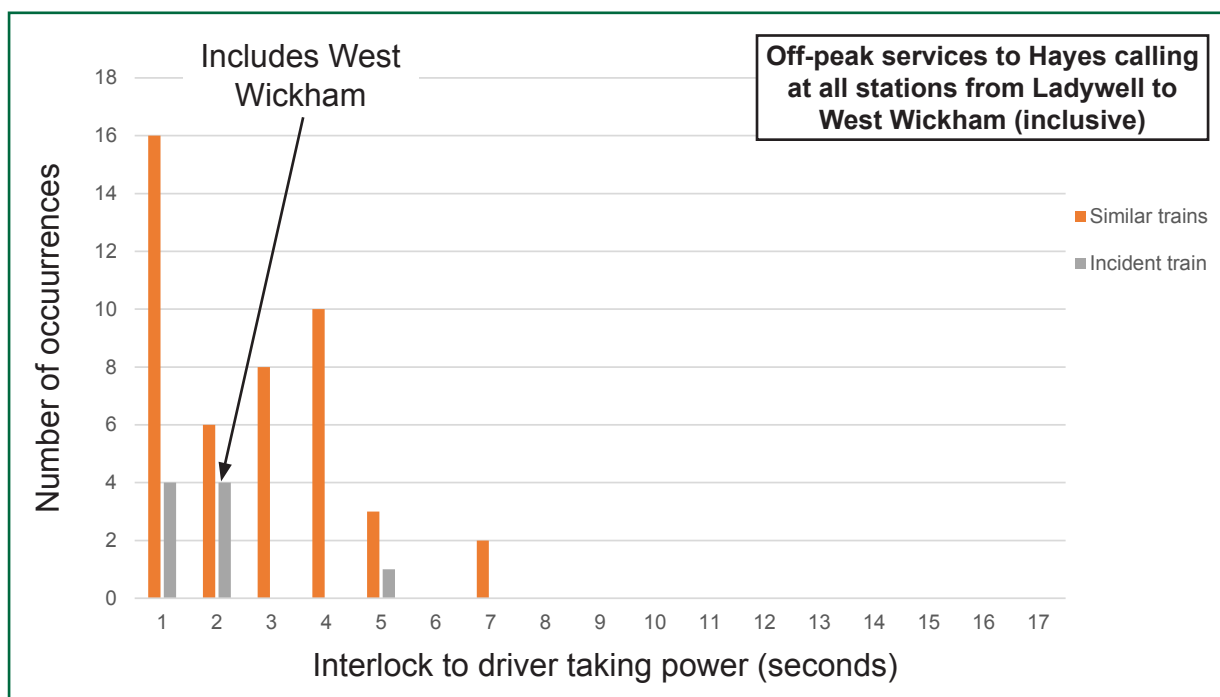


Figure 13: Time interval between interlock and taking power

94 The RAIB found no evidence that fatigue, distraction, or either drivers' eyesight were factors in the accident.

#### Monitoring the train's doors as they close

95 The RAIB has previously recommended monitoring train doors while they are closing in addition to the train safety check which is required by the railway rule book after the doors are closed (RAIB report 19/2011, Passenger accident at Brentwood station, 28 January 2011). This recommendation is discussed further at paragraphs 120 to 126, in the section of the report dealing with previous recommendations. Before the accident at West Wickham, Southeastern did not require its train drivers to monitor the train's doors as they close, although it believed that most drivers did this informally. Since the accident, Southeastern has issued its drivers with guidance including a requirement for them to observe the DOO monitors or mirrors during the door closing cycle.

#### The gap between the platform and the train

**96 The gap between the platform and train was large enough for the passenger to fall into.**

97 CCTV footage from platform 2 at West Wickham showed the passenger fell between the front and leading set of doors of the fifth vehicle (figure 14).

98 The RAIB measured a horizontal gap of 305 mm between the platform edge and the body side of a class 465 train at the approximate location where the passenger fell. The average gap between the body side of a class 465 train and platform 2 over the length of the platform was about 330 mm.

99 A gap is required between trains and platforms. If the gap is too small, trains may strike the edge of platforms. If the gap is large, passengers will have difficulty getting on and off trains, and there is an increased risk of people falling between the platform and trains. Railway group standards seek to achieve an appropriate balance between these requirements.

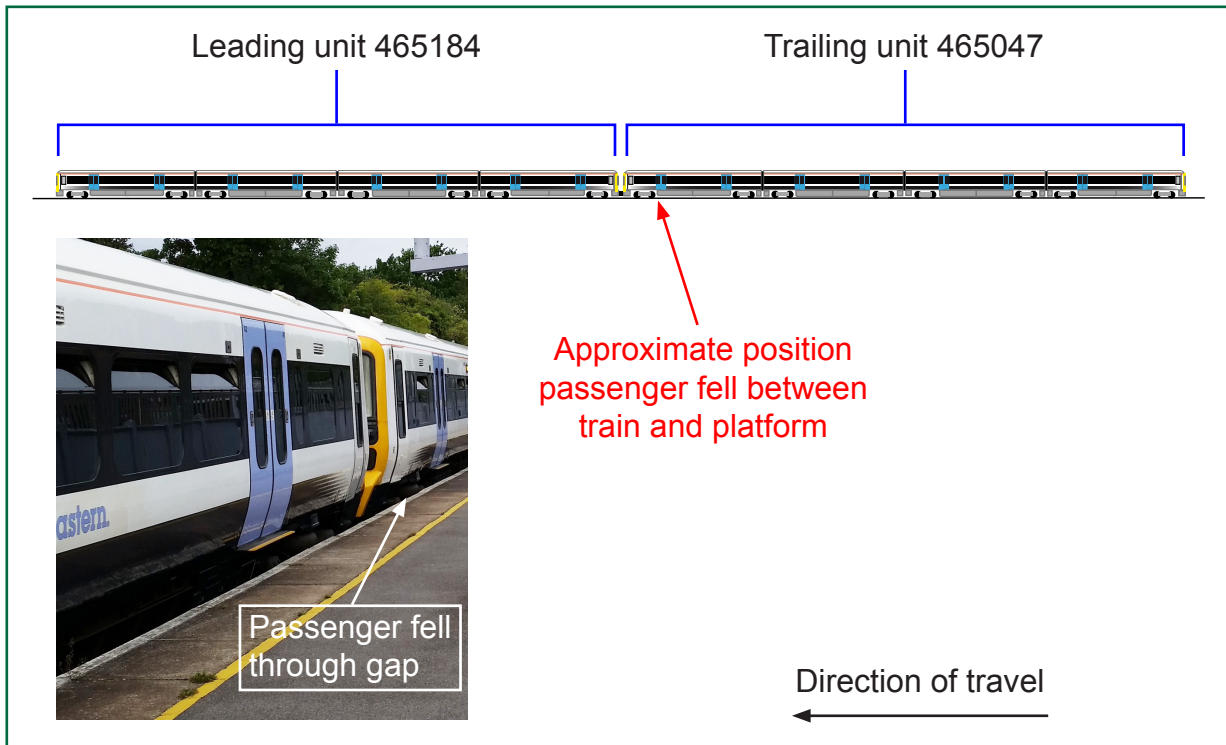


Figure 14: Approximate location where the passenger fell between the platform edge and train

- 100 Railway group standard GI/RT7016 'Interface between station platform, track and trains' requires that new platforms are built with a height above the rail of between 890 mm and 915 mm and a horizontal offset of between 730 mm and 745 mm from the nearest rail. Platform 2 at West Wickham was built before the requirements of standard GI/RT7016 applied. The platform has an average height of 899 mm (ie compliant with current requirements) and an average horizontal offset of 782 mm, about 37 mm more than permitted for new platforms. However, if the platform and track were 37 mm closer together, the average gap between a class 465 train body side and the platform edge be around 268 mm at the location of the accident, which is still large enough for a person to fall into.
- 101 The RAIB made a recommendation aimed at reducing the likelihood of falls through the platform edge gap following a fatal passenger accident at James Street, Liverpool on 22 October 2011 ([RAIB report 22/2012](#)). This is discussed further at paragraphs 127 to 128.

## Factors affecting the severity of consequences

### Platform recess

**102 The area of the platform where the accident occurred at West Wickham did not have a platform recess.**

103 When the passenger fell through the platform edge gap she could not roll away from the train because, at the location where the accident occurred, there was no recess in the platform face beneath the platform edge (figure 15). It is possible that a recess would have allowed the passenger to move further from the train, and reduced the severity of her injuries.



- 104 This part of the platform was built before railway standards introduced a requirement for recesses in new platforms. The current Railway Group Standard GI/RT7016 'Interface between station platforms, track and trains' requires that new platforms, or existing platforms that are modernised, shall have a recess with a minimum width of 300 mm, and a minimum height of 480 mm, formed beneath the platform edge.
- 105 In 2015, the RSSB completed research into recesses under platforms<sup>10</sup>. The research recommendations included increasing the recess width in certain circumstances. Output from this research will also feature in the implementation of the *platform-train interface* (PTI) strategy (paragraph 126).



Figure 15: Recess providing survival space beneath platform

<sup>10</sup> RSSB research project brief T1062 'Platform recess: review of requirements'. Available at [www.sparkrail.org](http://www.sparkrail.org).

## Observation

### CCTV evidence

**106 It is unlikely that the RAIB would have identified the door behaviour which led to the accident without the use of CCTV equipment provided on the platform and fitted to the train.**

107 Without the information obtained by viewing CCTV footage, it is unlikely the issues associated with the door control system would have been found. This is because other sources of evidence did not provide the accurate record of events needed to identify the brief period (less than a second) in which operation of the door-open button led to a partial opening of the doors followed by rapid closure, the sequence which trapped the passenger's backpack (paragraphs 31 and 46). It is possible that similar trapping events have occurred previously in circumstances when investigations took place but CCTV images were not available because the event occurred before CCTV was fitted, or because the CCTV was defective.

108 Defective on-train CCTV equipment meant that potentially valuable information was not available to RAIB investigations into accidents at Cheshunt Junction ([RAIB report 06/2011](#)), Brentwood ([RAIB report 19/2011](#)), and Frampton Level Crossing ([RAIB report 05/2015](#)). As a result, the RAIB wrote to train operators in May 2015 to highlight the importance of maintaining high availability of CCTV systems fitted to trains.

### Previous occurrences of a similar character

109 In 2014/15 there were around three billion interactions between passengers and trains at the PTI<sup>11</sup> and RSSB reported that the overall level of harm to passengers at the platform-train interface had decreased by 21% when compared to data from 2013/2014<sup>12</sup>. Between 31 March 2014 and 1 April 2015, there were three fatal accidents at the platform-train interface, but none involved passengers in the act of getting on or off trains. The RSSB observed that fatal accidents of this type were rare, with the last recorded fatality occurring in January 2005.

110 Accident data provided to the RAIB by the RSSB, showed that excluding the West Wickham accident, there had been 66 reported accidents attributed to people being trapped in train doors and then dragged (trap-and-drag) on the national railway network between April 2005 and the end of May 2015. The precise detail of these reported accidents is not always clear, and in around half of the reports the detail provided suggests that the passenger was not actually dragged along by the departing train. Where the details suggest that a person was trapped, and then dragged, there were no recorded fatal accidents. The passengers involved in the accidents at Huntingdon (paragraph 69) and West Wickham suffered serious injuries. In nearly all the other accidents, the passengers suffered minor injuries, typically bruising or shock.

<sup>11</sup> Information provided in RSSB's '[Platform train interface strategy document](#)'.

<sup>12</sup> RSSB [Annual Safety Performance Report 2014/2015](#).

- 111 The RAIB has investigated the following accidents where passengers became trapped in train or tram doors and were then dragged along as the train or tram departed:
- Huntingdon – the train driver did not think the presence of a passenger in close proximity to the side of the train was unusual, and started the train ([RAIB report 11/2007](#));
  - Wellesley Road – neither the instructor driver nor trainee driver carried out a final check before the tram moved off (Croydon Tramlink; [RAIB report 40/2007](#));
  - King’s Cross – platform dispatch staff assumed that a visible passenger was not trapped and dispatched the train ([RAIB report 09/2012](#));
  - Jarrow – the driver ‘looked but failed to see’ trapped passenger and started the metro train (Tyne and Wear Metro; [RAIB report 26/2012](#)); and
  - Newcastle – train guard did not carry out the train safety check before dispatching the train ([RAIB report 19/2014](#)).
- 112 The RAIB is currently investigating two other passenger trap-and-drag accidents:
- On 12 March 2015 at Clapham South station on the Northern Line of the London Underground network<sup>13</sup>, the edge of a passenger’s coat became trapped in the closed doors of a train. The train departed and she was dragged by it for a short distance before falling into the gap between the platform and train. The passenger suffered serious injuries to her arm and head.
  - On 25 July 2015 at Hayes and Harlington station<sup>14</sup>, a passenger’s hand became trapped in the closing doors of a train. The train departed and she was dragged a short distance before she fell onto the platform and her hand became free. She did not fall into the gap between the platform and the train, but she did suffer bruising to her head and hand. The RAIB issued an Urgent Safety Advice following this accident.
- 113 During the RAIB investigation into the accident at West Wickham, a member of the public contacted the RAIB to report that he had experienced train doors closing on him on two separate occasions. On both occasions, he could not recall any warning that the doors were going to close, and the doors closed quickly and with ‘significant’ force. There is insufficient evidence available for the RAIB to determine if the doors involved in these events displayed similar characteristics to the class 465 units involved in the accident at West Wickham.
- 114 The risk of backpacks and similar items being trapped between train doors was demonstrated again on 22 August 2015 when a backpack was found lying on the track on London Underground’s Bakerloo line. A review of CCTV images identified that the backpack had been caught in the doors of a train on departure from Paddington station. There were no reports of anyone being dragged by the train as it departed.

<sup>13</sup> A [summary of the accident](#) is available on the RAIB website.

<sup>14</sup> A [summary of the accident](#) is available on the RAIB website.

115 The RAIB has previously recognised risks associated with the platform edge gap and train dispatch arrangements. These issues are included in the reports listed below and the recommendations they contain, relevant to the West Wickham accident, are presented in paragraphs 120 to 128.

- Brentwood ([RAIB report 19/2011](#)): the platform edge gap and DOO train dispatch.
- James Street ([RAIB report 22/2012](#)): the platform edge gap and guard train dispatch.
- Charing Cross ([RAIB report 10/2013](#)): the platform edge gap and platform staff train dispatch.

## Summary of conclusions

### Immediate cause

116 A strap on the passenger's backpack was trapped by the train doors as they closed. As the train departed from the platform, she was dragged until she fell onto the platform and then into the gap between the platform and train (**paragraph 39**).

### Causal factors

117 The causal factors were:

- a. The train doors closed unexpectedly and quickly as the passenger stepped off the train (**paragraph 42, Learning point 4 and Recommendation 1**).
- b. The train doors were not released long enough to allow the passenger to get up, gather her belongings, and get off the train (**paragraph 55, Learning point 1**).
- c. The door obstruction detection system did not detect the trapped backpack strap. As a consequence, the driver was able to take power and drive the train out of the station (**paragraph 62**).
- d. The passenger was not able to pull the trapped backpack from the doors and her arm may have remained within the strap while she was dragged (**paragraph 71**).
- e. Although shown on the DOO monitors, neither driver was aware of the trapped passenger when the train doors were closing, or afterwards (**paragraph 78, Learning points 2 and 3 and Recommendation 2**).
- f. The gap between the platform and train was large enough for the passenger to fall into (**paragraph 96 and previous recommendation at paragraph 127**).

### Factors affecting the severity of consequences

118 It is possible that the consequences of the event were exacerbated because the area of the platform where the accident occurred did not have a recess (paragraphs 102 to 104).

### Additional observation

119 Although not linked to causes of the accident at West Wickham on 10 April 2015, the RAIB observes that it is unlikely it would have identified the door behaviour, which led to the accident, without the use of CCTV equipment provided on the platform and fitted to the train (paragraphs 106 to 108).

## Previous RAIB recommendations relevant to this investigation

### Previous recommendation that had the potential to address one or more factors identified in this report

[Accident at Brentwood on 28 January 2011, RAIB report 19/2011, Recommendation 2](#)

**120 The RAIB considers that more effective implementation of recommendation 2 in report 19/2011 could have led to the drivers checking the DOO monitors while the train doors were closing, thus addressing one of the factors that led to this accident (paragraphs 78 to 95).**

121 This recommendation read as follows:

*'The Rail Safety and Standards Board should, in consultation with train operators, consider the inclusion of guidance in Rail Industry Standard RIS-3703-TOM that those responsible for train dispatch (including the drivers of DOO trains) should, so far as is reasonably practicable, observe the closing of the train's doors and be alert for any dangerous occurrence while this is taking place'.*

122 The Office of Rail and Road (previously named the Office of Rail Regulation) reported to the RAIB, on 27 February 2013, that action had been taken to implement this recommendation. The RSSB included guidance on this issue in RIS-3703-TOM 'Passenger train dispatch and platform safety' published in March 2013. This stated (in guidance note 23) that:

*'When developing the train dispatch process, consideration should be given to the level of monitoring required during train dispatch, with specific emphasis on monitoring during the door close process and during train departure'.*

123 Southeastern has stated that it considered RIS-3703-TOM to be written from the viewpoint of platform staff being involved in train dispatch. As a result, Southeastern had used the railway rule book, and not specifically referred to RIS-3703-TOM, when considering its DOO dispatch processes.

124 Southeastern's understanding of the scope of RIS-3703-TOM is shared by RSSB who, in September 2015, stated to RAIB that the RIS '*was really intended for station managers, and not train operators*'. However, RSSB also noted that the RIS did state that '*railway undertakings responsible for developing their own train dispatch processes at stations operated by infrastructure managers may choose to adopt those parts of the [RIS] that apply to their operations*'. This would apply to dispatch arrangements for DOO services such as those operated by Southeastern.

125 Prior to publishing recommendation 2 in the report on the Brentwood accident, the RAIB had met RSSB in September 2011 and proposed that railway rule book module SS1 'Station duties and train dispatch' included a requirement for the drivers of DOO trains to monitor the closing doors where it was practicable to do so. RSSB told the RAIB that this proposed requirement would sit better in RIS-3703-TOM, as this document shared good practice in train dispatch and covered all train dispatch methods.

126 The RSSB-facilitated Platform Train Interface Strategy Group (PTISG)<sup>15</sup> was established in 2013 and published a report, 'Platform train interface strategy', in January 2015. Southeastern has stated that it had discussed the application and limitations of RIS-3703-TOM with RSSB prior to the publication of this report. The report recommended that the scope of RIS-3703-TOM needed to be extended to include train dispatch duties of drivers, guards, other *train crew*, and managers (see recommendation 2).

## Recommendations that are currently being implemented

### Accident at James Street on 22 October 2011, RAIB report 22/2012, Recommendation 3

127 The above recommendation includes consideration of measures to reduce the size of the gap between trains and platforms, thus addressing one of the factors in the accident at West Wickham (paragraph 96). The recommendation, and its current status, are given below:

#### Recommendation 3

*The Office of Rail Regulation should, in conjunction with railway industry parties, ensure that the findings of this report are taken into account in published guidance on the types of measures that promote the safe movement of trains from platforms through the adequate control of risk. The areas that should be the subject of particular consideration in such guidance include ... adaptation of trains and infrastructure to reduce the size of the platform edge gap when this is possible and appropriate, for example in connection with investment in new trains and infrastructure.*

128 In response to this, and other recommendations in the James Street investigation, RSSB formed the PTISG on behalf of the railway industry (paragraph 126). In its January 2015 report, this group set out the short and long-term targets in areas which included optimising the gap between train and platform. The RSSB also started an on-going research project 'Evaluating platform gap filler to reduce risk at the train/platform interface' (research project T1054).

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<sup>15</sup> A group formed by RSSB in December 2013 to investigate PTI risk and develop a strategy to support the railway industry in managing the platform-train interface. The PTISG members included: the Department for Transport, Office of Rail and Road, the Association of Train Operating Companies, RSSB, train operators, station operators, and rolling stock owners.

## Actions already taken or in progress relevant to this report

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

- 129 Southeastern reports that it has begun implementing measures aimed at increasing driver awareness of PTI risk. These measures include modifying train drivers' training and briefings to place greater emphasis on the train safety check, instructing its drivers to monitor train doors throughout the time they are closing, and updating its driving policy in line with developments in industry good practice.
- 130 Southeastern also reports that new train-driving simulators, introduced in May 2015, are being used to raise drivers' awareness of platform-train interface risk. The new simulators generate platform-train interface incidents such as people standing close to the train. However, some types of incident, such as people being trapped and dragged, cannot be simulated because of limitations with the graphics software (Learning point 4).
- 131 Southeastern reports that, in conjunction with Eversholt Rail, a modification programme completed in January 2016 removed the ability for passengers to open the doors on its class 465/0 and class 465/1 trains during the door closing cycle (paragraphs 43 to 46). It also reports that it intends to remove illumination of the door-open lights during the door closing cycle, and reduce the peak door closure force on its class 465 trains, as part of modifications to be completed by August 2016.
- 132 In response to an Urgent Safety Advice issued by the RAIB to the railway industry following the accident at West Wickham, the rolling stock owners report that they have worked with train operators to assess passenger door operation in relation to the factors that could lead to a similar, potentially unsafe situation occurring. The rolling stock owners have co-ordinated the results of the assessment of 49 vehicle classes and sub-classes. Of these, 22 vehicle classes<sup>16</sup> (including class 465) currently allow the situation of door open activation by a passenger for a short period following initiation of the door close sequence by train crew. The rolling stock owners report that they are jointly commissioning a review of the door control system behaviour characteristics of these additional train classes, and are investigating the practicability of modifications to remove the ability of passengers to open train doors during the door closing cycle.

<sup>16</sup> Class 142, 143, 144, 150, 155, 156, 158, 165, 166, 313, 317, 318, 319, 320, 321, 322, 365, 395, 442, 455, 456 and 465.



## Other actions

- 133 On 30 November 2015, following an accident at Hayes and Harlington station on 25 July 2015 (paragraph 112), when a passenger was dragged along by a train after her hand became trapped in the closed doors, the RAIB issued an Urgent Safety Advice. This advice was issued because discussions with some train drivers, driver managers, control room staff, and station staff indicated a common misconception that it is not possible to obtain door interlock, and for a train to depart, if a person's hand is trapped in the train's doors. The Urgent Safety Advice highlights the importance of not relying on the illumination of the door interlock light to mean nothing is trapped in the train doors, and the importance of a thorough final train safety check.
- 134 RSSB has stated that it is considering extending the scope of RIS-3703-TOM to include the duties of drivers, guards, other train crew and managers (paragraph 123).

## Learning points

135 The RAIB has identified the following key learning points<sup>17</sup>:

- 1 People dispatching trains must allow train doors to be released for sufficient time for passengers to get on and off trains safely. This should take account of passengers with reduced mobility, passengers with children and passengers that need to gather their belongings (paragraph 55).
- 2 Train crew must not rely on illumination of the train door interlock light as a reassurance that nothing is trapped in the train's doors. It can illuminate when objects including clothing, straps, fingers and hands are trapped between the closed doors (paragraphs 64, 90 and 117e). This reinforces the need for a thorough and systematic train safety check.
- 3 People dispatching trains must allow sufficient time to undertake the train safety check. The check must be carried out systematically, without reducing vigilance even when a station is quiet or a train is lightly loaded. The check is vitally important because it makes sure that people will not be in danger when the train moves off (paragraph 117b).
- 4 People involved in train specification and train design should ensure that door control systems do not have the potential to mislead passengers (eg passenger door-open push-button lights illuminated during the door closing period). They should also ensure that, if opened by a passenger operated door control, doors reach the fully open position and remain fully open, for a period consistent with safe use by a passenger (paragraph 117a).
- 5 Train operating companies should, where practicable, use simulation to allow drivers to practise handling low probability, high hazard PTI events such as passengers trapped in closed doors by thin objects which are not detected by the door obstruction system (paragraph 130).

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<sup>17</sup> 'Learning points' are intended to disseminate safety learning that is not covered by a recommendation. They are included in a report when the RAIB wishes to reinforce the importance of compliance with existing safety arrangements (where the RAIB has not identified management issues that justify a recommendation) and the consequences of failing to do so. They also record good practice and actions already taken by industry bodies that may have a wider application.

## Recommendations

136 The following recommendations are made<sup>18</sup>:

- 1 *The intent of this recommendation is to prevent passengers being put at risk of an accident at the platform train interface, in circumstances where they have been able to open passenger train doors using the door open controls after the door closing cycle has been initiated. The recommendation seeks completion of work already started by some railway organisations.*

Operators and owners of trains with power operated doors should jointly review passenger door operation, and apply any necessary modifications so that, if doors are opened by passengers using the door open controls during the door closing cycle, the doors will fully open for a period consistent with safe use by a passenger (paragraph 117a).

- 2 *The intent of this recommendation is to increase the opportunity for seeing incidents and accidents at the platform-train interface during the train dispatch process, therefore reducing the risk that a train departs with a passenger in an unsafe position. Although continuous monitoring of all doors is preferable during this period, the recommendation acknowledges that this is sometimes impracticable (eg if staff cannot see all doors at the same time).*

The RSSB, in consultation with the railway industry, should include in suitable guidance that train crew undertaking dispatch duties should, where practicable, monitor train doors during the door closing period. This is additional to the existing railway rule book requirement for a train safety check after doors are fully closed (paragraph 117e).

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<sup>18</sup> 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 and Road 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 200 to 203) can be found on RAIB's website [www.gov.uk/raib](http://www.gov.uk/raib).

## Appendices

### Appendix A - Glossary of abbreviations and acronyms

CCTV	Closed-Circuit Television
DOO	Driver Only Operation
N	Newton (unit of force)
OTDR	On-train Data Recorder
PTI	Platform Train Interface
PTISG	Platform Train Interface Strategy Group

## Appendix B - Glossary of terms

Door interlock light	An illuminated light or indication provided in the train driver's cab that indicates the train's doors are closed and locked.
Edge seal (door)	Seals provided along door edges to primarily prevent water from entering the train.
Infrastructure manager	In relation to a railway station, it is the organisation that manages and uses the infrastructure at a station.
Interlock circuit	A circuit that prevents an action unless prescribed conditions have been achieved.
Leaves (door)	Door leaves are the doors themselves. A single door is formed by a single leaf.
Obstacle detection system	A system designed to detect obstacles as train doors close.
Peak door closing force	The maximum force applied over a short period of time. Typically, the force needed to commence closing a door.
Released	In this report, released means that the train driver has operated the door-open push-buttons in the driving cab and the body side passenger doors can be opened by passengers using the door-open push-buttons.
Rolling Stock Library	A database containing details of all passenger carriages and freight wagons approved by Network Rail for operation on its infrastructure.
Starting signal	In the context of a platform location, it is the signal that is normally provided at or near the end of the platform.
Thin-film transistor	A special kind of transistor typically used in liquid crystal displays (for example, computer monitors and televisions).
Third rail	A rail energised with the electric current required to power electric trains.
Train crew	Staff involved in the operation of a train. This includes train drivers and guards.
Trap-and-drag	An incident where a passenger is trapped in closed train doors, and then dragged along as the train moves away.

## Appendix C - Investigation details

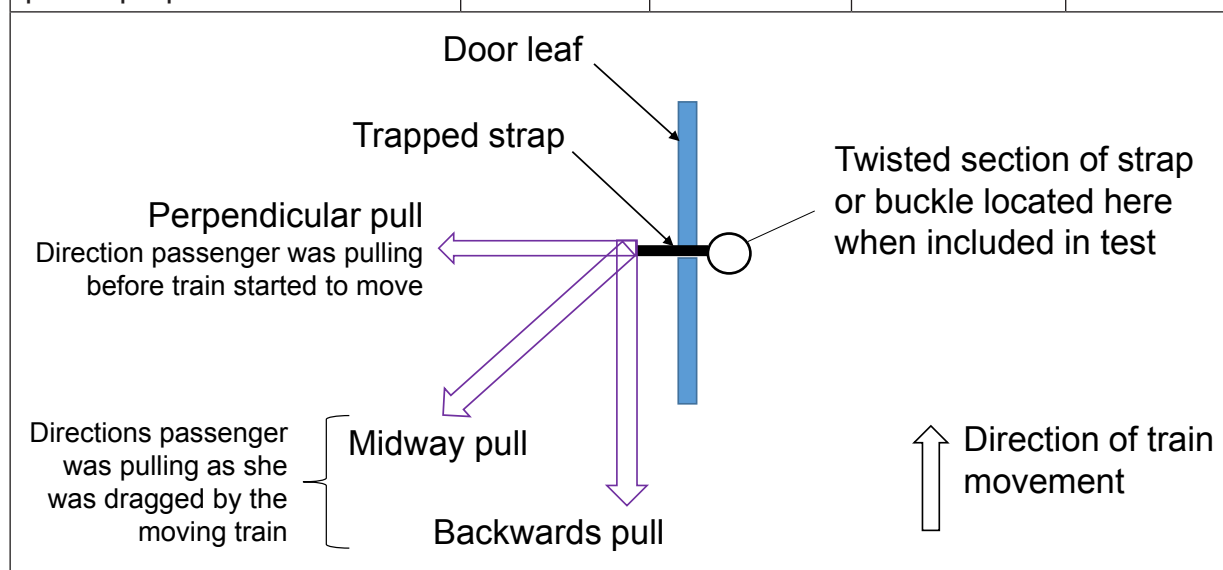
The RAIB used the following sources of evidence in this investigation:

- information provided by witnesses and rail industry organisations;
- information taken from the train's on-train data recorder (OTDR);
- closed circuit television (CCTV) recordings taken from the train and West Wickham station;
- site photographs;
- testing undertaken by RAIB and Southeastern; and
- a review of previous RAIB investigations that had relevance to this accident.

## Appendix D - RAIB tests on incident doors

<b>Peak door closing forces</b>	Test 1	Test 2	Test 3	Average
Peak closure force starting with door fully open	252 N	203 N	210 N	222 N
Peak closure force starting with 0.7m gap between door edges	572 N	698 N Force gauge damaged during test	-	635 N

<b>Pull out forces for strap on incident backpack</b>	Test 1	Test 2	Test 3	Average
Strap (untwisted), no buckle, pulled perpendicular to train	87 N	84 N	94 N	88 N
Strap (untwisted), no buckle, pulled in midway direction	107 N	104 N	103 N	105 N
Strap (untwisted), no buckle, pulled backwards	125 N	128 N	129 N	127 N
Strap (untwisted) and buckle, pulled perpendicular to train	516 N Buckle broken during test	>300 N Using other strap (test load limited to avoid further damage to backpack)	-	N/A
Twisted strap, no buckle, pulled perpendicular to train	278 N	283 N	273 N	278 N



## Appendix E - RAIB Urgent Safety Advice

RAIB SF-3.1.9.1  
 ISSUE : 1  
 27 OCTOBER 2005

### URGENT SAFETY ADVICE



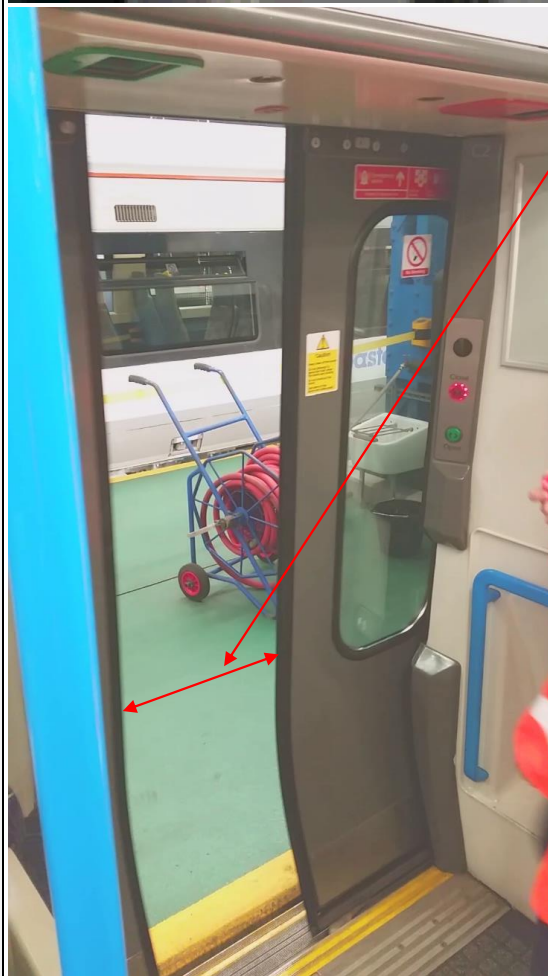
1. INCIDENT DESCRIPTION			
<b>LEAD / INSPECTOR</b>		<b>CONTACT TEL. No.</b>	
<b>INCIDENT REPORT No</b>	780	<b>DATE OF INCIDENT</b>	10 April 2015
<b>INCIDENT NAME</b>	Passenger accident at West Wickham station		
<b>TYPE OF INCIDENT</b>	Passenger trapped in train doors and dragged under train		
<b>INCIDENT DESCRIPTION</b>	<p>At approximately 11:35 hrs on 10 April 2015, a passenger alighting at West Wickham station from the 11:00 hrs Southeastern service from London Cannon Street to Hayes (Kent), became trapped in a set of doors when part of a rucksack that she was carrying over one shoulder caught between the doors as they closed. She was unable to free the rucksack and when the train departed she was pulled along the platform before she lost her balance and was dragged off the platform and under the train, suffering life-changing injuries as a consequence.</p> <p>The train comprised two four-car Class 465 'Networker' units, with a class 465/1 unit (465 184) leading a class 465/0 unit (465 047). The doors involved were the rear passenger doors on the fourth coach of the leading unit.</p> <p>The train was driver-only operated. CCTV monitors located on the platform are used by drivers during the train dispatch process to check that it is safe to close doors and depart from the platform.</p>		



**SUPPORTING REFERENCES**



Passenger exiting through a door opened during the door closure sequence



Extent to which the door opened when requested to open during hustle sequence, before reclosing rapidly (as observed during testing)

## URGENT SAFETY ADVICE



<b>2. URGENT SAFETY ADVICE</b>	
<b>USA DATE:</b>	23 April 2015
<b>TITLE:</b>	Risk of passengers becoming trapped in power-operated doors
<b>SYSTEM / EQUIPMENT:</b>	Power-operated train doors
<b>SAFETY ISSUE DESCRIPTION:</b>	<p>The RAIB's preliminary examination of the circumstances of this accident, and initial testing, has found a safety issue with the operation of doors of the type fitted on class 465/1 units.</p> <p>The power-operated doors are opened by passengers using an 'open doors' push button which is illuminated when the driver has released the passenger doors at a station. When the driver commences the door closure sequence, a 'hustle alarm' sounds for approximately three seconds (the 'hustle period') in any coach where any doors have been opened by passengers. At the end of the hustle period, any open doors start to close. The hustle alarm does not sound in a coach where none of the passenger doors have been opened. During the hustle period, the 'open doors' button remains illuminated at any doors on the train that are already closed, and it is still possible for a passenger to initiate door opening by pressing the button.</p> <p>However, if the 'open doors' button is pressed during the hustle period, any closed door will only open for the balance of the time available to the end of the three second hustle period. In practice, this means that there are situations when a door will only come partially open before closing again, rapidly and without warning, because the 'open doors' button has been pressed relatively late in the hustle period.</p> <p>These are the circumstances which contributed to the accident at West Wickham. The passenger approached the closed door and pressed the 'open doors' button after the driver had initiated the door closure sequence. There was no hustle alarm sounding in the coach she was travelling in because no-one had left or joined that coach through either of its doors. The 'open doors' button was still illuminated and the doors started to open when she pressed it, but they had only partially opened before they closed again as she was stepping off the train. While she managed to push through the gap between the doors, part of her rucksack became trapped when the doors closed rapidly and forcefully behind her.</p> <p>The train driver did not see that the passenger was in an unsafe position, and he was able to obtain traction interlock because the width of the item caught in the door was not sufficient to prevent completion of the 'round-the-train' circuit.</p> <p>Preliminary testing by the RAIB has revealed the potential for passengers to be misled by the 'open doors' button remaining illuminated after the driver has initiated the door closure sequence into thinking that the doors will open for sufficient time for them to safely join or alight from the train (particularly where the hustle alarm is not sounded because no doors have been opened in that coach). In such instances the door can then suddenly close with considerable force, and without warning, onto a passenger.</p>
<b>CIRCUMSTANCES:</b>	<p>The RAIB has investigated other accidents involving passengers becoming trapped in train doors and dragged along platforms: Huntingdon on 15 February 2006 (RAIB report no. 11/2007); and King's Cross on 10 October 2011 (RAIB report no. 09/2012), but none that have occurred in exactly the same circumstances as those described in this urgent safety advice.</p> <p>The RAIB has also investigated a number of accidents involving trains departing from platforms where those responsible for train dispatch had not noticed passengers in unsafe situations or had not responded appropriately: Brentwood on 28 January 2011 (RAIB report no. 19/2011); James Street on 22 October 2011 (RAIB report no.22/2012); and Newcastle Central on 5 June 2013 (RAIB report no. 19/2014).</p>
<b>CONSEQUENCES</b>	In this case, the passenger suffered serious injuries. Under slightly different circumstances, the accident could have been fatal.
<b>SAFETY ADVICE:</b>	<p>The RAIB is issuing this Urgent Safety Advice to alert operators of rolling stock with power-operated doors that can be opened by passengers to the circumstances under which a passenger might be misled into thinking that it is safe for them to join or leave a train when in fact the doors will not fully open and will then close very rapidly.</p> <p>On this basis, the RAIB is advising all operators of trains with power-operated doors in the UK to assess the extent to which the same conditions could occur on rolling stock they operate. Where the same design characteristics are identified, the RAIB advice is as follows:</p> <ol style="list-style-type: none"> <li>1. Carry out an urgent review of the means of reducing the risk to passengers becoming trapped in this way. It is suggested that this should include an evaluation of the safety benefit of modifying the design of powered door control systems to remove the capability for passengers to open doors once the door closure sequence has been initiated by the driver.</li> <li>2. Train operators are advised to use the circumstances of this accident as a basis for re-briefing drivers, and other staff involved in train dispatch, about the value of monitoring train doors during the closing period, whenever this is practicable. Such a briefing can also be used to remind drivers and other dispatchers that they are required to perform a thorough final safety check after the doors have closed and before starting the train.</li> </ol>

## URGENT SAFETY ADVICE



USA SIGN-OFF*			
<b>INSPECTOR NAME:</b>		<b>DCI NAME:</b>	
<b>INSPECTOR SIGNATURE:</b>	ELECTRONIC COPY	<b>CI / DCI SIGNATURE:</b>	ELECTRONIC COPY
<b>DATE:</b>	24 April 2015	<b>DATE:</b>	24 April 2015

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