



Rail Accident Investigation Branch

Rail Accident Report



Derailment at Blackpool Pleasure Beach 6 July 2006

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.

© Crown copyright 2006

You may re-use this document/publication (not including departmental or agency logos) free of charge in any format or medium. You must re-use it accurately and not in a misleading context. The material must be acknowledged as Crown copyright and you must give the title of the source publication. Where we have identified any third party copyright material you will need to obtain permission from the copyright holders concerned. This document/publication is also available at www.raib.gov.uk.

Any enquiries about this publication should be sent to:

RAIB	Email: enquiries@raib.gov.uk
The Wharf	Telephone: 01332 253300
Stores Road	Fax: 01332 253301
Derby	Website: www.raib.gov.uk
DE21 4BA	

This report is published by the Rail Accident Investigation Branch, Department for Transport.

Derailment at Blackpool Pleasure Beach 6 July 2006

Contents

Introduction	4
Summary of the report	5
The Incident	6
The Investigation	9
Analysis	10
Identification of the immediate cause	10
Identification of the causal and contributory factors	12
Identification of the underlying causes	14
Conclusions	16
Recommendations	17
Appendices	18
Glossary of abbreviations and acronyms	18
Glossary of terms	19

Introduction

- 1 The sole purpose of a Rail Accident Investigation Branch (RAIB) investigation is to prevent future accidents and incidents and improve railway safety.
- 2 The RAIB does not establish blame, liability or carry out prosecutions.
- 3 Access was freely given to staff from Blackpool Transport Services (BTS) and Blackpool Borough Council (BBC) in connection with the investigation.
- 4 Appendices at the rear of this report contain Glossaries explaining the following:
 - acronyms and abbreviations are explained in the glossary at Appendix A; and
 - technical terms (shown in *italics* the first time they appear in the report) are explained in the glossary at Appendix B.

Summary of the report

- 5 On the afternoon of 6 July 2006, tram 720 was traversing *hand points* at Blackpool Pleasure Beach (Figure 1) when it became derailed at less than 4 mph (6 km/h). There were no injuries and only minor marking to the *switch tips* and the surrounding concrete as a consequence of the incident.
- 6 The immediate cause of the derailment was the trailing *wheelsets* of the tram travelling toward the inner loop (the loop) after the leading wheelset correctly travelled toward the *normal*, southbound route.
- 7 The causal factor was that the hand points mechanism had not been correctly returned to the normal position before the passage of tram 720.
- 8 The contributory factors were:
 - the stiffness of operation of the hand points mechanism;
 - the disturbance of the *switch rails* and subsequently the hand points mechanism by the passage of the leading wheelset; and
 - the *crabbing* of the leading *bogie* on the approach to the switch rails.
- 9 The underlying cause was the procedure for operating the hand points mechanism.
- 10 Two recommendations are made in relation to operating the hand points mechanism. The recommendations may be found at paragraph 56.

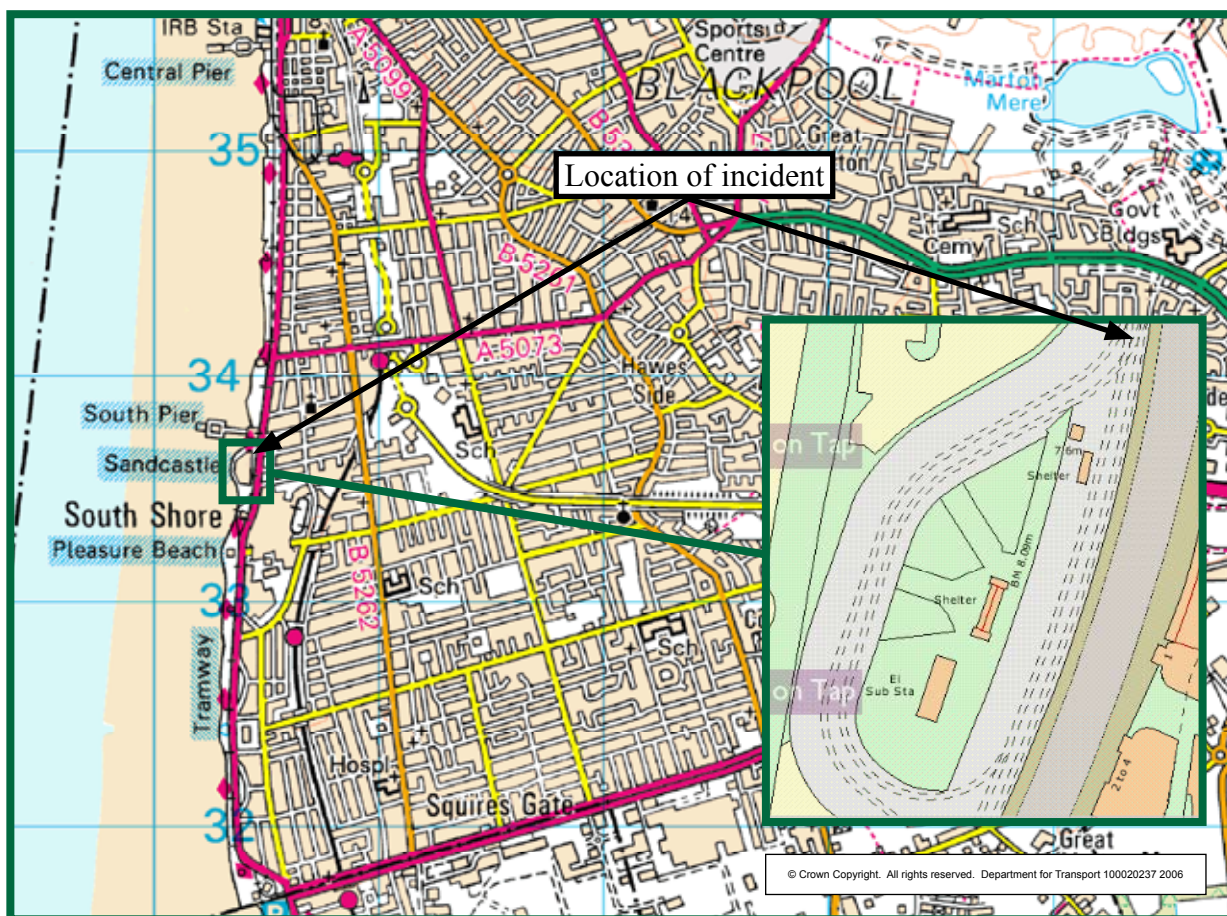


Figure 1: Extract from Ordnance Survey map showing location of incident

The Incident

- 11 At 14:45 hrs on 6 July 2006, tram 720 was traversing hand points at Blackpool Pleasure Beach when it became derailed at less than 4 mph (6 km/h). There were approximately 15 passengers on board.
- 12 The trams are operated by BTS and the infrastructure is maintained by BBC.
- 13 The persons involved in the incident were:
 - the driver of tram 720; and
 - the driver, conductor and trainee conductor of preceding tram 724.
- 14 The location of the incident was the hand points at the intersection of the southbound line and the loop (Figure 1). The line speed at this location was 4 mph (6 km/h).
- 15 The weather was dry, fine and clear.
- 16 Tram 720 was manufactured by English Electric and entered service in 1935. The tram comprises a coach body mounted on two bogies. Each bogie has two wheelsets.
- 17 Prior to the incident, tram 720 had followed tram 724 from Cleveleys. Both trams were bound for Starr Gate, the southernmost point of the line (Figure 2).
- 18 A 'change over' crew including driver, conductor and trainee conductor boarded tram 724 at Manchester Square. The driver contacted the depot and requested to turn back on the loop at Pleasure Beach to make up time as the tram was running late. The depot agreed with this request.
- 19 The conductors transferred the passengers of tram 724 to tram 720 at the South Pier tram stop for onward travel to stops up to and including Starr Gate.
- 20 The trainee conductor *reversed* the position of the points under the supervision of the conductor and tram 724 travelled onto the loop. The trainee conductor then returned the position of the points to normal for southbound travel toward Starr Gate, again under the supervision of the conductor.
- 21 Tram 720 traversed the points. The leading wheelset travelled toward the normal, southbound route. The switch rails then moved away from the *stock rails* and the trailing wheelsets travelled toward the loop, *flange climbed* up and over the track and ran derailed. See Figure 3 for the sequence of events.
- 22 The consequences of the incident were minor. There were no injuries and only minor marking to the switch tips and the surrounding concrete. Tram services south of the incident site were suspended for approximately 90 minutes.

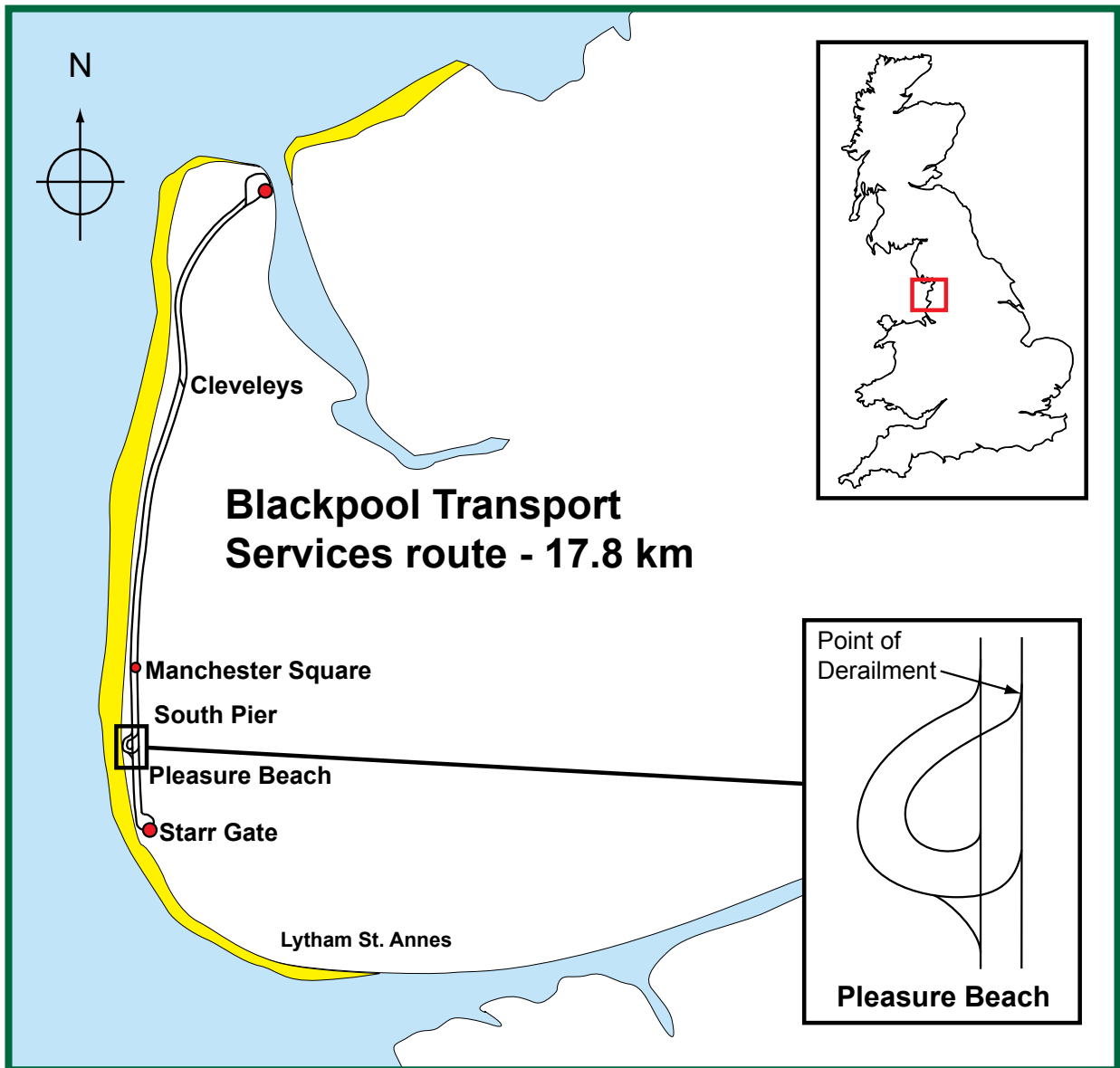


Figure 2: The BTS route and tram stops identified in the report

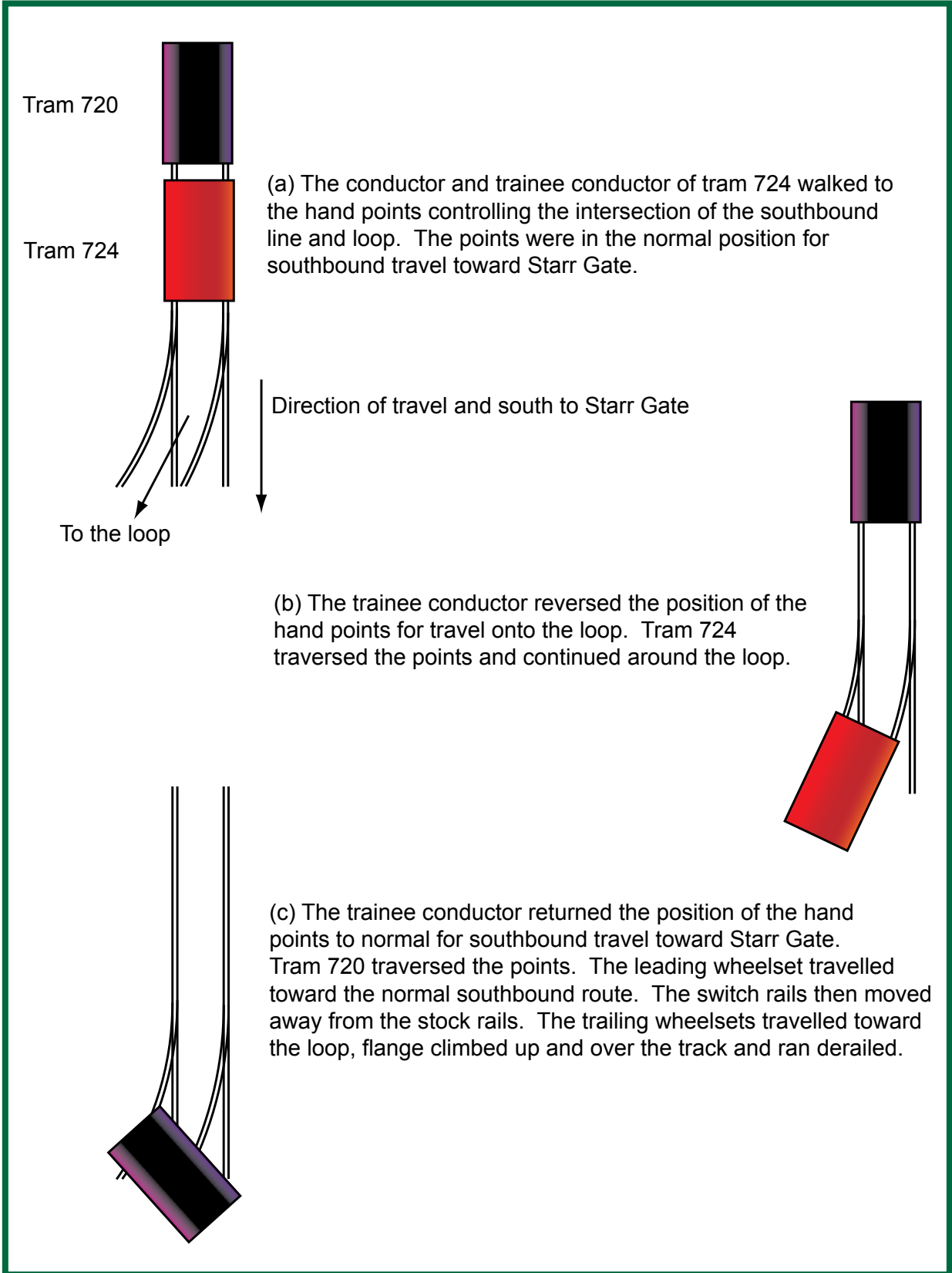


Figure 3: Sequence of events during the incident

The Investigation

- 23 The RAIB attended the site on the day of the incident. The RAIB permitted the tram to be recovered, the points to be secured in the normal position and passenger operation resumed before the arrival of its inspectors on site.
- 24 The RAIB investigation included:
- examination of tram 720 and its wheel profiles;
 - examination of the infrastructure including the hand points;
 - operation of the hand points mechanism to test for satisfactory and unstable conditions;
 - interviews with members of staff involved;
 - review of the BTS induction training manual and BBC technical documentation.

Analysis

Identification of the immediate cause

- 25 BTS custom and practice for operating the hand points mechanism is as follows:
- a points bar is inserted into a slot in the mechanism cover;
 - the points bar is pulled or pushed until the switch rails locate against the stock rails;
 - the points bar is removed and then used to lever within the space between both pairs of stock and switch rails to confirm that the switch rails are satisfactorily located (Figure 4).
- 26 There was no evidence to indicate that the hand points mechanism was operated in a manner contrary to BTS custom and practice.
- 27 After the passage of tram 724 the trainee conductor returned the points to the normal position and both conductor and trainee conductor confirmed that the switch rails were satisfactorily closed against the stock rails.
- 28 The driver of tram 720 observed the normal position of the switch rails and that they were satisfactorily closed against the stock rails before tram 720 proceeded over the points at less than 4 mph (6 km/h).
- 29 The driver became aware that tram 720 had derailed as it slewed. At this time the conductor shouted that the tram was derailed. The driver brought the tram to a controlled stop within a distance of approximately a tram length from the hand points. The driving of the tram was considered neither causal nor contributory to the derailment.

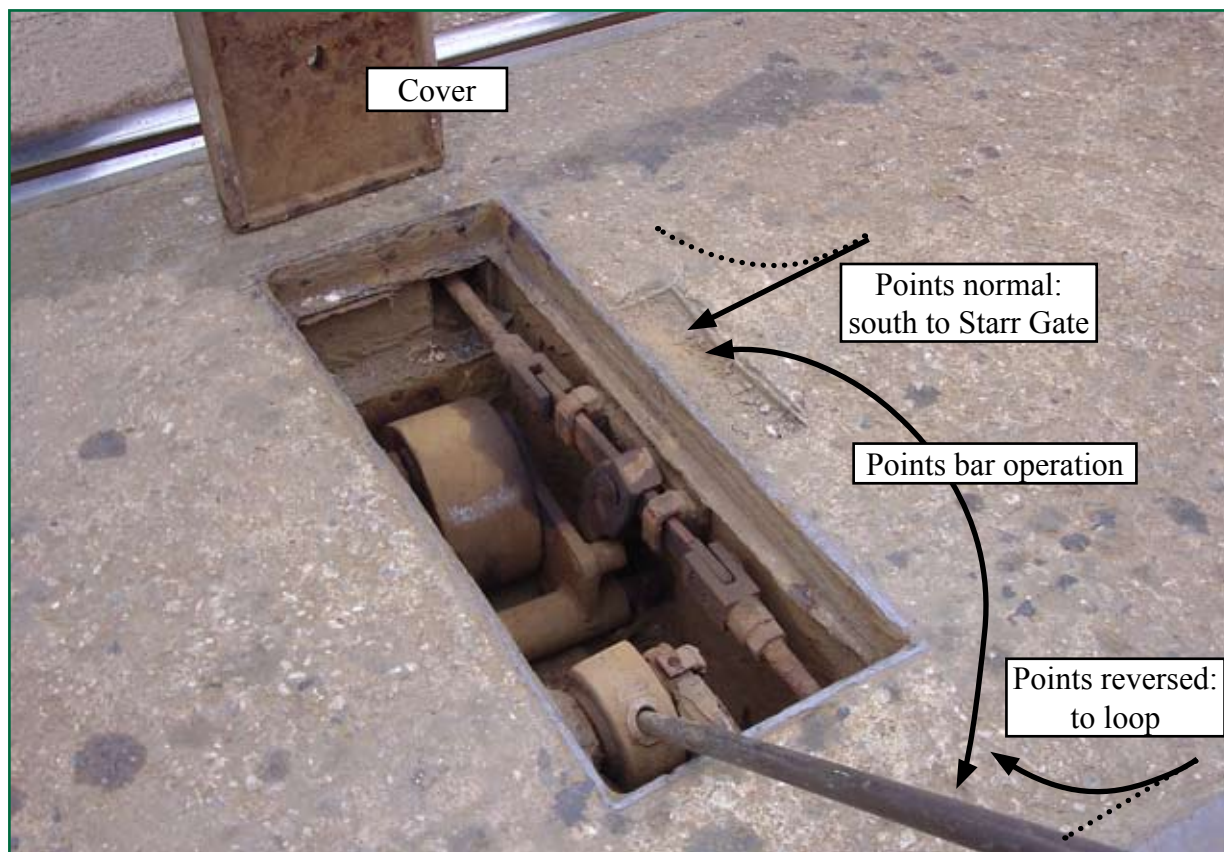


Figure 4: Operation of hand points using a points bar (cover removed)

- 30 Tram 720 was examined after the incident and no faults were found, nor was there evidence of any abnormal operation in traffic immediately prior to the incident. Therefore the condition of tram 720 was considered neither causal nor contributory to the incident.
- 31 The switch and stock rails were examined after the incident and no faults were found. Therefore the condition of the infrastructure was considered neither causal nor contributory to the incident.
- 32 Indentation marks were found on both switch tips. The marks corresponded with the tram wheel profile and were separated by a distance that corresponded with the back to back dimension of the tram wheels.
- 33 Derailment marks in the concrete corresponded with the paths taken by the trailing wheelsets after they had flange climbed from the loop track and ran derailed (Figure 5).

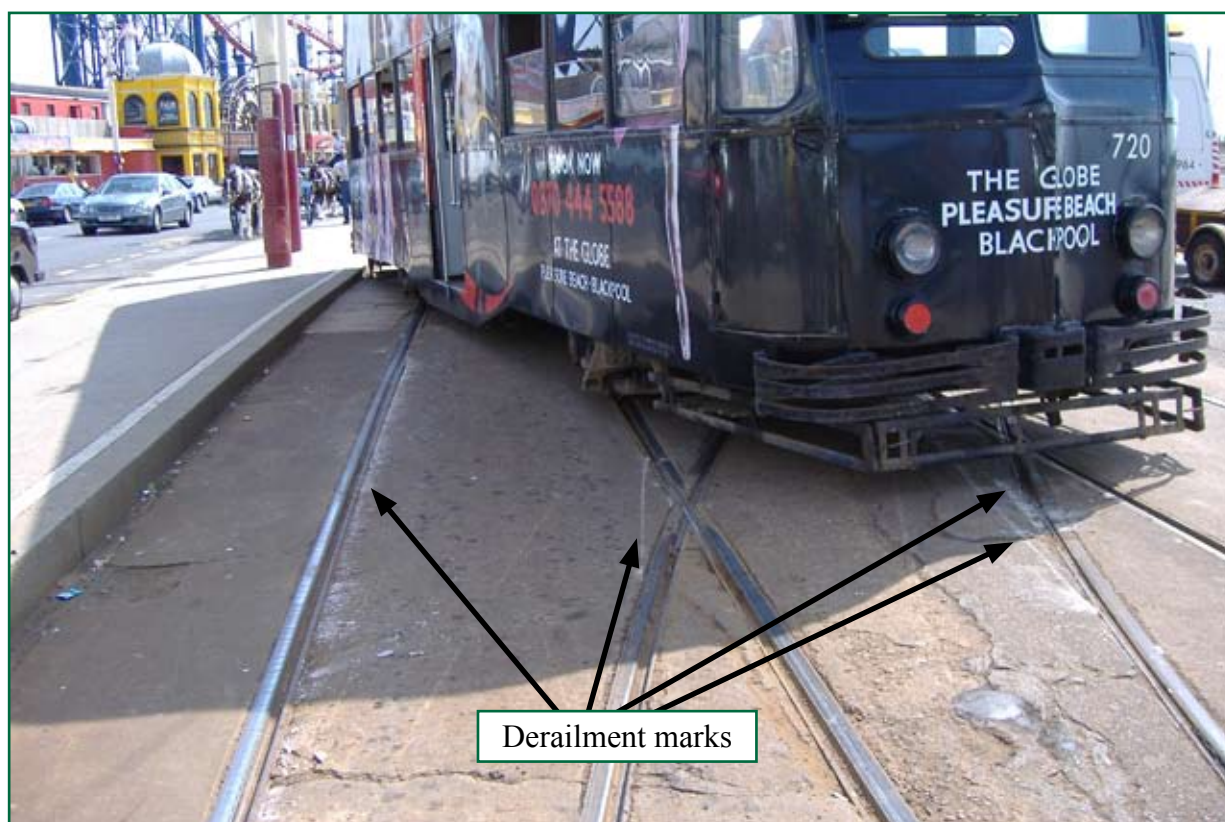


Figure 5: Tram 720 from the rear and derailment marks in the concrete

- 34 The position of the tram post-derailment and the marks on switch rails and concrete confirmed that the immediate cause of the derailment was the trailing wheelsets travelling toward the loop after the leading wheelset correctly travelled toward the normal, southbound route.

Identification of the causal and contributory factors

- 35 The hand points are operated by a manually levered mechanism. The components of the hand points mechanism are shown in Figure 6.
- 36 The switch rails are moved by the drive bar via connecting rods and are held in position by the counterweight lying fully over its pivot centre.

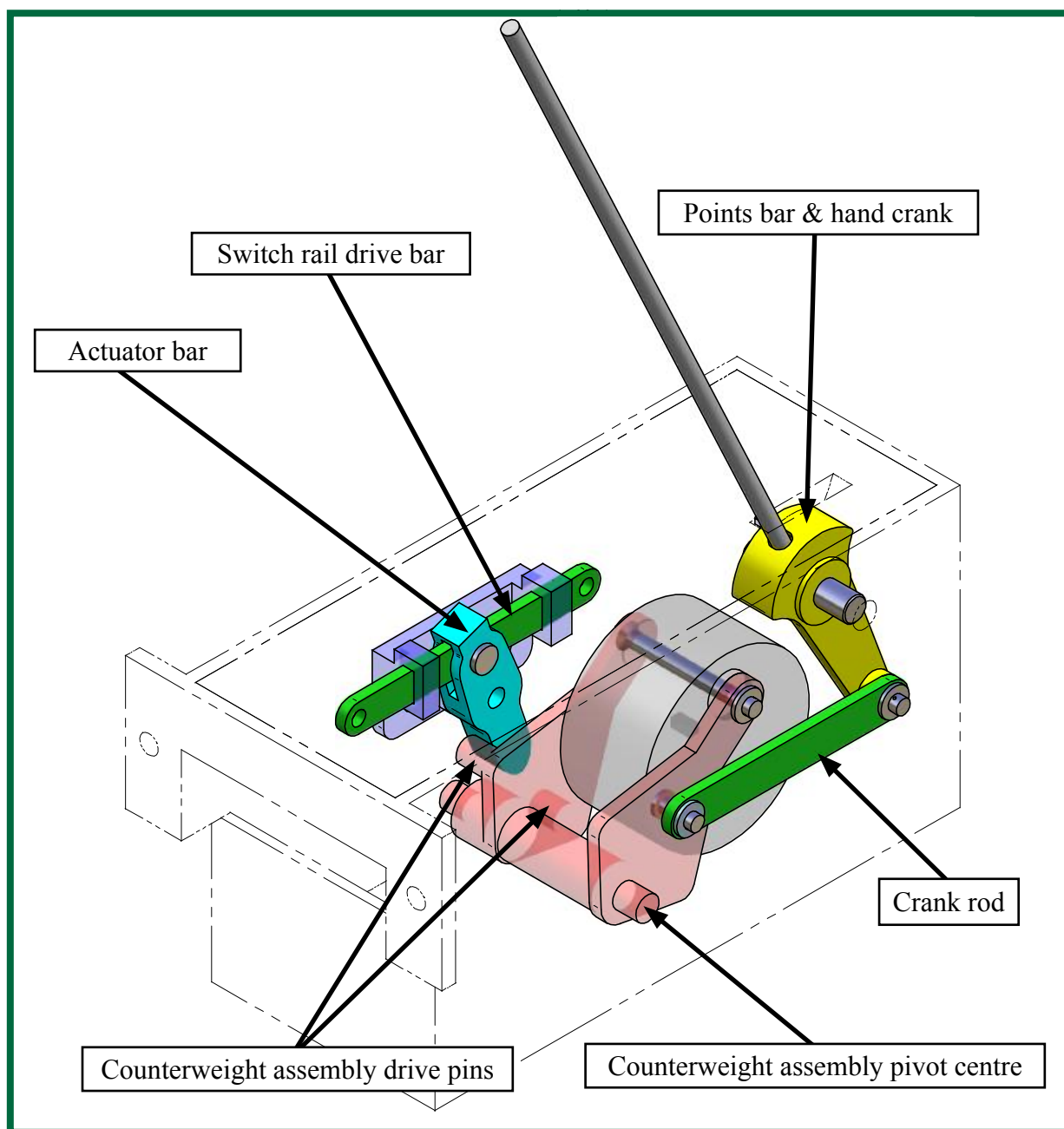


Figure 6: The components of the hand points operating mechanism

- 37 The RAIB testing undertaken after the incident demonstrated that the switch rails could be closed against the stock rails with the counterweight held by friction and not lying fully over its pivot centre. In this unstable state, a disturbance can cause friction to be overcome, the counterweight to move and the switch rails to open away from the stock rails in either normal or reverse positions (Figure 7). The causal factor of the derailment was that the hand points mechanism had not been correctly returned to the normal position and was in an unstable state before the passage of tram 720.

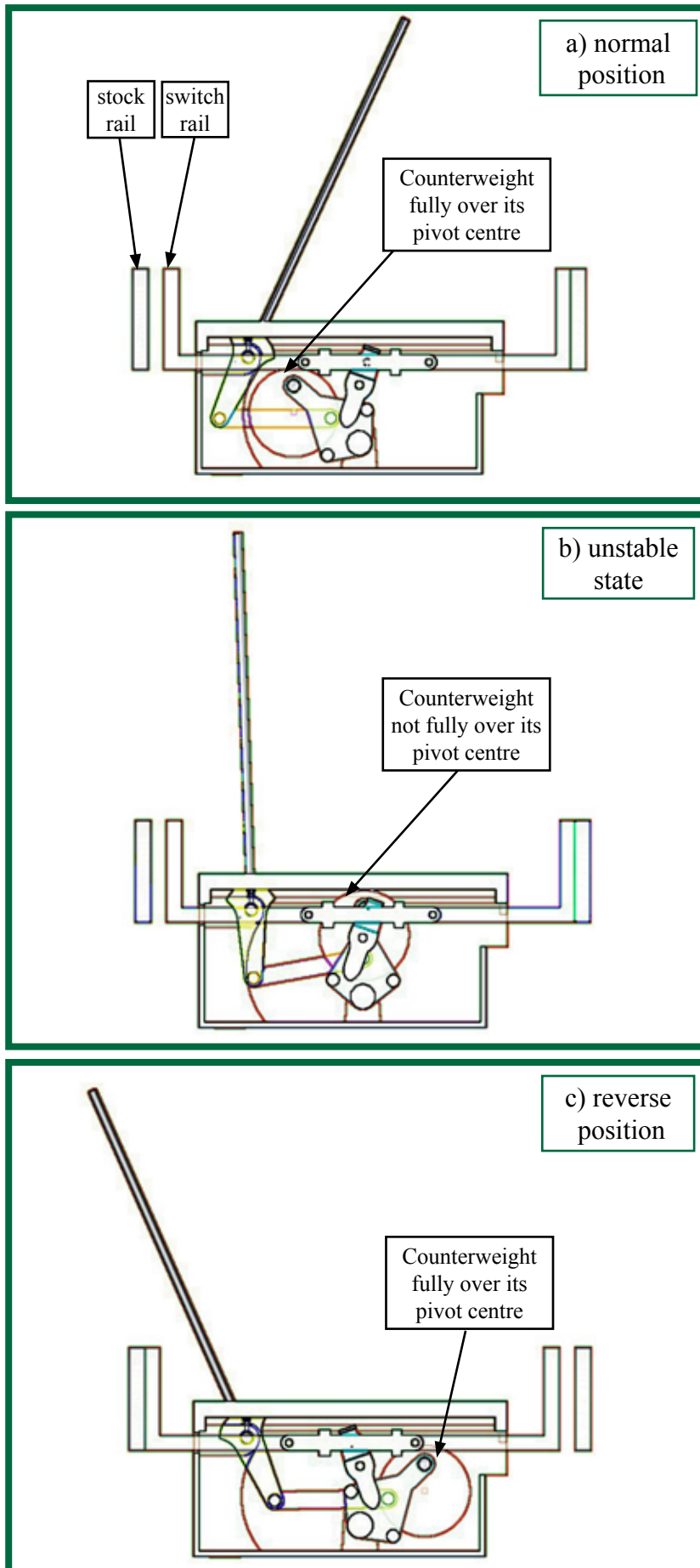


Figure 7: The hand points mechanism under operation

- 38 The conductor and trainee conductor found that the hand points were stiff to operate before the incident despite the mechanism and switch rail motion being clean and free from debris. This was confirmed by a BTS induction trainer who had operated the hand points mechanism while instructing trainees the day before the incident and by RAIB testing undertaken after the incident.
- 39 The mechanism becomes less stiff in operation after lubrication with water. This was perceptible when the mechanism was operated repeatedly during testing, first in the dry condition and then in the water lubricated condition. A manufacturer of this type of hand points used in this location would not require lubrication of the mechanism with oil or grease because the lubricant would bind with sand and grit and promote wear.
- 40 The force required to operate the mechanism was not measured as it varied with lubrication by water, the speed of the push or pull operation, the position of the hands on the points bar and the frequency of operation of the mechanism.
- 41 The passage of several trams was observed at rail level. The observed tendency was for the leading bogie's leading and trailing wheelsets to contact left and right hand *gauge corners* respectively. Track curvature on the approach to the points caused this crabbing of the leading bogie, and aided the passage of the leading wheelset through the normal position of the points while the trailing wheelset was biased toward the switch tips, the reverse position of the points and the loop.
- 42 The contributory factors to the derailment were therefore:
- the stiffness of operation of the hand points mechanism;
 - the disturbance of the switch rails and subsequently the hand points mechanism by the passage of the leading wheelset and
 - the crabbing of the leading bogie on the approach to the switch rails.

Identification of the underlying causes

Operation of the Points

- 43 The BTS Induction and Training Manual 2006 (the training manual) valid from 30/03/06 states the following with respect to the method of operation of manual (lever) points:
- ‘These points are operated by placing a points bar into a box in the centre of the track. Within this box is a counterbalanced weight and when the points bar is levered over, the track leafs will move in your required direction of travel’.**
- This description of the method of operation is not supplemented by diagrams or photographs.
- 44 The method of operation adopted through BTS custom and practice is as follows:
- a points bar is inserted into a slot in the mechanism cover;
 - the points bar is pulled or pushed until the switch rails locate against the stock rails;
 - the points bar is removed and then used to lever within the space between both pairs of stock and switch rails to confirm that the switch rails are satisfactorily located.
- This method of operation was taught during training both in the classroom and on the infrastructure.

- 45 Trainees were taught to operate the hand points mechanism slowly in wet weather to avoid being showered by water ejected from the closing of the switch rails to the stock rails. Slow operation was shown during testing to be more likely to leave the counterweight not lying fully over its pivot centre and the mechanism in an unstable state.
- 46 Neither the use of the points bar to lever the switch rails, nor slow operation in wet weather are mentioned in the training manual. Thus, the methods of operation that were taught differed from what was prescribed in the training manual.
- 47 The unstable state of the mechanism can result from any of the following actions:
- operating the mechanism slowly;
 - operating the mechanism after it was previously left in the unstable state;
 - using the points bar in error to lever the switch rails away from the stock rails.
- 48 Neither the BTS custom and practice method of hand points operation nor that prescribed in the training manual satisfactorily eliminate the risk of generating an unstable state in the mechanism. Therefore the underlying cause of the derailment was the procedure for operating the hand points mechanism.

Maintenance of the Operating Mechanism

- 49 The maintenance regime for the hand points mechanism is defined in the BBC Tram Track Standard (the standard). It requires inspection, an assessment of operation, the identification and repair of damage and the removal of debris on a weekly basis.
- 50 The standard does not require lubrication with oil or grease as this would bind with sand and grit and promote wear. Lack of such lubrication results in the mechanism becoming stiff to operate in the dry condition and less stiff to operate in the water lubricated condition.
- 51 The maintenance regime for the hand points mechanism is not considered to be a causal or contributory factor to this incident.

Conclusions

- 52 The immediate cause of the derailment was the trailing wheelsets of the tram travelling toward the loop after the leading wheelset had correctly travelled toward the normal, southbound route.
- 53 The causal factor was that the hand points mechanism had not been correctly returned to the normal position and was in an unstable state before the passage of tram 720.
- 54 The contributory factors were:
- the stiffness of operation of the hand points mechanism;
 - the disturbance of the switch rails and subsequently the hand points mechanism by the passage of the leading wheelset;
 - the crabbing of the leading bogie on the approach to the switch rails.
- 55 The underlying cause was the procedure for operating the hand points mechanism (Recommendations 1 and 2).

Recommendations

56 The RAIB's recommendations are directed at those parties who the RAIB believes are best placed to mitigate the identified risks (the implementers). When these parties have considered the recommendations they should establish their own priority and timescale for the necessary work, taking into account their health and safety responsibilities and the safety risk profile and safety priorities within their organisations.¹

- 1 Blackpool Transport Services should develop and document a method of hand points operation to ensure that the mechanism is not placed in an unstable state (paragraph 55).
- 2 Blackpool Transport Services should put in place a system to ensure that the method identified in Recommendation 1 above is correctly trained at induction and applied in day to day operations by staff throughout their employment (paragraph 55).

¹ The RAIB addresses its recommendations to the ORR (HMRI), the safety authority, in accordance with Article 25(2) of the European Railway Safety Directive 2004 (the Directive) and Regulation 12(2)(a) and (b) of the Railways (Accident Investigation and Reporting) Regulations 2005 (RAIR). The RAIB does this to enable the ORR (HMRI) to discharge its responsibilities under Article 25(2) of the Directive and Regulation 12(2)(a) of the Regulations, namely that they must ensure that all RAIB recommendations addressed to it are duly taken into consideration and where appropriate acted upon by the end implementer.

The end implementer is required under Regulation 12(4)(b) of the Regulations, to provide the Safety Authority with the full details of the measures/actions they intend to take to implement the recommendation and the timescales for securing that implementation. The timeliness of this response to the Safety Authority is dictated by the Safety Authority's duty under RAIR Reg 12(2)(b) to report to the RAIB, without undue delay or within such other period as may be agreed with the Chief Inspector.

Appendices

Glossary of abbreviations and acronyms

BBC

BTS

Appendix A

Blackpool Borough Council

Blackpool Transport Services

Glossary of terms

Appendix B

Bogie	A frame equipped with two or more wheelsets used under a rail vehicle.
Crabbing	Movement in a sideways or diagonal manner.
Flange climb	A situation where the flange of a rail wheel rides up the inside (gauge) face of the rail head while rotating. If the wheel flange reaches the top of the railhead the wheel is no longer laterally supported and this could result in derailment.
Gauge corner	The curved portion of the rail head between the running surface of the rail and gauge face.
Hand points	Points that are worked manually by an adjacent lever.
Normal	The position of switch rails set for the most used route.
Reverse	The position of switch rails set for a route which is not the 'normal' route.
Stock rail	The fixed rails at each side of a set of points.
Switch rail	The movable rails at each side of a set of points.
Switch tip	The upper surface at the end of the switch rail traversed first by a vehicle negotiating a switch in the facing direction.
Wheelset	Two wheels mounted on the same axle.

This report is published by the Rail Accident Investigation Branch,
Department for Transport.

© Crown copyright 2006

Any enquiries about this publication should be sent to:

RAIB	Telephone: 01332 253300
The Wharf	Fax: 01332 253301
Stores Road	Email: enquiries@raib.gov.uk
Derby UK	Website: www.raib.gov.uk
DE21 4BA	