Transport Accident Investigation Commission

Erratum Slip

Rail Occurrence Report No. 94-117

Please replace paragraph 3.6 with the following:

3.6 Tranz Rail Limited responded:

"1. *The current safety barriers cannot be disconnected unintentionally. The only means of ensuring the safety barriers cannot be disconnected as a result of tampering (if this is even possible) is to design and construct them so that they cannot be disconnected at all. This would prevent the decoupling of carriages and render shunting and yard operations impossible.*

Please review this recommendation. It is impracticable.

2. *It is Tranz Rail Ltd's responsibility, under the TSL Act to set standards, not the TAIC's. In a number of respects the current safety barrier arrangements meet or exceed the NZS Standard but for reasons expressed earlier (our letters of 29th September 1994 and 24th February 1995) the standard in full is not appropriate. You have never commented on these letters. We note you have conducted no study of the applicability of the NZS standard to the rail environment and failed to justify the view that it should be used by Tranz Rail Ltd.*

The recommendation is inappropriate."

The line starting: "*Please review ...*" was not included in the published response.

No. 94-117

Train 700

Hundalee

2 July 1994

Revised Report

Abstract

On Saturday 2 July 1994 at approximately 1025 hours, a child fell from the gangway between a carriage and the end platform of the power van on New Zealand Rail Limited's "Coastal Pacific" express near Hundalee when a handrail dislodged. The child was seriously injured. The safety issues identified in this investigation were the maintenance and inspection procedures for the safety barriers on passenger trains, the adequacy of the handrail bracket detail once the bracket had been repaired, and passenger management policies concerning movement of passengers on trains.

The Transport Accident Investigation Commission previously approved a report on this accident on 12 October 1994. That report was released in November 1994. The investigation was reopened after further submissions by New Zealand Rail Limited. The Transportation Safety Board of Canada provided Mr R D Gnam, Chief of Railway Investigations, to complete the reopened investigation and he compiled this revised report. The Commission gratefully acknowledges the assistance provided by Mr Gnam and the Transportation Safety Board of Canada.

The Commission circulated a preliminary version of each report to interested parties for their comment and considered those submissions before approving each report for publication.

This report follows a format similar to the October 1994 report. Changes were made to the following parts of the October 1994 report:

Abstract
Title page
Paragraphs 1.4
1.6
1.7
1.9
1.14
1.31
1.35
1.37 - 1.47
1.55
1.58 -1.60
2.6
2.7
2.10
2.11
2.13
2.14
2.15
2.16
2.17
2.21
2.22
2.23
2.30
Figure 1
Figure 2

In addition to the above changes, paragraphs 1.59, 2.13, and 3.5 in the revised report are new. Other paragraphs also have editorial changes.

Transport Accident Investigation Commission

Rail Accident Report No. 94-117

Train type and number:	Christchurch-Picton Passenger No. 700 ("Coastal Pacific")
Date and time:	2 July 1994, 1025 hours
Location:	Hundalee, 152.4 km, Main North Line
Type of occurrence:	Child passenger fell from train
Persons on board:	Crew: 4 Passengers: 150 approx.
Injuries:	Crew: Nil Passengers: 1 serious Others: Nil
Nature of damage:	Nil
Information sources:	Transport Accident Investigation Commission field investigation
Original Investigator in Charge:	Mr W J D Guest
Reviewing Investigator in Charge:	Mr Randolph D Gnam Transportation Safety Board of Canada

1. Narrative

1.1 On Saturday 2 July 1994, New Zealand Rail Limited's Train 700 was the Christchurch-Picton ("Coastal Pacific") passenger service. The train consisted of a locomotive, four carriages, a servery car, and a power van (commonly known as a luggage van).

1.2 The power van had an open platform at the end attached to the carriages. This platform was accessible to staff who needed to enter the van via a gangway from the adjoining carriage.

1.3 The platform was equally accessible to passengers, for there were no signs or barriers to restrict them.

1.4 On other passenger services operated by New Zealand Rail Limited (NZRL), such as the "TranzAlpine" between Christchurch and Greymouth, the power van's body had been modified to provide passengers with a "viewing platform" from which they could take photographs and videos without the distortion of windows.

1.5 The "Coastal Pacific" train also passes through some attractive scenery, and passengers who were aware of the viewing platform facility on the "TranzAlpine" service were accustomed to visit the open platform on the power van of the "Coastal Pacific".

1.6 In general, the gangways between the carriages consisted of a steel plate, attached through a hinge on one carriage, and resting on a landing area on the adjacent carriage so that relative movement between the carriages, for example as they traverse curves and crossings, could be accommodated. They were approximately 600 mm wide, with a 50 mm upstand on either side, forming a toeboard. Throughout the train, side restraint was provided by two devices on each side of the gangway that were connected between the bodies of the carriages. The types of side restraint devices were not consistent at each gangway and could have been a telescopic arm, a chain, or a chain with a spring on one end.

1.7 The gangways between the carriages were protected from the adverse effects of weather by a bellows shaped weather shield. These weather shields are constructed of metal rods covered in a heavy reinforced plastic and securely fastened to the end frames of the carriages. Although not designed or intended as a restraint, these weather shields would act as a secondary barrier for anyone who had fallen past the handrails. These weather shields are not transparent and would block the passenger's view of the movement of the train over the track, which may enhance the balance and sense of security to some passengers.

1.8 The gangway between the carriage and the power van was very similar, except that no weather shield was provided because the open platform of the van did not have a frame to which the shield could attach.

1.9 The four side restraints were all telescopic arms made of light gauge stainless steel tubing. The lower arms were approximately 400 mm above the gangway surface, while the upper ones sloped from approximately 925 mm at the van end to approximately 1200 at the carriage end.

1.10 Shortly after 1000 hours, a passenger took his two sons, aged 9 and 6, out on the end platform of the power van. The boys were enthusiastic about train travel, and had asked to go to the "viewing platform". Their father had refused to let them go alone, and had accompanied them.

1.11 The weather was cold, and occasional snow flurries could be seen. After about ten minutes the older boy returned to the carriage, but the six year old asked to stay a bit longer, so his father also remained.

1.12 About three minutes later, the boy moved towards the carriage door without saying anything to his father. As he moved on to the gangway, the train entered a curve. His father saw the boy take hold of the upper handrail on his right with his right hand to steady himself against the motion of the train in the curve. The handrail was at the boy's shoulder height.

1.13 The handrail detached from the bracket which held it to the power van. The boy fell over the lower rail which was too low to restrain him once the upper rail had gone, and landed on the track. He suffered severe injuries.

1.14 There were no other persons on the viewing platform or gangway. The father looked for an emergency stop lever on the platform of the power van. It was located inside the compartment, behind a door, with no sign on the platform to indicate its presence. He ran into the carriage, but in his haste, did not see either of the two levers in that carriage. He continued into the second carriage along the train, where he saw the Train Manager, and told him that his son had fallen from the train. The Train Manager used his portable radiotelephone to tell the Locomotive Engineer to stop. A Stewardess who was also in the carriage and was close to an emergency stop lever heard the father, and turned the lever.

1.15 The Locomotive Engineer received both the message and the indication of the emergency stop lever at the same time, and applied the train brakes in emergency. By the time the train came to a stop, it had travelled approximately 1.2 km from the point at which the boy had fallen.

1.16 After receiving a brief report from the Train Manager, the Locomotive Engineer sent a radio message to Train Control in Christchurch, and emergency services were notified by the Train Control Officer. St. John Ambulance control in Christchurch received the call at 1036 hours and dispatched an ambulance with two staff from Cheviot, some 30 km distant. The ambulance arrived at the accident site at 1119 hours.

1.17 The father left the train when it stopped, and after checking that the boy was not trapped under the train, set off along the track as quickly as under foot conditions would allow. As he left the train, he noted that the time was 1027 hours. After a time, which he estimated to be almost ten minutes, he found his son semiconscious lying beside the track.

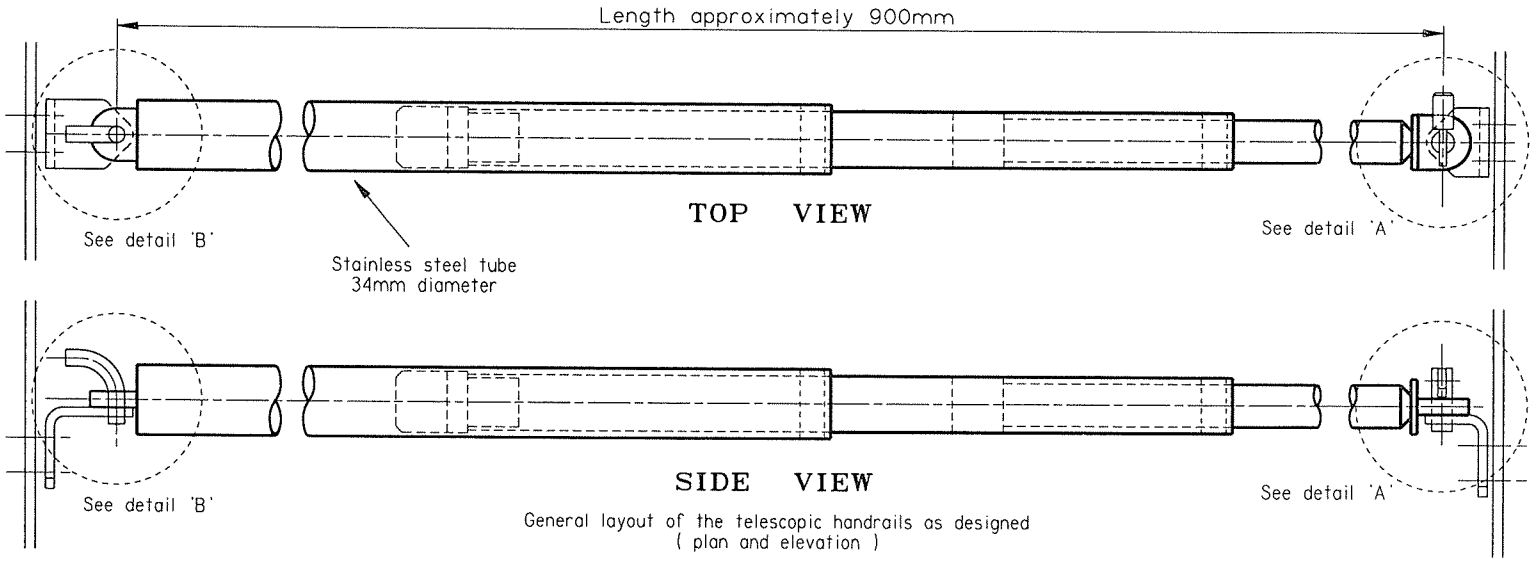
1.18 He sheltered the boy as best he could, using items of his own clothing. The temperature was about 4°C. No-one else from the train had arrived, and he picked the boy up and carried him along the track towards the train. After he had covered a short distance, he saw other people approaching. He put the boy down again, not wishing to aggravate his injuries.

1.19 The people who now arrived to assist included a registered nurse who was a passenger on the train, another passenger, and the Train Manager. The nurse was carrying some first aid material, and also had some knowledge of trauma management.

1.20 The first aid kit from the train was not taken to the site. The Train Manager did not know how far away the boy was, and the kit was bulky to carry. His concern was to reach the boy as quickly as possible and ascertain his condition. His intention was to call for the kit by radio if necessary.

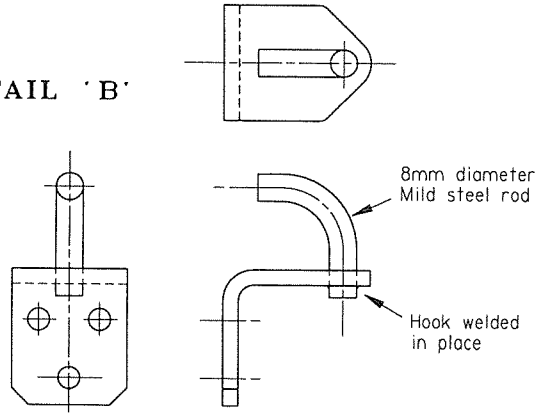
1.21 The nurse assessed the boy's injuries and told the Train Manager that a rescue helicopter was needed to transfer him to Christchurch Hospital.

1.22 The Train Manager said he could have used his portable radio to get the Locomotive Engineer to contact Train Control with a request to contact the emergency services and advise them of the need for the helicopter. However, he felt concerned that a long chain of communications might cause delays or errors.

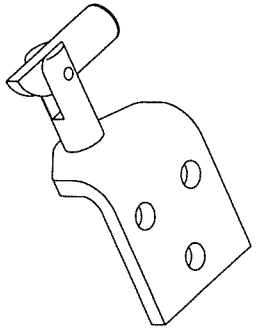


General layout of the telescopic handrails as designed
(plan and elevation)

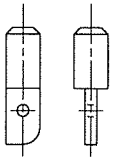
DETAIL 'B'



Details of hook bracket as designed

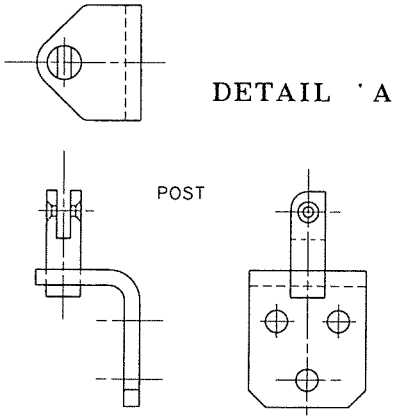


PICTORIAL VIEW OF
POST AND TOGGLE
ASSEMBLY



TOGGLE

DETAIL 'A'



Details of post and toggle bracket as designed

Figure 1 : HANDRAIL WITH BRACKETS (AS DESIGNED)

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1.23 The Train Manager saw a farmhouse some distance across several paddocks, and he judged that he could reach it more quickly than he could return to the train and speak to Train Control himself. He ran across country to the house, from where he was able to use a telephone to confirm to the emergency services the seriousness of the accident and to request the dispatch of a helicopter. He then returned to the accident scene.

1.24 The principal item that the nurse wanted was an oxygen kit. However, oxygen is not carried as part of a passenger train's first aid equipment. The train's kit was to a specification prepared for NZRL with the assistance of the Red Cross Society in 1993. After consideration of all factors, a decision was made not to carry oxygen.

1.25 An ambulance from Cheviot arrived at the accident site at 1119 hours, and the two ambulance officers worked with the nurse to stabilise the boy's condition. They were helped by two other passengers who lay beside the boy to help keep him warm. In cold and unpleasant conditions all the rescuers persisted, until the arrival of the helicopter.

1.26 The helicopter transported the boy to Christchurch Hospital.

1.27 The Stewardesses remained with the train. One cared for the brother of the injured boy, while the other looked after the rest of the passengers.

1.28 The train did not reverse down the track to the accident site. There are sound reasons why trains should not "set back" except under strictly controlled conditions. The immediate aftermath of an accident is not a situation in which strictly controlled conditions are easily applied. Further, the Train Manager did not wish to take the rest of the passengers to a potentially distressing accident scene. The Train Manager would have had to guide the train personally from the last carriage, and once he had left the train to locate the injured boy and his father, he would have had to return to the train to take charge of its movement. Reversing the train without first ascertaining the whereabouts of the boy, his father, and any other helpers would have been unwise.

1.29 After the departure of the helicopter, the Train Manager locked the door giving access to the gangway and power van platform and the train proceeded.

1.30 Police assisted the injured boy's father and brother to travel to Christchurch Hospital.

1.31 Tests determined that the handrail could be disconnected when an upwards and outwards force of approximately 1 to 2 kg was applied and the right angle bolt, attaching one end of the handrail to the power van, was pointed outwards. The boy, aged 6, measured 1030 mm tall to the shoulder. The handrail at the point where it was estimated that he held it was approximately the same height. Simulation conducted on a reconstructed gangway has indicated that his forearm would have been angled upward from his body to the handrail, so that if he braced himself against the handrail, he would have exerted a slight upwards and outwards force. Calculations based on Car Walkway Accelerations tests supplied by NZRL have indicated that the boy's body could have been subjected to a centrifugal force of approximately 2.6 kg which would have been sufficient to disconnect the handrail.

1.32 The handrails and the brackets which held them to the carriages were not as originally designed. The concept of using light stainless steel tubes was first used on the " Silver Star" passenger train in the North Island in the early 1970s, and a similar arrangement was used on the "Silver Fern" railcars. A copy of a plan showing the arrangement for the "Silver Star" is shown in Figure 1.

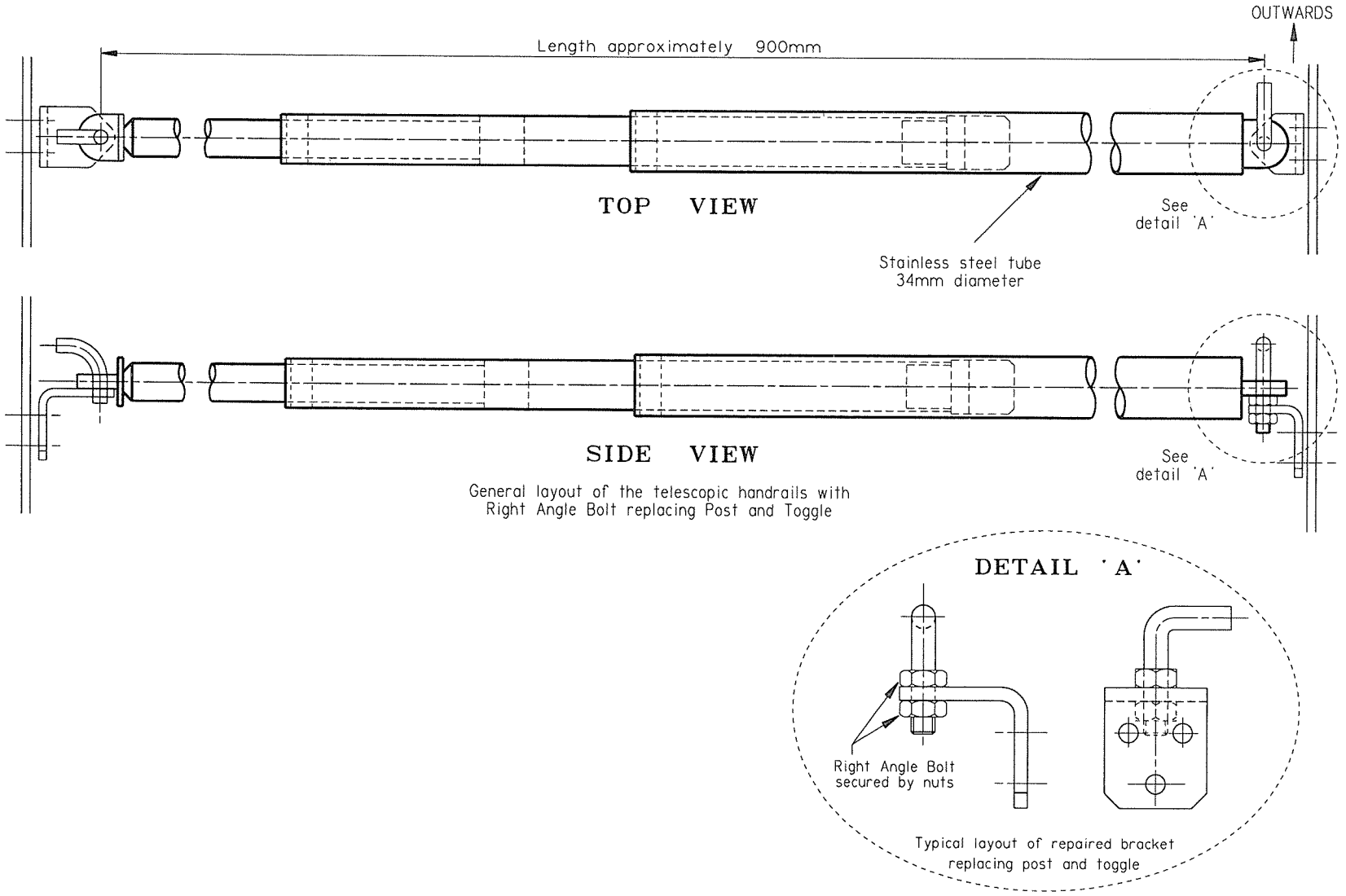

Figure 2 : SKETCH OF HANDRAIL WITH MODIFIED BRACKET (AS FOUND)

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1.33 When the passenger services in the South Island were progressively upgraded from the mid 1970s, the plan for the handrails was similar to those in the "Silver Star".

1.34 The design concept for this type of handrail was:

- The handrails were made of light gauge stainless steel tubes, assembled in telescopic fashion so that they could absorb the relative movements of the carriages round curves, and the slack of the drawgear connecting the carriages.

- The bracket at one end consisted of a curved hook, with the end of the hook pointing away from the arm but in line with its axis, so that the arm could not be removed from the hook while it was connected at the other end.

- The bracket at the other end consisted of a post and toggle. The toggle would be turned to a vertical alignment in order to place or remove the arm, and then bent over to a horizontal alignment to retain it. The toggle projected beyond the post on both sides when it was turned horizontally, so that the arm could not be removed without a deliberate movement of the toggle.

1.35 New Zealand Rail Limited and its predecessors, the New Zealand Railways Corporation and the New Zealand Government Railways Department, did not have a uniform design for gangway side restraints in passenger service. In the course of the investigation into this accident, a number of other passenger train services were inspected. Side restraint systems noted were:

- The light gauge stainless steel telescopic arm described above.
- The heavy steel telescopic arm with forged hooks, with a keeper to prevent the arm from becoming detached without manipulation.
- A heavy stainless steel telescopic arm, permanently secured through an eye at one end, and to a hook protected by a close mounted pendulum which had to move in order for the arm to be removed.
- A light chain, either attached to hooks, or with a light steel bolt.
- A heavy chain, sometimes covered with a plastic material, attached to hooks.
- A light chain with a long spring at one end, attached to hooks, eyes, or with light steel bolts.

1.36 The common feature on all trains was that only two restraint devices were installed on each side of the gangway, irrespective of their usage by passengers or staff only, or of the presence of a weather shield which might act as a secondary restraint system. The devices were generally at heights of 1000 mm and 400 to 500 mm above the gangway floor level.

1.37 From interviews with NZRL repair and examination staff at the NZRL Waltham Yard Depot, it was learned that at some time in the past when the post and toggle arrangements had become damaged they were replaced with an improvised replacement that could best be called a right angle bolt. The right angle bolt had the appearance, but not the function, of the welded hook at the opposite end of the handrail. A sketch of this arrangement is attached as Figure 2. Photographs of the gangway, the post and toggle and the right angle bolts that replaced the post and toggle are shown in Figures No. 3 to 6. These right angle bolts were constructed by maintenance staff at locations such as the Waltham Yard Depot and consisted of an 8 mm bolt attached to the horizontal plate by two nuts, one above and the other below the plate. The bolt was then bent at a right angle and the bolt head was removed by flame cutting. The handrail would then be connected to the right angle bolt, aligned along the axis of the handrail pointing away from the handrail, and the nuts securing the right angle bolt tightened. The exact origin of the type of connection could not be determined; however, from interviews with NZRL staff it is

Figure 3
A view of the gangway (taken at Picton on the day of the accident).
The top handrail on the far side is missing

Figure 4
An original post and toggle bracket

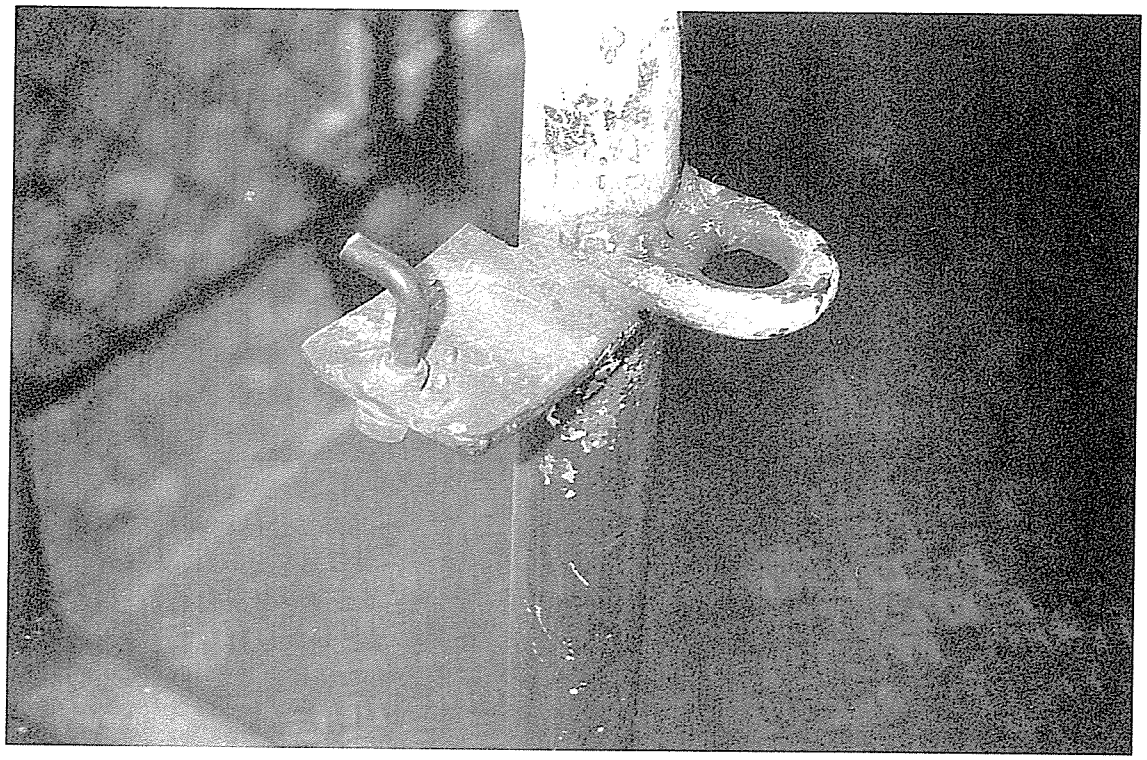

Figure 5
The bracket from which the handrail detached

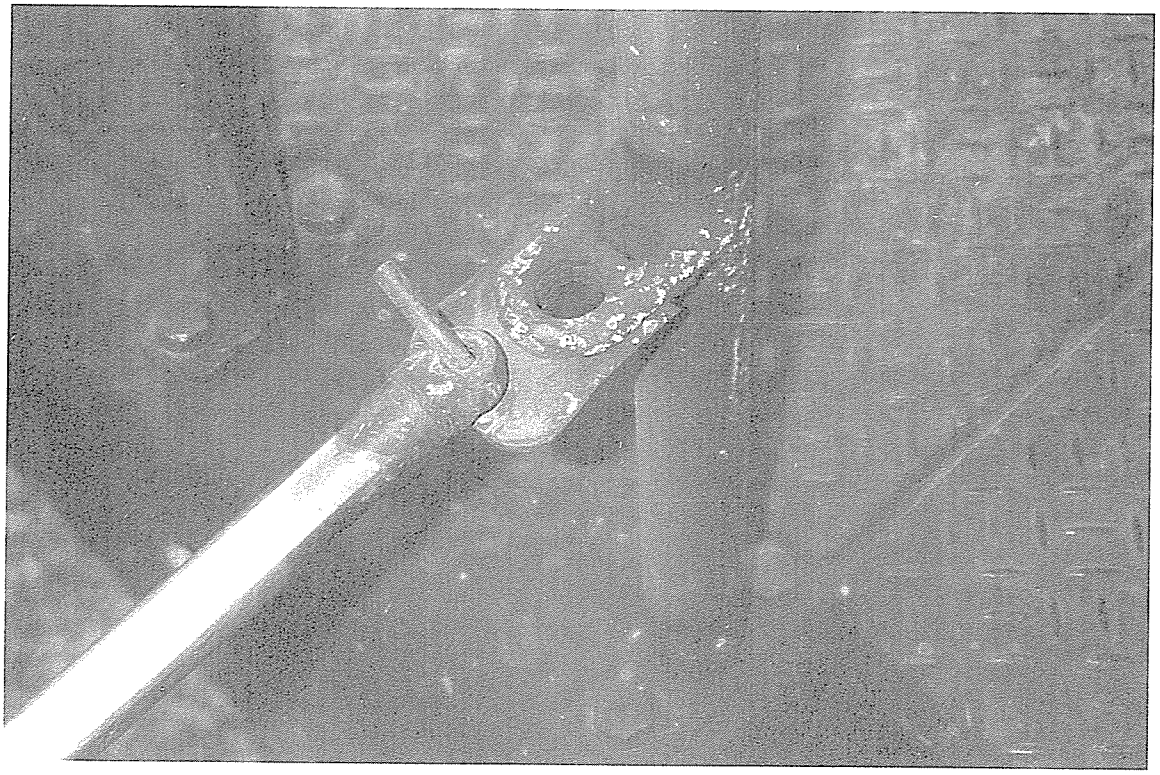

Figure 6
The bracket immediately below, with lower guardrail still in place

clear that it has been in use for some time. Some estimates date this back at least 10 years. Also, this connection had not been approved by NZRL design staff.

1.38 Repair and examination staff at Waltham Yard Depot revealed that they frequently used this right angle bolt to replace damaged and broken post and toggle arrangements. This replacement was preferred by them because the right angle bolt was easy to construct from material readily available and the carriage involved would not be delayed. It was their opinion that, provided the right angle bolt was aligned along the axis of the handrail and that the two nuts were secure so that it could not rotate, this arrangement would provide the same measure of safety as the post and toggle. As this arrangement was in use for quite some time, they believed that it had been approved by the design staff.

1.39 A Code of Standard Practices prepared by NZRL requires that the handrails and brackets be examined as part of an overall examination of the carriages. However, this standard does not outline a minimum condemning standard for wear or damage. The examination staff indicated that they relied on their experience and training to assess the handrails and brackets. Also, as a form of maintenance quality control, an Inspector would periodically examine the carriages and advise the maintenance staff of any defects or potential problems. Appropriate corrective action would then be taken by the maintenance staff.

1.40 An examination of the power van and carriage gangway immediately after the occurrence revealed that the right angle bolt from the upper handrail was not oriented along the axis of the handrail. It was pointed outwards. This would be the position that would allow the handrail to become easily dislodged. Also, there was corrosion and dirt built up around the nuts and the threads of the right angle bolt indicating that the nuts had not been either loosened or tightened for sometime. The Police officer who attended the site of this occurrence has indicated that the upper right angle bolt on the power van was loose and could be rotated by hand. There was no upper handrail section attached to the right angle bolt bracket on the power van; however , a single handrail section was found attached to the bracket on the first carriage. In order for the handrail sections to separate, the handrail would have been subjected to a force of sufficient magnitude that the retainers manufactured into the handrail to prevent their separation were damaged. Due to the sturdy construction of the handrail the damage could not have been caused by the boy falling and holding onto the handrail once it became disconnected. Therefore, the retainers were damaged at some time prior to this occurrence. The fact that the retainers were damaged allowing the handrail sections to be separated on the handrail once it was disconnected from the brackets is not considered to have contributed to this occurrence.

1.41 The reason that this bolt was pointing outwards could not be determined.

1.42 The NZRL Waltham Yard Depot has experienced a number of staff and procedural changes as the Rolling Stock Division (and other engineering groups) within NZRL were reorganised between 1990 and 1994. A Rolling Stock Division "Codes of practice manual" issued in August 1990 listed six staff positions with responsibility for the inspection of rolling stock. By early 1994 none of the six positions remained by name but the duties were re-allocated. The examination staff at Waltham Yard Depot indicated that their responsibility concerning the inspection of handrails was unchanged.

1.43 The use of power van platforms by passengers appears to have developed without the formal review and approval of managerial or engineering design staff.

1.44 The design work for the conversion of two vans to include a viewing area for the "TranzAlpine" train between Christchurch and Greymouth was formally approved, but a review of the gangways concluded that no changes were necessary.

1.45 There were no signs on the train advising passengers to take precautions while moving about the train, other than a sign forbidding passengers to open the doors while the train was moving. Other issues which were relevant were:

- Stepping clearly over the end of the gangway;
- Keeping the gangway clear, and not standing or loitering in it;
- The danger of climbing on handrails;
- The need to supervise children moving through the train or on the viewing platform;
- The danger of leaning out from the viewing platform because of the potential proximity of tunnel portals, tree branches or other obstructions.

1.46 A check on carriages from other passenger services showed that some trains did have signs relating to the viewing platforms, but that the wording was not consistent.

1.47 It was also noted that the van platforms were not uniform in design. Handrails and guardrails differed, and the side gates were sometimes over the top step, leaving a gap of approximately 175 mm in the deck near the gate.

1.48 The level of artificial lighting in the gangway areas also varied according to the number and location of lights provided at the ends of the carriages. Lights are needed for travel at night and through tunnels.

1.49 The train had a public address system which the Train Manager used to tell passengers about the journey, and the facilities on the train. His presentation did not include a safety briefing.

1.50 During 1993 NZRL introduced a prototype of a new side restraint arrangement, consisting of rigid "D" shaped rails extending outwards on either side of the gangway. There is a corresponding set of D rails on the connecting carriage. Three horizontal chains bridge the short gap left between the D rails of the two carriages. This arrangement enables passengers to hold a rail with one hand, and reach forward with the other hand to hold the opposite rail on the next carriage. Serviceability is improved because if the chains are not disconnected when the carriages are moved apart, they will break before the brackets or rails, and they are easily replaced.

1.51 The prototype was put into trial service in November 1993, and the principle has proved successful. A modified design incorporating some refinements was commissioned in June 1994. This design would have been progressively implemented as carriages were overhauled.

1.52 If the new design had been in use on the "Coastal Pacific", the accident would probably have been avoided.

1.53 The Commission has not located any foreign, international, or New Zealand Standard Specification or Code of Practice for handrails on rail vehicles that could be used as the basis for comparison with the designs used on New Zealand Railways. Any such comparison requires extrapolation from Codes designed for other purposes. Five Codes were identified:

1.53.1 Safe Access: A Guide to the Requirements of the Factories and Commercial Premises Act 1981, issues by the Occupational Safety and Health Division , Department of Labour, 1992.

1.53.2 International Labour Organisation "Draft Code of Practice on Accident Prevention on Board Ship at Sea and in Port" October 1993.

1.53.3 The Load Line Rules 1970: 4th Schedule "Protection of Crew". (This is a code for ships.)

1.53.4 New Zealand Building Code.

1.53.5 New Zealand Standard NZS/AS1657-92 "Fixed platforms, walkways, stairways and ladders -Design, construction and installation".

1.54 The publication "Safe Access" set standards deemed by the Labour Department to comply with requirements of the Factories and Commercial Premises Act 1981. (This Act has since been repealed, and replaced by the Health and Safety in Employment Act 1992.) In section 9 of "Safe Access", the essential features of handrails, guardrails, and toeboards are set out. Handrails should be at a height of not less than 1 m above the level of treads and landings, and be capable of taking a load of 750 N per metre run applied in and directed along the uppermost point of the rail. Guardrails should be fitted on the open side of stairs, ramps and landings, and should not have open spaces of more than 930 cm^2 (in Imperial measurement, equivalent to a 12 inch square) except when the space's least dimension is 150 mm (6 inches). Toeboards should be provided if there is a danger of objects such as tools being lost over the side.

1.55 The rails between the carriage and the power van on the "Coastal Pacific" were 900 mm long, at an average of 1100 mm and 400 mm high respectively. The toeboard was 50 mm high. The space enclosed in the gap between the top and intermediate rail was therefore approximately 5800 cm^2, and the gap between the intermediate rail and the top of the toeboard was approximately 3000 cm^2. The handrail (i.e. the top rail) should have been capable of taking a load by this criterion of 675 N (or about 69 kg weight) in any direction.

1.56 The ILO Draft Code on Accident Prevention on Board Ship at Sea and in Port requires ladders, access ways, and gangways to have adequate strength, and be free from defect, properly maintained, and properly illuminated. These terms are not quantified. A handrail at 1 m height, and one intermediate rail or chain is required, with stanchions not more than 3 m apart. The draft code also requires that "any gap between the dockside and the ship whereby a person on the ship's means of access might fall into the water, should be protected by a safety net, of suitable mesh and construction, secured to the ship and the dockside".

1.57 The Load Line Rules require external deck rails to be less than 230 mm from the deck, 1.0 m in height, with no opening greater than 380 mm. This effectively requires a handrail at 1.0 m height, a guardrail at 230 mm, and one further guardrail midway between them as a minimum. This requirement is for the protection of crew, and does not appear to consider passengers.

1.58 The New Zealand Building Code (in the provisions of section F4 and its accompanying Acceptable Solution AS1) requires that handrails be constructed so that a 100 mm sphere cannot be fitted between uprights; that no toehold is provided between 150 mm and 760 mm above floor level; that the top rail is at least 1.0 m above floor level, and that the rails can take "the foreseeable impact, and where appropriate, the pressure of people pressing on them".

1.59 NZS/AS1657-92 "Fixed platforms, walkways, stairways and ladders -Design, construction and installation" is a New Zealand Standard/Australian Standard harmonised standard. It is similar in some respects to the publication "Safe Access" but contains more detailed engineering information. The Standard does not consider removable handrails or removable sections of safety barriers.

1.60 The track was within normal maintenance tolerances. The locomotive event recorder confirmed that the train was travelling within the maximum allowable speed for the curve. The movement which caused the boy to hold the handrail was not unusual.

2. Findings

2.1 The train was being operated normally prior to the accident.

2.2 The track was within maintenance tolerances.

2.3 Passengers were neither forbidden to, nor advised not to, visit the platform on the power van.

2.4 The boy took hold of the handrail at his shoulder height to brace himself while crossing the gangway as the train entered a curve.

2.5 The boy's forearm was at an upwards angle to the handrail as he held it, with the effect that in bracing himself, he exerted an upwards as well as an outwards force.

2.6 The handrail detached at one end because it could be removed by the combination of an upwards and outwards force of between 1 and 2 kg.

2.7 The bracket to which the handrail was attached was not in accordance with the original design of the NZRL or its predecessors. However, this arrangement had become an acceptable repair at the NZRL Waltham Yard Depot and had been in use for over a decade.

2.8 NZRL's instruction to inspecting staff required that handrails be inspected, but did not specify how faults should be identified.

2.9 Handrails, guardrails, and the brackets throughout the train, and other passenger trains, were not always in accordance with original designs, or any approved design.

2.10 The repair and inspection staff at NZRL's Waltham Yard Depot believed that the right angle bolt arrangement, when properly aligned and secure, provided the same level of safety as the post and toggle. They did not identify this arrangement as a hazard to passengers.

2.11 Maintenance staff in Christchurch made repairs to the handrails and brackets using materials which were readily available to them.

2.12 The right angle bolt arrangement looked similar to the original design of the welded hook arrangement at the opposite end of the handrail but only securely attached the handrail to the power van against an upward and outward movement when the right angle bolt was aligned along the axis of the handrail and the nuts securing the right angle bolt were sufficiently secure to prevent the right angle bolt from rotating.

2.13 The reason the nuts securing the right angle bolt attaching the upper handrail to the power van were not tight enough to prevent the right angle bolt from rotating could not be determined. Nor could it be determined if they were secure at the time the carriage and power van were examined as part of the pre-departure examination. The exact time the right angle bolt became aligned at a right angle to the handrail and pointing outwards also could not be determined. However, based on the corrosion and dirt build up on the nuts and threads of the upper right angle bolt, it is likely that it would have been loose enough to rotate by hand at the time it was last examined.

2.14 The details of replacing the approved post and toggle arrangement with the right angle bolt arrangement were not recorded, nor were the design staff aware that the approved design was being replaced with the right angle bolt arrangement.

2.15 There is no New Zealand Standard or code pertaining to the application and maintenance of handrails, side restraints or gangways on trains.

2.16 The Factory and Commercial Premises Act 1981 (since replaced by the Health and Safety in Employment Act 1992) set out requirements for handrails and guardrails in factories and commercial premises, but did not cover trains.

2.17 The New Zealand Building Code 1992 also sets out requirements for barriers in buildings, but this code also does not cover trains.

2.18 The handrails and guardrails on passenger trains in New Zealand would not have complied with the Factory and Commercial Premises Act 1981 if provided on the open side of a stairway, ramp, or landing in a factory or commercial premise, or with the New Zealand Building Code if provided in any building where young children can be moving.

2.19 If there had been a weather shield in place between the carriage and the power van, the boy may not have landed on the track.

2.20 There were no signs on train 700 on 2 July 1994 advising passengers of safety requirements and procedures when moving about the train.

2.21 The use of a power van platform as a viewing platform (other than on the "TranzAlpine" service) had developed without formal approval or an engineering design review.

2.22 While some passenger trains did have signs relating to the viewing platforms, the signs were not uniform in content.

2.23 The Train Manager was not trained or required to give a safety briefing to passengers when the train left the originating terminal.

2.24 The power van platform did not have an emergency stop lever on it.

2.25 The power van platform had gates on each side which were located over a step, so that a gap of about 175 mm existed in the deck close to the gate.

2.26 Viewing platforms and power vans were equipped with handrails, guardrails, gates and gangway landings of different designs.

2.27 Gangway edges which can move relative to the landing they rest on were not marked to draw attention to them.

2.28 Gangways on some passenger services have only dim lighting at night when the train is in a tunnel.

2.29 Immediately after the accident, the Train Manager allocated duties appropriately, and the train crew carried out their duties correctly.

2.30 The assistance of passengers, particularly that of the nurse, was an important factor in the boy's rescue.

2.31 The Locomotive Engineer and the Train Manger were correct in deciding not to reverse the train towards the accident site.

2.32 The response of the emergency services was prompt and efficient.

2.33 In view of the extreme urgency of the situation, the Train Manager may have been better advised to have requested the services of the helicopter by means of his portable radio through the Locomotive Engineer, confirming this request by telephone from the farmhouse.

3. Safety Recommendations

3.1 On 7 July 1994, the Commission recommended to New Zealand Rail Limited that they:

3.1.1 Keep the ban on the use of the viewing platform in force until:
a review of all aspects of the design, inspection and maintenance of the safety rails is completed;
all remedial action is taken; and
the safety management of passengers is reviewed, including an assessment of the need to provide signage, the languages in which any such signage is displayed; the supervision of children, particularly unaccompanied children; and the introduction of a safety briefing by the Train Manager as the train departs. (057/94)

3.1.2 Ensure Train Managers are trained to inspect the safety features of the passenger areas of their trains and be required to make such an inspection prior to the departure of each passenger service from the terminal stations. (058/94)

3.1.3 When reviewing the design of the safety rails (or chains or strops as appropriate) take into account the spacing and layout of the safety rails, and the direction and magnitude of the loads which might be applied by passengers. (059/94)

3.1.4 Ensure the review of the design of the safety rails considers if a secondary safeguard is required where the concertina weather protection is not provided. (060/94)

3.1.5 Give clear instruction to carriage maintenance staff on the methods and quality of inspection, maintenance and repairs to the safety rails, chains and strops. (061/94)

3.1.6 Define the person (or persons) upon whom the responsibility for the inspection of safety equipment and safety features on carriages rests (062/94) and

3.1.7 Define the person (or persons) upon whom the responsibility rests to ensure that the execution of any remedial repair or redesign work is carried out to a satisfactory standard (063/94).

3.2 New Zealand Rail Limited responded on 8 July 1994:

"We accept the recommendations of your letter of 7 July and are in the process of implementing them. We are also still continuing our investigation into the gangways between carriages. Whilst we have had no previous problems with the interconnecting gangways, safety can always be improved".

3.3 It was recommended to the Land Transport Safety Authority that they:

3.3.1 Advise all operators of passenger trains of the circumstances of this accident with the recommendation that they:

- Review the adequacy and security of handrails, guardrails, and gates in areas where passengers may move;

- Ensure that staff who inspect and maintain handrails, guardrails, and gates are aware of the purpose of and the design intentions for the equipment; and
- Review their passenger management policies in respect of safety briefings, signage, and passenger supervision to reduce the possibility of falls, impacts with trackside objects, or injuries from other causes. (071/94)

3.4 Land Transport Safety Authority responded:

"We agree with your recommendation (071/94) and will communicate with the operators of passenger trains accordingly."

3.5 In the course of completing the reopened investigation resulting in this revised report, the Commission withdrew Safety Recommendation 059/94 and replaced it with the following safety recommendation to Tranz Rail Limited (formerly New Zealand Rail Limited):

For safety barriers on train gangways, ensure, if not already done, that:

- they can not be disconnected unintentionally or as a result of tampering and,
- the spacing and layout and strength of the barriers complies with or exceeds the standards specified in New Zealand Standard NZS/AS1657-92 "Fixed platforms, walkways, stairways and ladders -Design, construction and installation". (125/95)

3.6 Tranz Rail Limited responded:

"1. The current safety barriers cannot be disconnected unintentionally. The only means of ensuring the safety barriers cannot be disconnected as a result of tampering (if this is even possible) is to design and construct them so that they cannot be disconnected at all. This would prevent the decoupling of carriages and render shunting and yard operations impossible.

2. It is Tranz Rail Ltd's responsibility, under the TSL Act to set standards, not the TAIC's. In a number of respects the current safety barrier arrangements meet or exceed the NZS Standard but for reasons expressed earlier (our letters of 29th September 1994 and 24th February 1995) the standard in full is not appropriate. You have never commented on these letters. We note you have conducted no study of the applicability of the NZS standard to the rail environment and failed to justify the view that it should be used by Tranz Rail Ltd.

The recommendation is inappropriate."

13 December 1995

M F Dunphy
Chief Commissioner