

**Legislative Council Panel on Transport  
Subcommittee on matters relating to railways**

**Light Rail service and the incident on 18 December 2002**

Purpose

This paper gives Members an overview of the Light Rail service, and informs Members of the outcome of the investigation into the Light Rail incident on 18 December 2002.

Light Rail service

2. Since commissioning in September 1988, the daily patronage of Light Rail has been increasing continuously from 151,000 in 1988 to 313,600 in 2002, giving a year-on-year growth of about 5.4%. The route length has increased from 23.35 kilometres to 31.75 kilometres. With the completion of two new extensions to Tin Shui Wai by the end of 2003, another 4.4 kilometres will be added to the Light Rail system.

3. The Light Rail network is the backbone of an integrated public transport system serving the 900,000 population in the North West New Territories (NWNT). In 2002, Light Rail commanded a 62.1% market share of the transport system in the region. It is one of the busiest modern light rail systems in the world.

4. Light Rail has been operating with a good safety record which has been improving over the years. In 2002, the number of passengers and public injured per million passengers carried was 0.29, second to the lowest record of 0.23 achieved in 2000.

5. A table showing Light Rail's patronage, market share, service delivery and reliability, and safety performance is at Annex A.

6. Light Rail is now undergoing a HK\$2.3 billion improvement programme to fulfill its new role as a major feeder system of West Rail. The programme entails construction of two extensions in Tin Shui Wai and four West Rail/Light Rail interchanges, installation of a new signalling system, and grade separation between Light Rail and road traffic at several junctions in Tuen Mun. Light Rail will in future become an integral part of a complete KCRC network following the commissioning of West Rail and construction of the Shatin to Central Link and the Kowloon Southern Link.

#### Derailment on 18 December 2002

7. At 0747 hours on 18 December 2002, the front bogie of light rail vehicle (no. 1100) on Route 505 northbound went off the track before entering platform 6 of Light Rail Siu Hong Stop. No one was injured.

8. The derailment led to the suspension of four Light Rail routes and mobilization of shuttle buses to supplement the Light Rail service. Through service was restored at 1020 hours after Light Rail vehicle No. 1100 had been put back on to the track.

9. A specialist investigation team was formed to identify the cause of the incident, to examine incident handling, to determine if there was any failure on the part of systems or personnel, and to make recommendations on possible improvements.

10. The investigation has been completed. A copy of the Final Report of the Investigation is in Annex B.

11. The team concluded that the most possible major factors leading to the derailment were as follows:

- (a) The two left-turning turnouts in close proximity to one another had resulted in a high rate of wear of both the tongue rail and the stock rail. A groove had also been worn in the tongue blade by the wear resulting from the centrifugal force of the light rail vehicle.

- (b) The high rate of wear of the left-turning tongue blade was attributable to a temporary re-routing of Route 505 since 15 September 2002 to facilitate the construction works at the West Rail/Light Rail interchange station at Siu Hong. The re-routing led to a substantial increase in the frequency of Light Rail vehicles running over this section of tracks.
- (c) Although the unusually high rate of wear had resulted in the inspection by the Senior Supervisor on 9 November 2002, and had been noted by the Maintenance Officer, no further action had been taken. The undesirable combined profiles of the tongue blade and stock rail head had not been noted or reported by either the Senior Supervisor or the patrolman. As a result, preventive maintenance had not been effected which might have prevented the derailment.

12. The investigation team also concluded that there had not been any sign of aging of the Light Rail system which is well maintained with regular inspections, servicing and design improvements.

13. Following the derailment incident, KCRC has completed a system-wide check on the condition of all the track turnouts in the network; the condition of the wheels of all light rail vehicles; and the automatic point machines and the associated signalling system. Through this inspection, KCRC has confirmed that the Light Rail system is in good condition and is operating safely.

14. With regard to incident handling, the team found that all the emergency handling procedures were properly followed. It took longer to re-rail the incident vehicle because of two unsuccessful attempts to put the vehicle back on track due to the trapping of a gear box by the damaged turnout. The need to maintain Light Rail service on nearby tracks also limited the area that could be used by the recovery personnel and the equipment.

15. The investigation team recommended a series of measures to prevent a recurrence of the incident and to deal with emergencies. These include:

- Stop running light rail vehicles through the incident location until adequate measures have been implemented;

- Install an external checkrail on the outside rails of the incident turnout;
- Install a rail lubricator at the turnout;
- Investigate to see if there would be any benefit in installing a turnout of a different design;
- Review the maintenance management system, including the inspection frequency and maintenance standards of the track;
- Construction and maintenance works should be coordinated or phased, and its risk and impacts be carefully assessed;
- Explore the use of more effective tools and equipment to improve the efficiency of re-railing operation;
- Consider direct liaison with public transport operators to facilitate early mobilization of alternative transport services; and
- Explore increasing the volume, frequency and clarity of the public announcements.

16. The investigation findings as well as recommendations were endorsed by a reviewing team headed by Mr K K Lee, Director, East Rail Extensions.

17. The Corporation has accepted all the findings and recommendations of the investigation team. Some of the recommendations have already been implemented and some are being implemented as quickly as possible.

18. A special committee, which was set up to determine the accountability of the staff concerned, concluded that eight Light Rail staff members including some senior staff have failed to perform their duties to the full extent expected of them. Appropriate disciplinary action, ranging from verbal and written warnings to demotion and suspension without pay, has been taken against them.

<b>Year</b>	<b>Total number of passengers (million)</b>	<b>Daily average patronage ('000)</b>	<b>Market share for intra NWNT travel</b>	<b>Service delivery (%)</b>	<b>Service reliability (no. of km run per failure)</b>	<b>Service punctuality (%)</b>	<b>Passenger and public injuries per million passengers carried</b>
1998	114	314	67.0	99.92	89,060	99.54	0.37
1999	115	314	67.3	99.89	97,750	99.35	0.44
2000	118	323	67.6	99.90	89,340	99.39	0.23
2001	117	319	66.1	99.90	102,420	99	0.3
2002	115	314	62.1	99.91	103,660	99	0.29

# **Kowloon-Canton Railway Corporation**

## **Final Report of the Investigation into the Light Rail Vehicle Derailment Incident that Occurred on 18 December 2002 at Siu Hong Stop**



**FINAL REPORT OF THE INVESTIGATION INTO**  
**THE LIGHT RAIL VEHICLE DERAILMENT INCIDENT**  
**THAT OCCURRED**  
**ON 18 DECEMBER 2002 AT SIU HONG STOP**

**The Incident**

At 0747 hours on 18 December 2002, the front bogie of light rail vehicle (LRV) No. 1100 on Route 505 northbound went off the rails at the location of turnout W401 just before entering Platform 6 of Siu Hong Stop. (See Annex 1) No passengers or staff on the LRV were injured as a result of the derailment.

2. The derailment incident led to a suspension of LRV services along the Castle Peak Road Corridor between Siu Hong and Hung Tin Road, and the north-bound platforms of the LRT North East Link in Tuen Mun. Four LRV routes (Nos. 610, 614, 615 and 720) were affected. (See Annex 2) Four LRVs were stranded between LRV stops and about 670 passengers had to be detained on to the trackside.

3. Eighty members of staff were mobilized to assist passengers at LRV/bus interchange locations and at those LRV platforms that suffered service suspension. Twenty-seven buses were mobilized to supplement LRV services on two routes. Twenty-four served a route between Siu Hong and Hung Tin Road and the remaining three served the short route between Tuen Mun Town Centre and Siu Hong. (See Annex 3)

4. Through service was restored at 1020 hours after LRV 1100 had been put back on to the track, and by running Route 505 to Platform 5 of Siu Hong instead of Platform 6 to bypass Point W401.

5. Based on patronage statistics on similar weekdays, it was estimated that about 15,000 passengers were affected by the derailment. A 43-year-old female passenger at Leung King Stop also complained about some discomfort arising from chest pain. She was conveyed to and discharged from hospital on the same day.

### **The Site of the Incident**

6. As shown in the drawing at Annex 4, the derailment took place on a section of track where there are two left-turning turnouts located in very close proximity to one another. The left turning 50-metre radius turnout W401, where the actual derailment occurred, has only 3.3 metres of straight track in between it and another earlier left turning 50-metre trailing turnout. This is the only location on the Light Rail running line with this turnout arrangement.

7. The turnout was commissioned in 1988 after inspection by an Inspector of Railways from the UK, who found it to be safe for normal revenue services. The turnout was used for such services between 1988 and 1990 for Routes 505, 511 and 512. From what records can be found, there appear to have been no maintenance problems with the turnout at that time. Subsequently, this section of track was only subject to low frequency use. However, on 15 September 2002, LRV route 505 commenced using this section of track and the two turnouts in order to facilitate the construction works at the Siu Hong West Rail/LRT interchange station. The frequency of LRVs running on this section jumped from several times a day to about 130 times a day. This higher level of usage continued up to the date of the incident.

### **Committee of Inquiry**

8. On 19 December 2002, Director, Light Rail formed a Committee of Inquiry. The Committee was chaired by the Corporation's General Manager, Railway Systems, West Rail, with other members being General Manager, Light Rail Operations, General Manager, Light Rail Engineering, Quality & Safety Manager, Light Rail, and Signalling Manager, West Rail. The terms of reference of the Committee were -

- (a) to investigate and determine the cause of the incident;
- (b) to examine how the incident was handled;
- (c) to determine if there was any failure on the part of systems or personnel; and
- (d) to make recommendations on possible improvements .

9. Following production of a Preliminary Report, which was considered by the Corporation's Managing Board on 21 January 2003, the Committee was tasked to complete this Final Report. In order to assist in this work, the Committee's findings on the cause of the derailment were subjected to



peer review by the Director, East Rail Extensions (who was formerly the Director, East Rail) assisted by the Civil Engineering Manager, East Rail, who is responsible for the track maintenance of East Rail. This Final Report thus reflects their combined findings.

### **The Investigation by the Committee**

10. The Committee visited the site on 20 December 2002, two days after the incident, and thoroughly reviewed the evidence remaining on site, including most importantly photographs taken shortly after the derailment. It went on to examine documentary records pertaining to the track, the signalling system and LRV 1100, including reviewing maintenance records, reports of tests carried out immediately after the incident, and reliability/failure statistics of the key systems that might have any bearing on the incident. On 23 December 2002, the Committee interviewed all concerned members of the operating and maintenance staff. Subsequent equipment testing was also carried out to determine if this might have been a cause of or contributing factor in the incident.

11. In undertaking its investigation as to the actual causes of the derailment, the Committee looked for evidence as to whether the cause could have been a result of factors such as human failure (for example, the speed of the LRV being higher than it should, or a failure to carry out proper inspection and maintenance procedures), electrical or mechanical failure (for example, the LRV's braking system had failed or the points at W401 had failed to lock into the correct position when indicators showed that they had), or external factors (for example, a foreign object lying on the track).

12. The following key facts were collected during the investigation –

- (a) there had not been any special maintenance risk assessment carried out prior to increasing the frequency of use of the section of track in question. It appeared to have been assumed that the tracks' previous higher use in earlier years and adherence to prescribed maintenance standards would be adequate;
- (b) the Crash Log Recorder of LRV 1100 indicated that the speed of the LRV at a distance of about 27.5 metres before the point of derailment was 14.8 km/hr, below the speed limit of 15 km/hr, and that the LRV was slowing such that its speed at the time of derailment was only about 11 km/hr;

- (c) both left and right switch rails were in the correct positions for left turning into Platform 6;
- (d) the points indicator had been showing a left turning signal;
- (e) no foreign object or debris was found on the track or on turnout W401 when LRV 1100 was removed from the scene;
- (f) the Train General Information System of LRV 1100 indicated that there had been no problem with its braking system;
- (g) the tongue blade of the right hand side switch rail of W401 had signs of severe wear and the top edge was slightly broken over a length of approximately 70 mm, commencing 50 mm from the tongue tip – this is shown in the photograph at Annex 5. The breakage appeared to have taken place immediately before or at the time of the derailment;
- (h) a Point Monitoring Report revealed that the width of the tongue blade of the right hand side switch rail, measured 50 mm from the tongue tip had reduced from 3.4 mm, when measured on 12 June 2002, to 2 mm when measured again on 26 October 2002. The thickness of the tongue blade at this point had thus reduced by 1.4 mm in four months, whereas the wear recorded over the previous six months had been only 0.2 mm. While a fast rate of localized wear had been noted, which triggered a special inspection on 9 November 2002, the Senior Supervisor involved considered the condition of the turnout to be acceptable. He so advised his superior, the Maintenance Officer, when the latter was made aware of the high level of wear. This was based on the fact that one of the maintenance standards laid down that the tongue blade should not require repair or replacement until the thickness fell to 1.5 mm. He did not anticipate any problem and no special follow up action was called for. The routine daily inspection by patrolmen continued without any special emphasis being made on the need to inspect the tip of this tongue blade much more carefully. The next scheduled measurement of the tongue blade thickness was in fact not due until two days after the incident took place;
- (i) the manufacturer's design of the turnout was such that the tongue tip of the right hand side switch rail was not fully accommodated by the recess of the right hand side stock rail. As a result the whole top edge of the tongue blade could be seen in plan view – see

photograph at Annex 6. This contributed to the accelerated wear of the tongue blade during the increased frequency of service over the turnout during the preceding weeks;

- (j) the wear on the top inner corner of the right hand side stock rail at W401 was much higher than that of the left hand side stock rail although the dimensions of both stock rails were within prescribed maintenance tolerances; and
- (k) detailed checks of the condition of turnouts, using various prescribed methods of checking, had been carried out five times a year for each turnout. Moreover, in view of the diversion of the Route 505 over this section of track, staff had been reminded to pay extra attention to the maintenance of the track in that location.

### **The Findings of the Committee on the Causes of the Derailment**

13. The Committee noted that the incident was the first LRV derailment on the running line since the commencement of Light Rail service in 1988. It found that there was no sign of aging of the Light Rail system. The railway systems and equipment had been generally well maintained to ensure safety and reliability of operations, and there had been on-going replacement of worn components before failure in accordance with prescribed standards as well as design improvements.

14. The Committee concluded –

- (a) that the track was designed for normal traffic;
- (b) that the speed limit imposed was appropriate and had been followed;
- (c) that the Driver of LRV 1100 did not operate the vehicle in any way that might have contributed to the derailment;
- (d) that the derailment was not a result of vandalism; and
- (e) that both the signalling control of point W401 and the LRV 1100 had performed correctly.

15. The Committee considered that the main factors leading to the derailment were as follows -

- (a) the two left-turning turnouts in close proximity to one another had resulted in a high rate of wear of both the tongue rail and the stock rail. The centrifugal force exerted on each LRV resulting from this left turning movement throws the wheel sets against the tongue rail early at its weakest point. This causes a higher rate of wear of both the tongue blade and the top corner of the stock rail on the right hand side. A groove had also been worn in the side of the tongue blade by the wear resulting from the centrifugal force. The combined profile of the tongue blade and the stock rail created by this wear was conducive to the LRV wheel riding over the rail at that point;
- (b) the substantial increase in the frequency of LRVs running on the left turning tongue blade since 15 September 2002 had significantly increased the rate of wear; and
- (c) although the unusually high rate of wear had resulted in the inspection by the Senior Supervisor on 9 November 2002 and had been noted by the Maintenance Officer, no further action had been taken. The undesirable combined profiles of the tongue blade and stock rail head had not been noted nor reported by either the Senior Supervisor or the patrolman. As a result, preventive maintenance had not been effected which might have prevented the derailment.<sup>1</sup>

16. These factors, it is believed, led to the eventual breakage of the top edge of the tongue blade by the right hand side wheels of the first bogie of LRV 1100, which was heavily laden at the time, thus derailing the vehicle.

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<sup>1</sup> Further interviews of the personnel involved by the Committee set up to establish the “Accountability” for the incident (see paragraphs 33 and 34 below) have established that the inspection carried out by the Grade 6 Senior Supervisor on 9 November resulted from the Senior Supervisor orally reporting to the Grade 7 Maintenance Officer the abnormal rate of wear recorded in the Grade 4 Ganger’s measurements taken during routine planned track measurement on 26<sup>th</sup> of October 2002 (see paragraph 12(h)). The Maintenance Officer upon receipt of that oral report requested the Senior Supervisor to make an inspection of the turnout. The Senior Supervisor made that inspection but noted “nothing special” about the turnout on that day, and reported his findings to the Maintenance Officer, who in turn included reference to the abnormal rate of wear reported and the actions taken by him in his report to the Grade 8 Senior Maintenance Officer dated 14 November.

The track inspection and maintenance engineer on the Accountability Enquiry Committee considers it to be quite probable that the abnormal wear pattern on the turnout was not visually apparent on 9 November 2002, some 5 weeks before the derailment.

17. The Committee concluded that, most probably, immediately prior to the derailment, the right hand side (when viewed in the direction of traffic) tongue blade of the W401 turnout was broken at the thin top edge over a length of approximately 70 mm commencing 50 mm from the tip of the tongue blade by the first right hand side wheel of LRV 1100 (see Annex 7). Then the wheel, under the centrifugal force of the left turning LRV, rolled over the worn-out groove and rough broken top edge of the tongue blade and derailed between the tongue blade and the stock rail of W401. The LRV then continued forward until the gear box of the first axle was trapped by the convergent roots of the left and right tongues of W401 (see Annex 8).

18. The Committee sought a second opinion from independent track and rolling stock experts with international experience from the West Rail project team to establish independently how the derailment could have happened; they reached the same conclusion. The Director East Rail Extensions and the Civil Engineering Manager, East Rail also concurred with the Committee's conclusions after reviewing the evidence.

### **Incident Handling**

19. The Committee observed that the operating and maintenance teams in Light Rail had properly followed the LR emergency incident handling procedures following the incident, i.e. safe and efficient detrainment of the four stranded LRVs via passenger doors without using the emergency rear doors, dissemination of information, mobilization and deployment of relief bus services, assistance to passengers and endeavouring to resume normal services as soon as practicable,. The handling of the incident was somewhat hampered by site conditions, and its effects were exacerbated because it occurred during the morning peak hour of travel, which inevitably led to inconvenience to a large number of passengers.

20. The main reason for the longer than expected time to re-rail the LRV 1100 was the trapping of the first gearbox by the convergent tongue rails of W401. This led to the initial failure of the jacking of the car body and the bogie. One rescue LRV attempted to pull LRV 1100 from the back to release it but still failed. It was released only after two rescue LRVs were coupled together to pull LRV 1100 from behind. The need to maintain Light Rail service on nearby tracks also limited the area that could be used by recovery personnel and equipment.

21. The incident affected a large number of LRT routes because it was located at the only point through which all northbound movements of the LRV routes terminating or passing through Siu Hong must pass. The derailment

caused suspension of services over a section of Castle Peak Road Corridor north of Tuen Mun.

22. As the incident occurred at the morning peak hour, a large number of passengers were affected. Since passengers were mainly going to workplaces or schools, tremendous inconvenience and ill feeling were caused. Like similar incidents on all major public transport system, there were complaints on the adequacy of information disseminated.

23. The Committee noted that there was immediate and repeated information dissemination to passengers after the incident. Despite the fact that the volume of the public announcement system at the LRV platforms had been turned to the highest level, there were still complaints that the announcements could not be clearly heard.

24. There were also complaints about the audibility of public announcements on board LRVs. The volume and frequency of LRV public announcements depended on the initiative of the drivers, the content of the messages is prescribed in a manual.

25. Interchange between LRV and emergency bus services was generally satisfactory and in good order at Hung Shui Kiu on the north side. However, site constraints affected the rapid handling of affected passengers as well as the ease of transfer from Light Rail platforms to the relief bus services at Siu Hong on the south side. Platform 5 at Siu Hong Stop, which was the location for the boarding and alighting of Light Rail passengers to interchange to the emergency bus services, was restricted in length and area by the adjacent construction works for the West Rail/Light Rail interchange, leading to crowded conditions which slowed down passenger boarding and alighting, which in turn led initially to a queue of LRVs waiting to enter the platform.

26. The construction of West Rail's Siu Hong Station had also resulted in the closure of a pedestrian footbridge, which had provided a short connection from Siu Hong LRT Stop to the original emergency bus stop along Castle Peak Road. As a result, the emergency bus stop for passengers affected by this incident had to be located some 250 metres away (at the other end of the LRT stop, separated by Siu Hong Estate). Although Light Rail assistants were deployed and orderly passenger movement was maintained, there were inevitably complaints about the long walking distance. The Committee noted that this temporary arrangement would cease on completion of the West Rail works and the opening of a new public transport interchange at Siu Hong.

### **Immediate Follow-up Action taken by Light Rail Division**

27. Immediately following the incident, a reminder notice to drivers to strictly follow operating rules and procedures when driving LRV's through turnouts was issued; an extra system-wide check of LRVs, point-machine and turnout equipment was conducted without finding any further anomalies; and a reminder notice for track maintenance staff to use extra vigilance was issued, to ensure the whole LRT system was safe to continue operations.

### **The Committee's Recommendations**

28. The Committee recommends that the following measures should taken as a matter of urgency to minimize the probability of such an incident recurring -

- (a) stop running LRVs through this location, with its two consecutive left turning turnouts until adequate measures have been implemented to the satisfaction of the Hong Kong Railway Inspector to mitigate potential risks;
- (b) install an external checkrail on the outside rails of turnout W401 to guide the wheels of the turning LRV so as to reduce the wear at the tongue blade and prevent derailment and demonstrate its effectiveness to the satisfaction of the Hong Kong Railway Inspector (See Annex 9);
- (c) install a rail lubricator in front of the facing curved tongue rail at turnout W401 and other similar locations to reduce the wear rate of the tongue (See Annex 9);
- (d) investigate to see if there would be any benefit in installing a turnout design that has the tip of tongue extended further with part of its length accommodated in a recess into the right hand side of the stock rail so that the wheel can contact the tongue and be guided more smoothly along the curve resulting in less of a localized wear pattern on the tip (and the weakest part) of the tongue blade;
- (e) investigate to see if there would be any benefit in installing a type of turnout with a smaller radius to allow more space to fit in a longer straight section of track. This would help the LRV bogie to centre itself between the two consecutive trailing and facing turnouts;

- (f) review the inspection frequency and maintenance standards of the track, in particular for components that are subject to heavy or unusual service duty. Pay extra attention to tongue blade wear and tear, condition monitoring and wear rate analysis for critical components, adverse rail profile development, and track differential settlement development. From a more comprehensive and scientific analysis of the information collected, develop more discriminating maintenance strategies accordingly;
- (g) explore the development of specialized but simple gauges and instruments and provide associated training for patrolman to assist them to more effectively measure and monitor tongue blade and stock rail profiles for the early identification and reporting of potential problem areas;
- (h) prior to any change to being made to major LRT equipment or any re-routing of services, and major changes to LRT operating environment, carry out a comprehensive and systematic Change Impact and Risk Analysis to identify any impact or risk that may be caused by such change, and develop necessary measures or actions to address these;
- (i) construction and maintenance work should be coordinated or phased to avoid having a large number of routes pass through a single critical point or special track component and, if this is unavoidable, the duration should be minimized and extra vigilance should be exercised over the condition of the equipment involved; and
- (j) engage an external expert to carry out a comprehensive review of the maintenance management system, including advising on the scope for computerising the system for monitoring of maintenance, within six months.

29. On more effective measures for re-railment and service recovery, the Committee recommends that, as soon as possible, the Corporation should explore the use of -

- (a) some simple optical instrument that can help inspection of the LRV under-frame or other confined space in case of derailment or other incidents to enable quick and detailed diagnosis of the damage and



other aspects of the situation so as to develop the most effective recovery strategy within the shortest possible time; and

- (b) lightweight portable diesel driven hydraulic pumps, jacks and control manifolds to enable more powerful and faster re-railing operation.

30. On information dissemination and assistance to passengers, it is recommended that -

- (a) consideration be given in the case of major service disruptions to liaise directly with public transport operators to enable early mobilization of alternative transport services in addition to the normal notification to the Transport Department;
- (b) explore increasing the volume and clarity of the platform public announcement system with possible adjustment at the Operations Control Centre for louder emergency broadcast at LRV stops;
- (c) explore the stowing of emergency detrainment ladders at strategic LRV stops and/or on emergency vehicles to assist passenger detrainment on to track level;
- (d) specify in the LRV drivers' Work Instruction the frequency and volume of making public announcements to the LRV saloons during various types of emergency/incident;
- (e) minimise the occupation of operating facilities by project or maintenance works or, if that is unavoidable, attempt to secure quick release of space during emergencies to minimize impact and inconvenience to emergency services or passenger facilities.

### **Accountability**

31. The Committee's terms of reference, inter alia, call for it to identify any failure in systems and personnel. The Committee concludes that there was such a failure in the maintenance planning and execution for this section of track. It was not that prescribed systems and standards were not adhered to. Indeed the converse is perhaps true, in that there appears to have been an over reliance on what was laid down in the manual rather than using common sense and initiative. The problem appears to have been one of failure to anticipate potential problems, failure to interpret correctly and respond to clear warning signs of heavy wear, and an over heavy reliance on the routine practice of daily

visual inspections being carried out by a relatively junior patrolman. Even if detected, the absence of simple measuring devices to gauge the extent of wear and profile of the rail rendered the visual inspections less effective than they could have been. The fact that the section of track in question had been recommended as fit for revenue use by the UK Railway Inspector in 1988 and that there had not been a derailment on the Light Rail running track in the past 14 years as a result of adopting the prescribed maintenance standards also appears to have given rise to a certain degree of complacency in those responsible for operating and maintaining the track. In mitigation, however, the Committee acknowledges -

- (a) that the layout of the section of track concerned is unique on Light Rail;
- (b) that this track was subjected to far higher frequencies of use than had been the case for many years during the few weeks preceding the derailment; and
- (c) that the wear on the tongue blade and the stock rail created by the centrifugal force was unusual and difficult to monitor visually (for example, it not easy for the human eye to judge the thickness of the tongue blade and profile when the difference between no maintenance and maintenance is measured in fractions of a millimetre).

32. The Committee also notes that other systems worked well. What under other circumstances could have been a far more serious incident only resulted in a minor derailment causing no injuries to passengers. Unfortunately, the nature of the derailment with the gearbox becoming stuck, and the timing and location of the incident combined to give rise to problems which might have otherwise have passed relatively unnoticed at another time and location.

### **The Corporation's Response**

33. The Corporation accepts unreservedly the findings and recommendations of the Committee of Inquiry. More particularly, on the recommendations of the Committee, these have or will be implemented as a matter of urgency. To this end, the timetable shown at Annex 10 has been established.

34. On the question of accountability, on 23 January 2003, the Chief Executive Officer of the KCRC authorised the setting up of a further committee to determine the accountability of the staff concerned in this incident and, if

found necessary, to put forward recommendations on the need for disciplinary action. This committee will be chaired by the Director, East Rail. The committee has been asked to submit its findings and recommendations to the Chief Executive Officer by early February 2003.

24 January 2003

Attachments

Annex 1 - Layout Plan Between Bridge E and Siu Hong

Annex 2 - Route Map Showing LRV Services Affected

Annex 3 - Route Map of Diverted LRV Services and Emergency Bus Services

Annex 4 - Plan for Turn out W401 and T129

Annex 5 - Condition of Tongue Blade Immediately After Removal of LRV

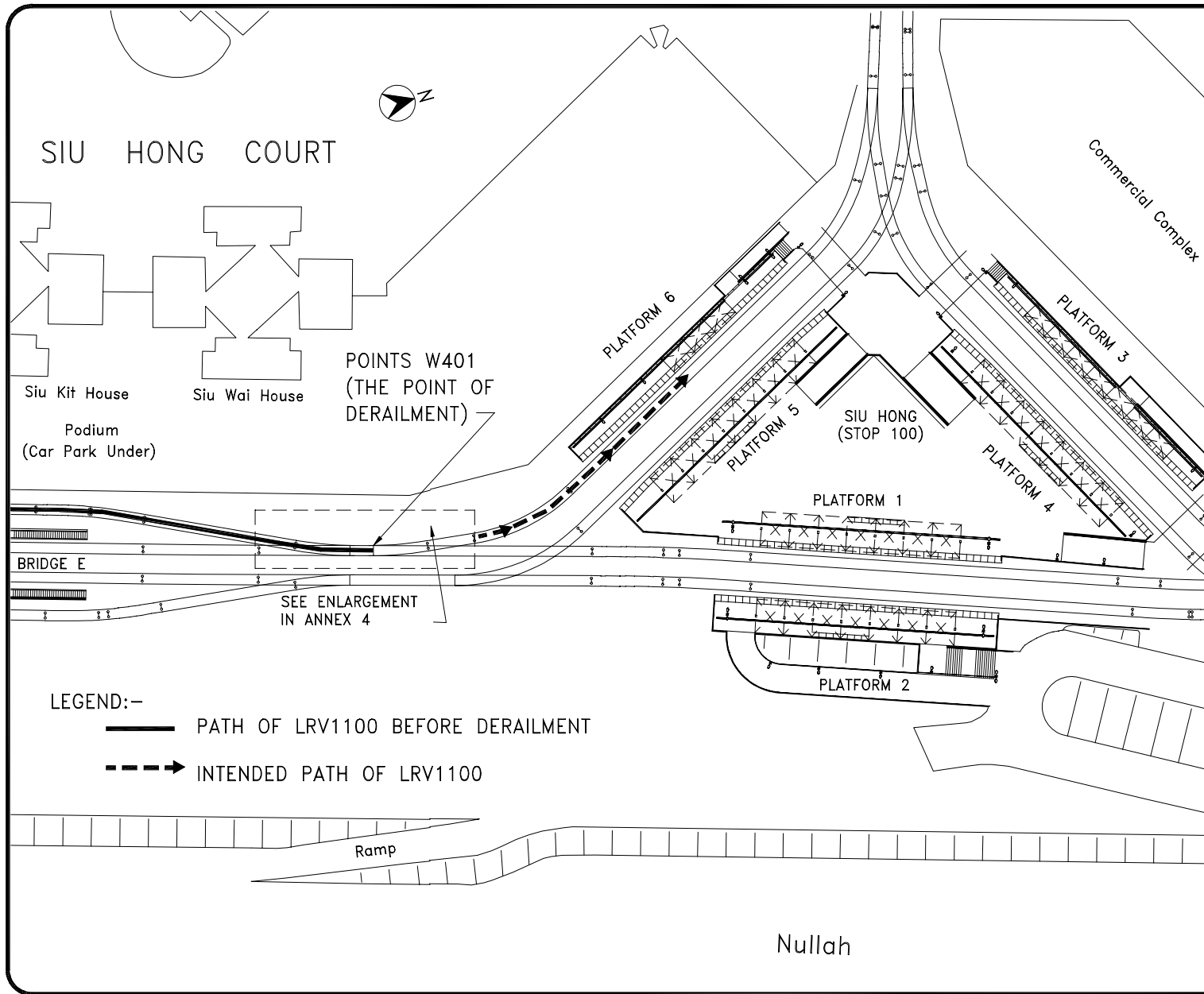
Annex 6 - Photograph showing the exposure of the top edge of the tongue blade

Annex 7 - Cross-section of Wheel - Rail Profiles

Annex 8 - How Derailment Occurred

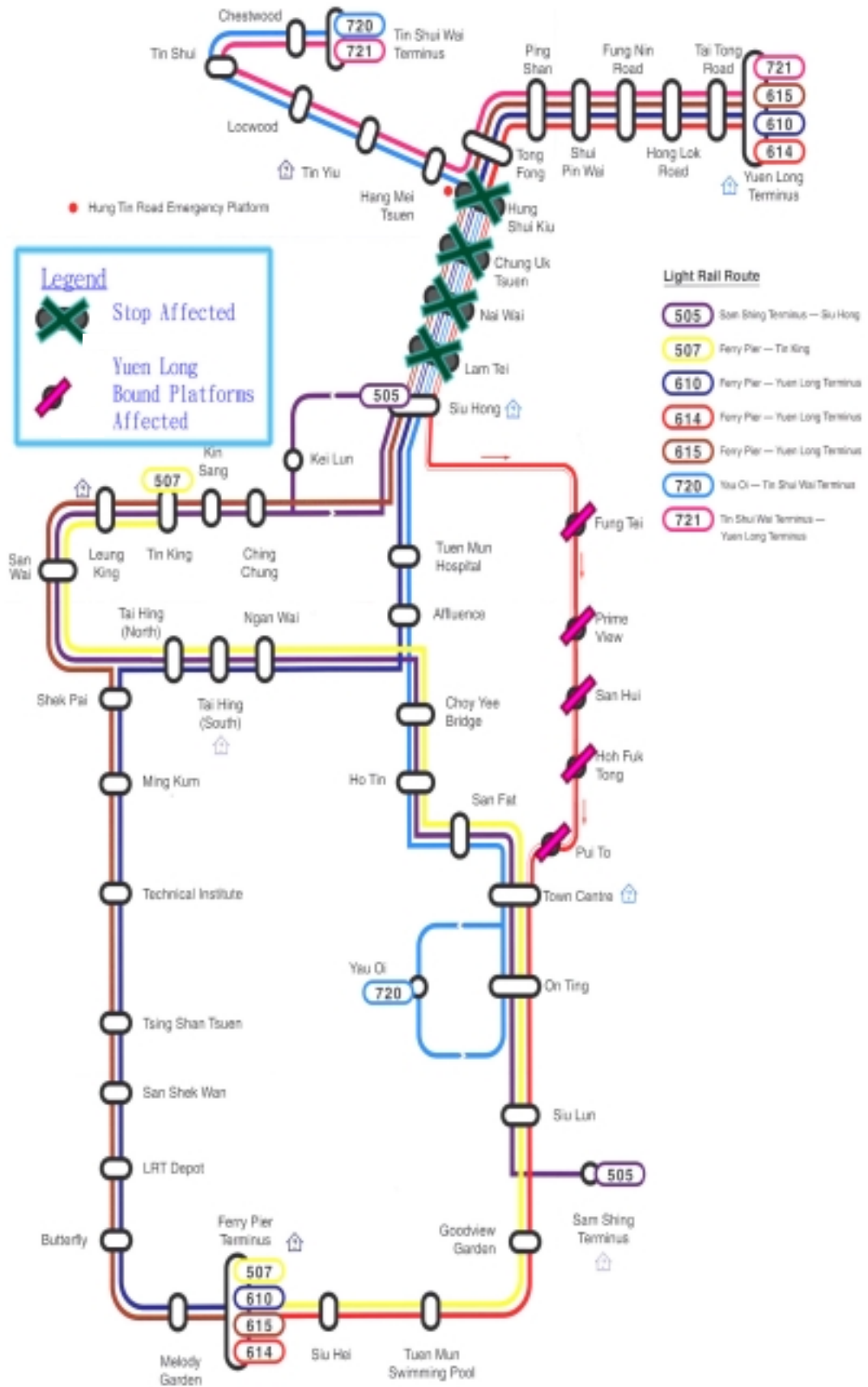
Annex 9 - Improvement For Turnout W401

Annex 10 - Timetable for implementing recommendations

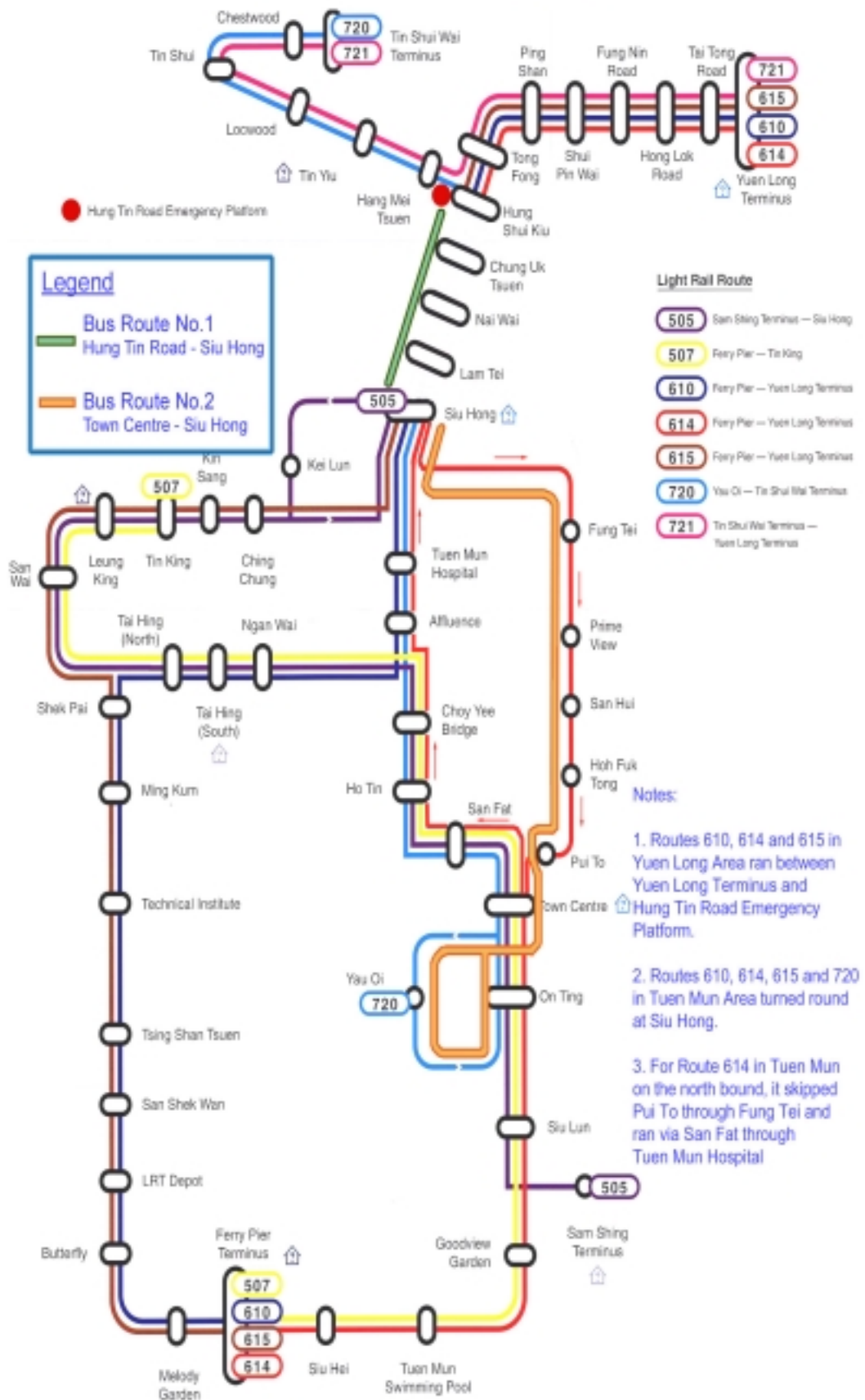


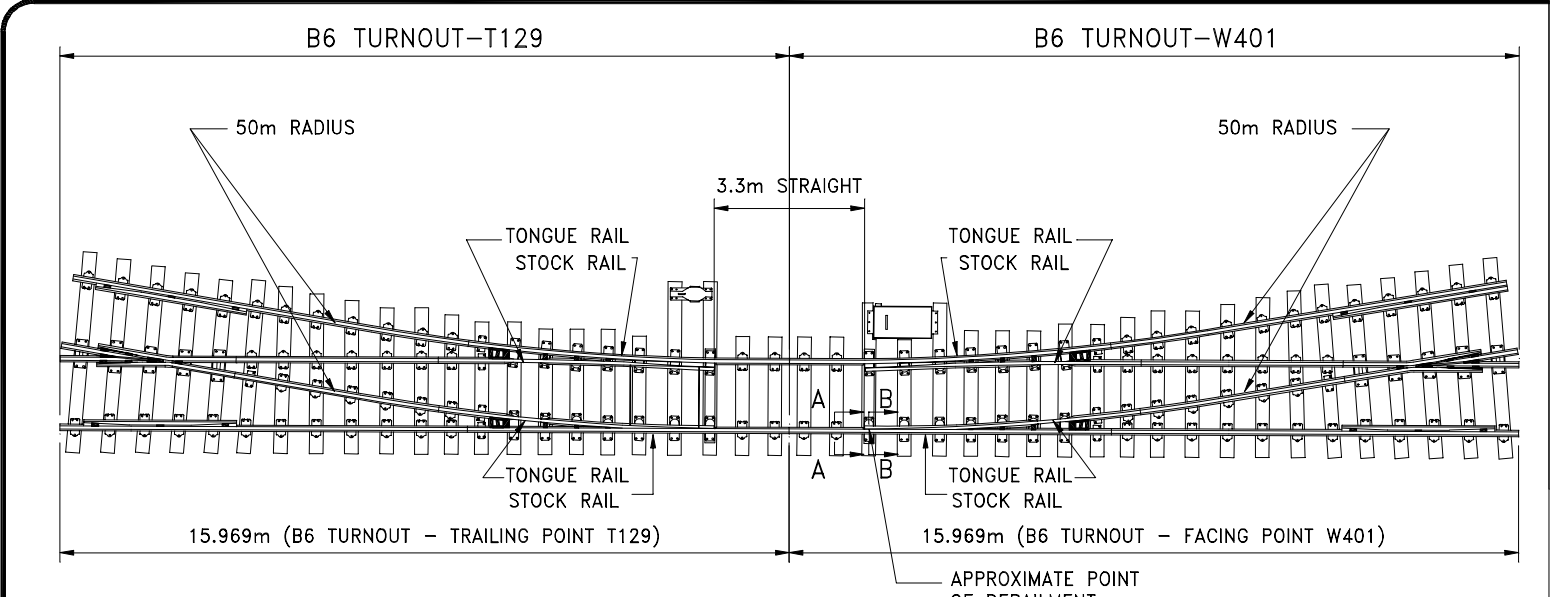
**Layout Plan Between Bridge E and Siu Hong**

## Affected LRV Services

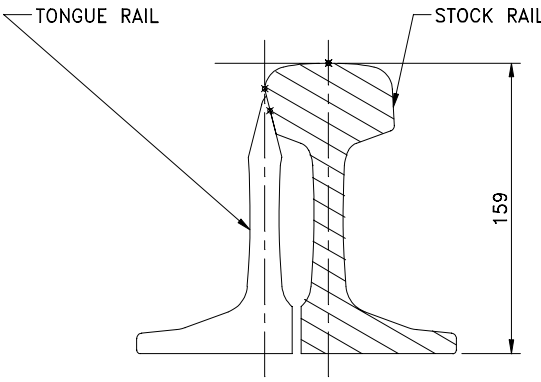


## LRT Service Adjustment and Emergency Bus Routes

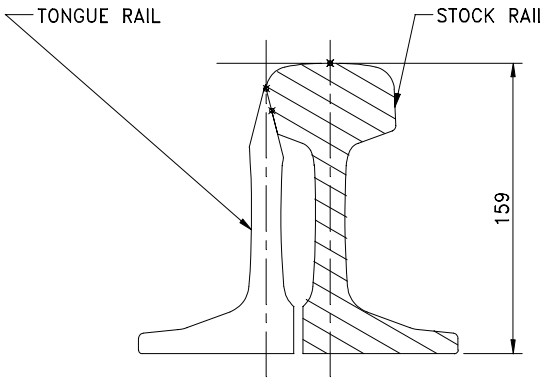




**ENLARGEMENT VIEW** SCALE 1 : 100  
UNIT : mm



**VIEW A-A** SCALE 1 : 2.5  
UNIT : mm



**VIEW B-B** SCALE 1 : 2.5  
(100mm FROM TOE) UNIT : mm

**Plan For Turnout W401 and T129**



**Condition of Tongue Blade Immediately After Removal of LRV**



# Photograph showing the exposure of the top edge of the tongue blade

Point switched to right



Plan view of Point tongue



# Cross-Section of Wheel-Rail Profile

Figure 1  
At 50mm from the Toe of Tongue Rail

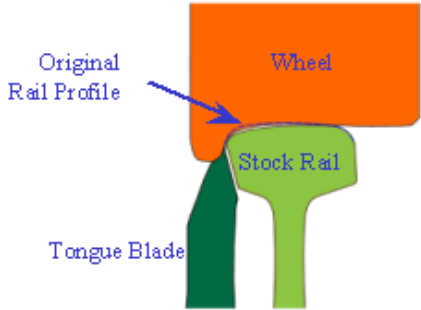


Figure 2  
At 100mm from the Toe of Tongue Rail

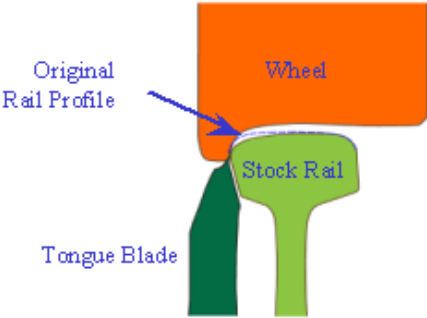


Figure 3  
At about 1500mm from the Toe of Tongue Rail

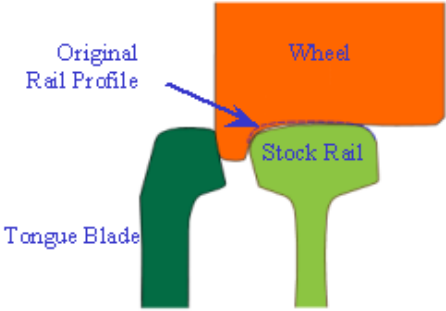
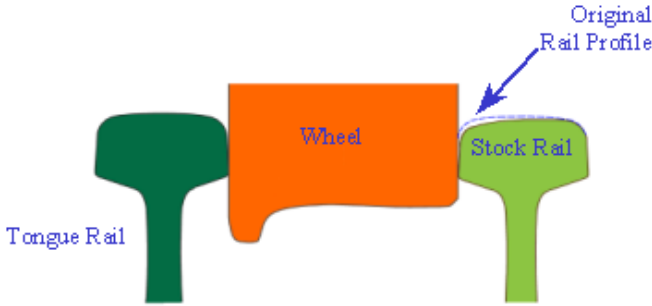
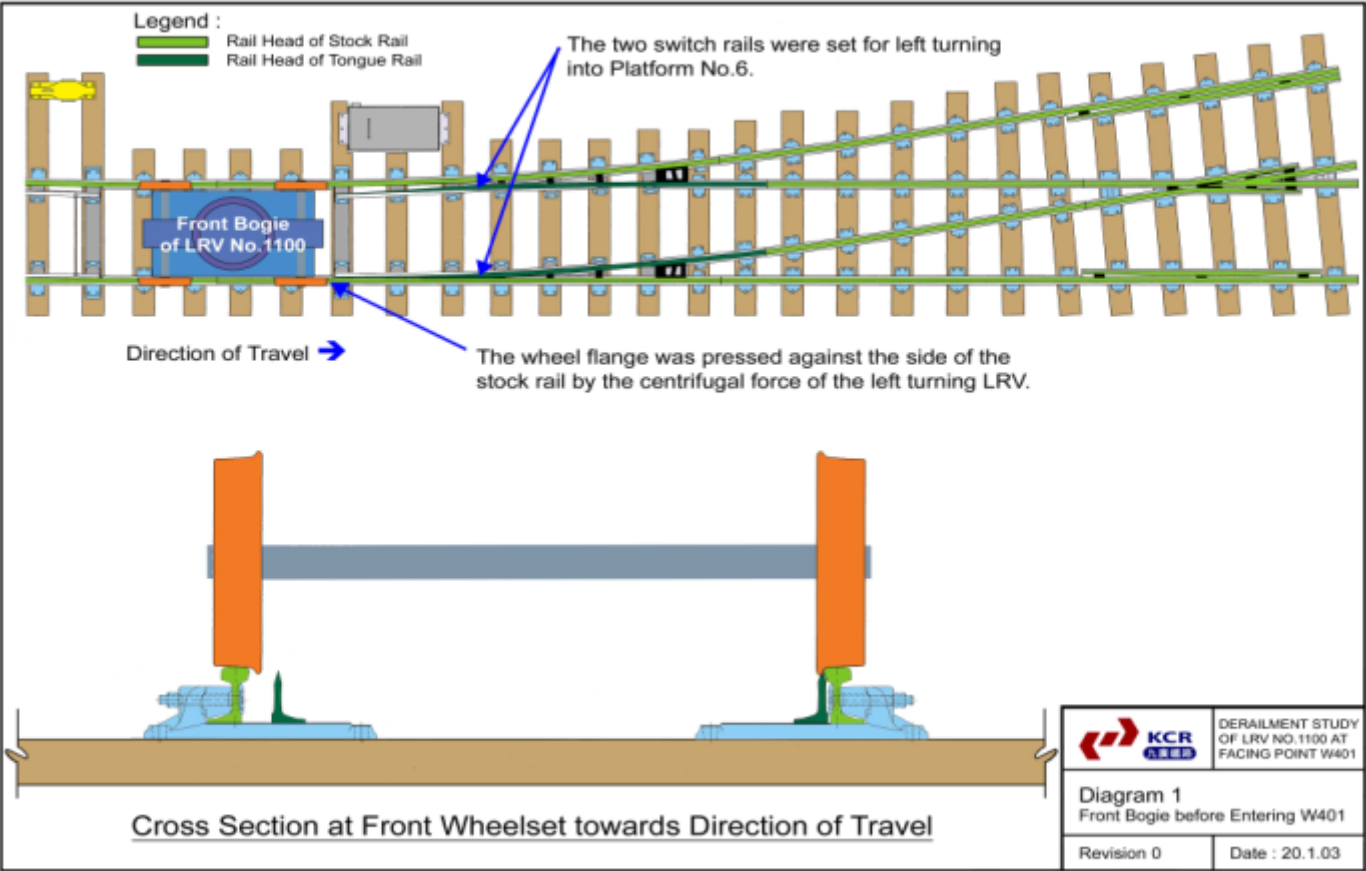


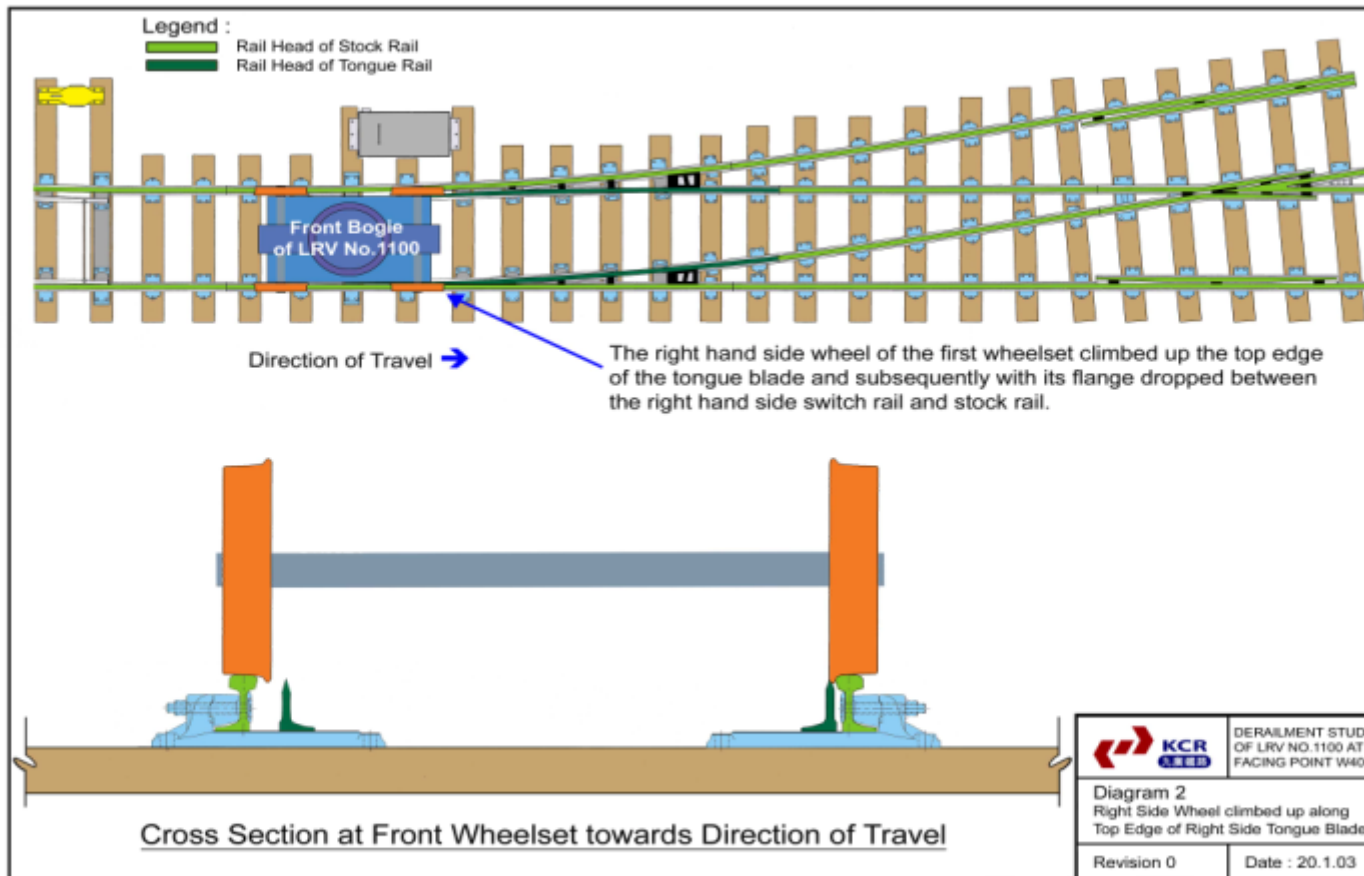
Figure 4  
At about 3700m from the Toe of Tongue Rail

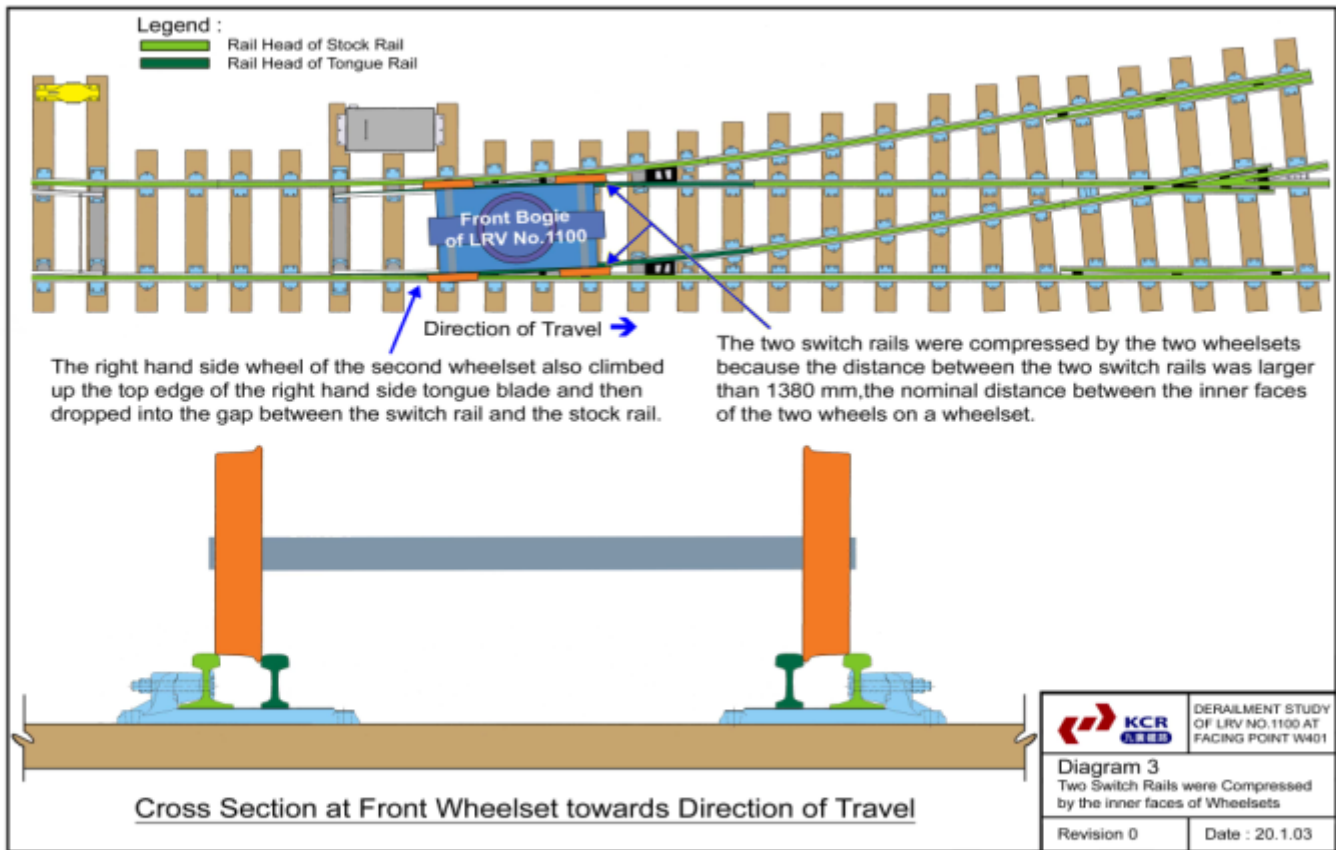


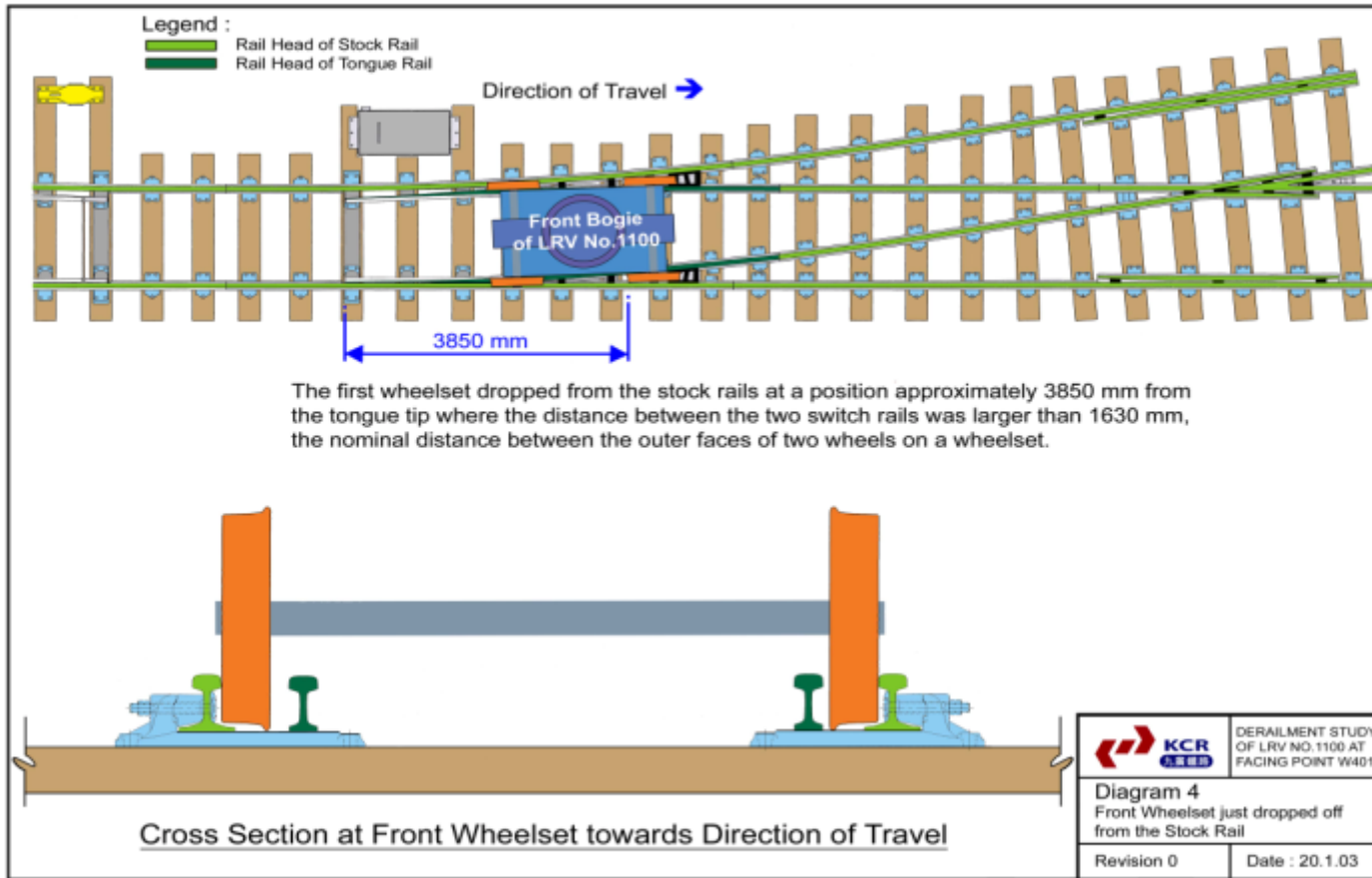
## How Derailment Occurred

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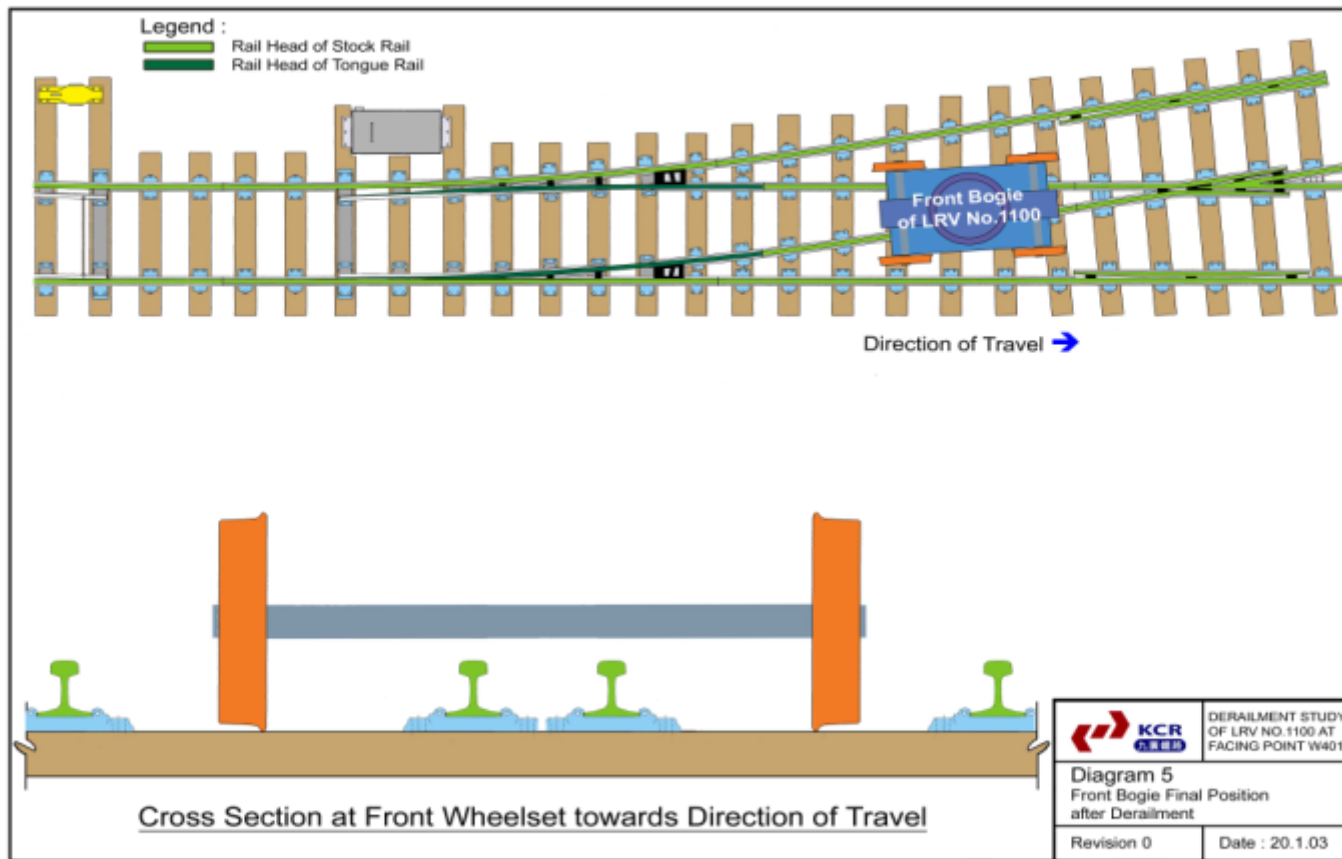


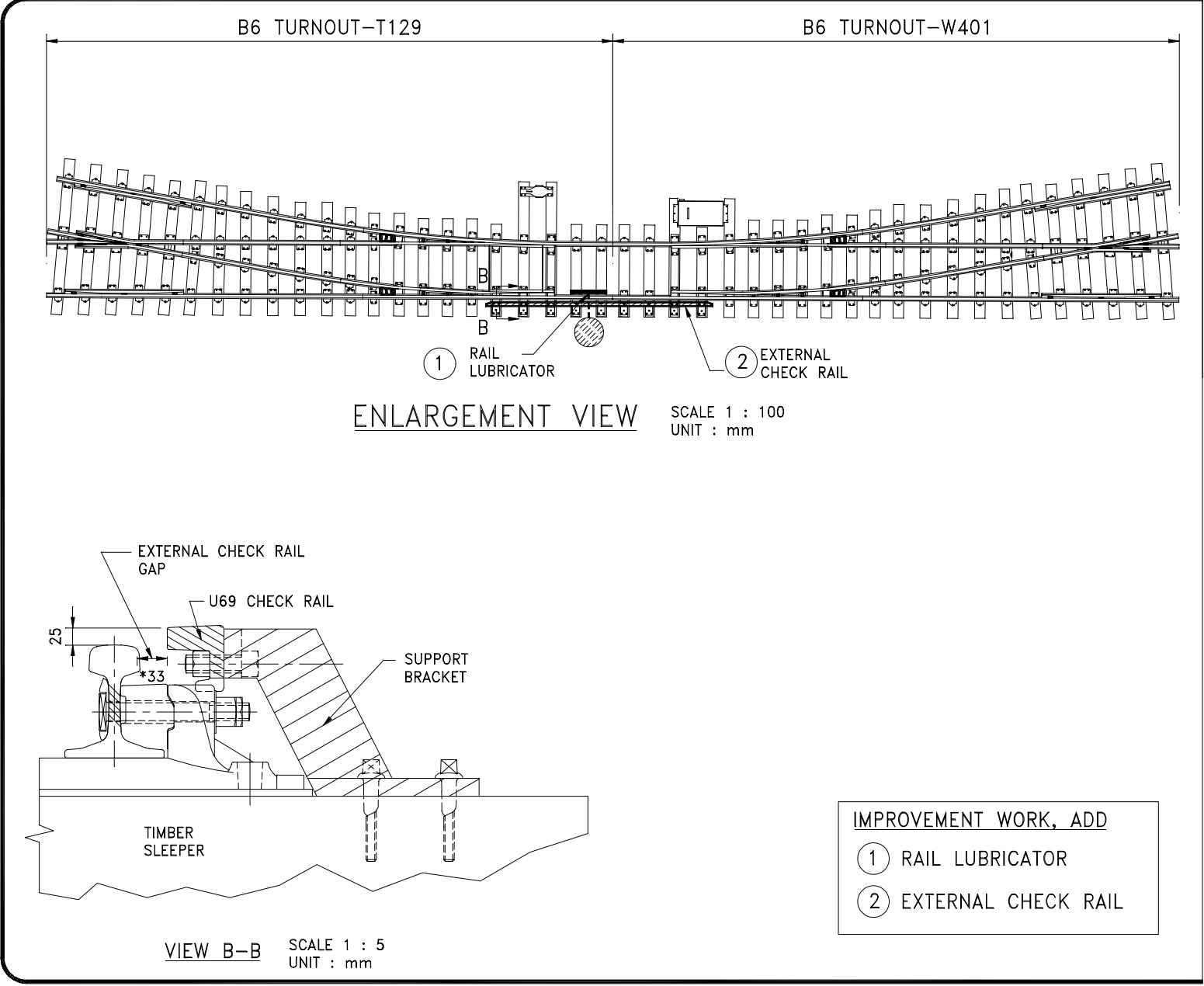












Improvement for Turnout W401

Paragraph	Recommendation	Timing
28 (a)	Stop running LRVs through this location, with its two consecutive left turning turnouts until adequate measures have been implemented to the satisfaction of the Hong Kong Railway Inspector to mitigate potential risks.	With immediate effect
28 (b)	Install an external checkrail on the outside rails of turnout W401 to guide the wheels of the turning LRV so as to reduce the wear at the tongue blade and prevent derailment and demonstrate its effectiveness to the satisfaction of the Hong Kong Railway Inspector.	To be completed within six months
28 (c)	Install a rail lubricator in front of the facing curved tongue rail at turnout W401 and other similar locations to reduce the wear rate of the tongue.	By end February 2003
28 (d)	Investigate to see if there would be any benefit in installing a turnout design that has the tip of tongue extended further with part of its length accommodated in a recess into the right hand side of the stock rail so that the wheel can contact the tongue and be guided more smoothly along the curve resulting in less of a localized wear pattern on the tip (and the weakest part) of the tongue blade.	Within six months
28 (e)	Investigate to see if there would be any benefit in installing a type of turnout with a smaller radius to allow more space to fit in a longer straight section of track. This would help the LRV bogie to centre itself between the two consecutive trailing and facing turnouts.	Within six months

Paragraph	Recommendation	Timing
28 (f)	Review the inspection frequency and maintenance standards of the track, in particular for components that are subject to heavy or unusual service duty. Pay extra attention to tongue blade wear and tear, condition monitoring and wear rate analysis for critical components, adverse rail profile development, and track differential settlement development. From a more comprehensive and scientific analysis of the information collected, develop more discriminating maintenance strategies accordingly.	Within two months
28 (g)	Explore the development of specialized but simple gauges and instruments and provide associated training for patrolman to assist them to more effectively measure and monitor tongue blade and stock rail profiles for the early identification and reporting of potential problem areas.	Within three to six months
28 (h)	Prior to any change to being made to major LRT equipment or any re-routing of services, and major changes to LRT operating environment, carry out a comprehensive and systematic Change Impact and Risk Analysis to identify any impact or risk that may be caused by such change, and develop necessary measures or actions to address these.	With immediate effect
28 (i)	Construction and maintenance work should be coordinated or phased to avoid having a large number of routes pass through a single critical point or special track component and, if this is unavoidable, the duration should be minimized and extra vigilance should be exercised over the condition of the equipment involved.	With immediate effect

Paragraph	Recommendation	Timing
28 (j)	Engage an external expert to carry out a comprehensive review of the maintenance management system within six months.	Within six months
29 (a)	Explore the use of some simple optical instrument that can help inspection of the LRV under-frame or other confined space in case of derailment or other incidents to enable quick and detailed diagnosis of the damage and other aspects of the situation so as to develop the most effective recovery strategy within the shortest possible time.	Within three months
29 (b)	Explore the use of lightweight portable diesel driven hydraulic pumps, jacks and control manifolds to enable more powerful and faster re-railing operation.	Within three months
30 (a)	Consideration be given in the case of major service disruptions to liaise directly with public transport operators to enable early mobilization of alternative transport services in addition to the normal notification to the Transport Department.	With immediate effect
30 (b)	Explore increasing the volume and clarity of the platform public announcement system with possible adjustment at the Operations Control Centre for louder emergency broadcast at LRV stops.	Before 27 January 2003
30 (c)	Explore the stowing of emergency detrainment ladders at strategic LRV stops and/or on emergency vehicles to assist passenger detrainment on to track level.	Within six months
30 (d)	Specify in the LRV drivers' Work Instruction the frequency and volume of making public announcements to the LRV saloons during various types of emergency/incident.	With immediate effect

Paragraph	Recommendation	Timing
30 (e)	Minimise the occupation of operating facilities by project or maintenance works or, if that is unavoidable, attempt to secure quick release of space during emergencies to minimize impact and inconvenience to emergency services or passenger facilities.	With immediate effect

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