PERMANENT WAY

INSTITUTION

YOUNG ACHIEVER'S AWARD

APPLICATION 2007

Name: Damian Brizzi

Date: 4/09/2007

Application Title: Mixing Broad and Standard Gauges

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1. INTRODUCTION

Please find attached an application for the PWI Yong Achievers award. The following covers Damian's Eligibility, Brief Statement of Ambition, A Description of the Entry, the Entries Relevance to Permanent Way Institution, the Difficulties Overcome in the Project, Amount of Innovation, Ongoing Benefits to the Rail Industry, Technical Excellence and Technical Report.

2. ELIGIBILITY

The detailed design of the Wodonga Rail Bypass as described in the technical paper attached took place between 01/06/2006 to 01/01/2007. The main line alignment project covers all of the required criteria listed by the Permanent Way Institution and was presented as a technical presentation at the May PWI quarterly meeting in Sydney and at the 2007 GHD Rail Conference in Brisbane. I am also a design engineer under the age of 35 which qualifies me for the PWI Young Achievers award.

3. BRIEF STATEMENT OF AMBITIONS

Whilst completing my degree part time at Monash University I worked for McConnell Dowel Contractors. It was during this time with McConnell Dowel that I was first exposed to the rail industry, and where I learnt of the shortage of engineers in this field. After 18 months in construction I made the decision to move into a more design based role. GHD offered me a position in their Rail Group, and since then I have been heavily involved in track design work, of which most has taken place in NSW.

At this stage of my career I am heavily involved in the detailed design and project management aspects of rail projects. In the near future, I would also like to gain further experience in the operational side of the railway industry. This would include improving my understanding of the general requirements for operating a railway, and in particular focusing on track maintenance and renewals.

Earlier this year I took the initiative to enrol in a railway engineering postgraduate course that covers Railway Business and Engineering. The course is based at the Queensland University of Technology and the Australian Railway Research Institute, and covers a series of topics ranging from railway management through to network access and track design. While the course is by no means a substitution for actually working in these fields, it is allowing me to gain exposure to areas of the rail industrywhich are not normally encountered as a track designer. I see this additional study as a great opportunity, as it will allow me more flexibility of movement within the industry in terms of employment possibilities.

As a young engineer in the rail industrythere are numerous career options available both here in Australia and overseas. Over the course of the next few years I intend to further enhance my design abilities before relocating for a period of time overseas, most likely to Europe. Given the high quality of rail work in areas of Europe, such a move would be of great benefit to my rail skills in both design and operations. I look forward to the challenges and opportunities that will arise when working in another country. When I return I hope to continue working in the Australian rail industry, taking on a senior role involving management of a rail group for one of the larger consultants.

4. A DESCRIPTION OF THE ENTRY

The detail design of the project entitled the Wodonga Rail Bypass (WRB), took place between the 01/06/2006 to 01/01/2007. The project involves a major deviation of the main southern railway at Wodonga to bypass the central business district (to the north of the city). The design consisted of both a standard gauge and dual gauge main line track.

The technical paper attached was presented as a technical presentation at the May PWI quarterly meeting in Sydney and at the 2007 GHD Rail Conference in Brisbane. It discusses the design constraints within the project and the design issues that arose. It looks at dual gauge issues on concrete sleepers (new to the industry) and it discusses in detail how these issues were overcome and designed around. The design covers the permanent way design and issues related to the dual gauge turnouts.

5. RELEVANCE TO PERMANENT WAY INSTITUTION

As a track design project, the design of the Wodonga Rail Bypass is particularly relevant to the Permanent Way Institution. The project covers all aspects of the track design including turnouts, formation including ballast and bulk earthworks. The WRB differs somewhat from the ordinary permanent way design due to the dual gauge arrangement.

6. DIFFICULTIES OVERCOME

There were several major difficulties addressed in the design of the Wodonga Rail Bypass, all of which are discussed in the technical paper attached. The following highlights the major issues discussed:

Standards: the design of the dual gauge component of the track had to meet the criteria of two separate design standards. The standard gauge component used the ARTC Track and Civil Code of Practice (CoP) and the broad gauge component used the PTC MetRail Design Manual. During the design of the project it was critical that both standards were taken into consideration especially on tight radii curves where four traffic classes had to be satisfied.

Sleeper Constraints: the concrete sleeper design caused issues on tight radii curves where a required 90 mm superelevation was required for the standard gauge rails. This placed the broad gauge rail on a superelevation greater than 100 mm, which was unacceptable by the PTC standards. Several design solutions were considered, however the final solution saw the standard gauge speed limit reduced from 130 kph to 125 kph.

Transition Sleepers: the existing cant reducing sleepers on the dual gauge turnout were not suitable for use with the concrete sleepers due to superelevation ramp created being in excess of 1 in 300. The design of two new sleepers was proposed, one on a modified concrete sleeper, and the other using machined base plates. The decision made by TKL was to adopt the machined base plate solution.

Turnout Angles: unlike previous dual gauge design, this design required a dual gauge / standard gauge crossover arrangement. Unlike conventional standard and broad gauge turnouts the dual gauge turnouts are only made in a 1 in 8 angle. This meant that the design required a 1 in 9 standard gauge turnout to match tangentially to a 1 in 8 dual gage turnout. Several options were considered, and the final arrangement consisted of a curved infill panel which was made up of a 200m radius, used to tangentially connect the difference in angles. This meant that a unique infill panel was required for the construction of the crossover.

7. AMOUNT OF INNOVATION

The dual gauge design on concrete sleepers was the first of its type in Victoria. The ARTC type approved sleeper had never been used in a mainline design where tight radii were present and high speeds were to be maintained. All of the design issues which arose were able to be overcome using first principles, and it was possible to develop design solutions that addressed the problems while still maintaining a high level of operating conditions. The dual gauge design was required to meet two separate operating standards. Although it was a difficult task appropriate design solutions were developed to manage the differences.

8. ONGOING BENEFITS TO THE RAIL INDUSTRY

The dual gauge design issues discussed in the technical report are a source of information for future dual gauge designs. Thus, if the industry is confronted with similar issues related to the dual gauge arrangements, there is now an example of how such issues can be overcome. After the detailed design of the Wodonga Rail Bypass was completed, GHD was awarded the contract to independently verify six new dual gauge turnouts. With the experience of the detailed design of the WRB, GHD was able to anticipate several of the major design issues before starting the project. The experience gained during the design of the WRB has already been of benefit in the execution of other designs.

9. TECHNICAL EXCELLENCE

The design of the Wodonga Rail Bypass presented several design issues which required an understanding of permeant way design and turnout design. The design solutions provided were realistic, adaptable to other designs, and all options were affordable. The design required not only an understanding of the track design limitations but also the knowledge and skills required to work to the fullest capability within these boundaries. The dual gauge component of the design required a comprehensive understanding of the track design standards necessary for the standard and broad gauge components of the track.

10. TECHNICAL PAPER

Mixing Broad and Standard Gauges –Discussion on a Detailed Design example for the Wodonga Rail Bypass

Synopsis

The state of Victoria contains two rail gauges, broad gauge, which occupies the majority of the state's network, and standard gauge, which covers Western Victoria and provides interstate rail access. Currently there is a limited amount of dual gauge track, most of which is located in yards and terminals. Prior to the buy back of the lease of the Regional Rail Network by the state of Victoria, the proposed Wodonga Rail Bypass was scoped with two tracks, one standard gauge and one dual gauge. Unlike previous dual gauge designs, the bypass was to be constructed on Austrak dual gauge concrete sleepers as opposed to typical timber sleepers. This paper discusses the development of the dual gauge design, outlining issues identified. Issues include speed restrictions over the two gauges, superelevation deficiencies between standard and broad gauge standards, track centres and ARTC type approved dual gauge turnouts.

1. Introduction:

Since the introduction of standard gauge to Victoria in the 1960's, there has been conflict with the existing broad gauge network wherever the two gauges meet. Where possible, dual gauge arrangements have been avoided, with two separate tracks being maintained.Currently, both standard and broad gauge networks service the town of Wodonga, which is located on the Melbourne to Sydney interstate rail line. The decision was made in 2001 through a joint Victorian and Federal Government initiative, to upgrade the alignment which goes through Wodonga. As part of the upgrade, the existing standard and broad gauge alignments were to be removed and upgraded to a standard gauge track and a dual gauge track, both of which would bypass Wodonga. This upgrade would not only improve freight and passenger rail efficiency, but also promote improved road traffic flow by removing the continuous interruptions from rail traffic created by the existing 12 level crossings.

The proposed detailed design of the Wodonga Rail Bypass undertaken by GHD was to incorporate a dual gauge design on concrete sleepers, the first of its type in Victoria. Although there is a small amount of dual gauge track in Victoria, all previous designs have been constructed on timber sleepers and the turnouts on timber bearers. This reportdiscusses the design constraints related to dual gauge design on concrete sleepers.

2. History of Broad Gauge and Standard Gauge in Victoria:

The following outlines the series of events over the past 150 years that has lead to the current rail position in Victoria.

- 1857–Broad Gauge Network developed (Geelong line)
- 1870's–Broad Gauge Network reached Wodonga, Portland, Colac and Sale
- 1880's to early 1890's–Many new branch lines constructed
- 1942–Broad Gauge network reached a maximum size of 7668 route kilometres
- 1950's to 1960's–Many of the smaller branch lines were closed
- 1962–Albury to Melbourne standard gauge railway opened
- 1995 –Melbourne to Adelaide, Portland, Hopetoun and Yaapeet lines in Western Victoria converted to standard gauge
- 1999 –Sale of the Primary Infrastructure Lease for the Victorian Regional Rail Network to Rail America
- 2001 –Attempt to standardise 2000 km of broad gauge network collapsed after failure to

reach agreement with Rail America (Trading as Freight Australia)

- 2007 – Victorian State Government buy-back of the Primary Infrastructure lease for the Regional Rail Network
- Present – There is currently 3675 km of broad gauge regional network, and 454 km of standard gauge regional network in Victoria (not including interstate lines and metropolitan lines)

3. Project Overview:

The Wodonga Rail Bypass Project (WRB), as outlined below in Figure 3.1, involves a major deviation of the main southern railway at Wodonga to bypass the central business district (to the north of the city). The station facilities would be relocated along the new route, with the new railway station located on a separate broad gauge rail loop. The station would be positioned near the Melrose Drive entrance to the Hume Freeway.

The trackwork for the combined standard gauge / dual gauge design consisted of the following main elements:

- 4.9 km of new standard gauge track (Eastern Line)
- 5.2 km of new dual gauge track (Western Line)
- 1.1 km of new broad gauge track (Station Loop)
- 3 dual gauge turnouts (ARTC 1in 8 Type Approved Turnouts)
- 1standard gauge turnout (190m, 1in 9 Turnout)
- 1crossover infill panel (standard gauge/dual gauge combination)

Site Plan:

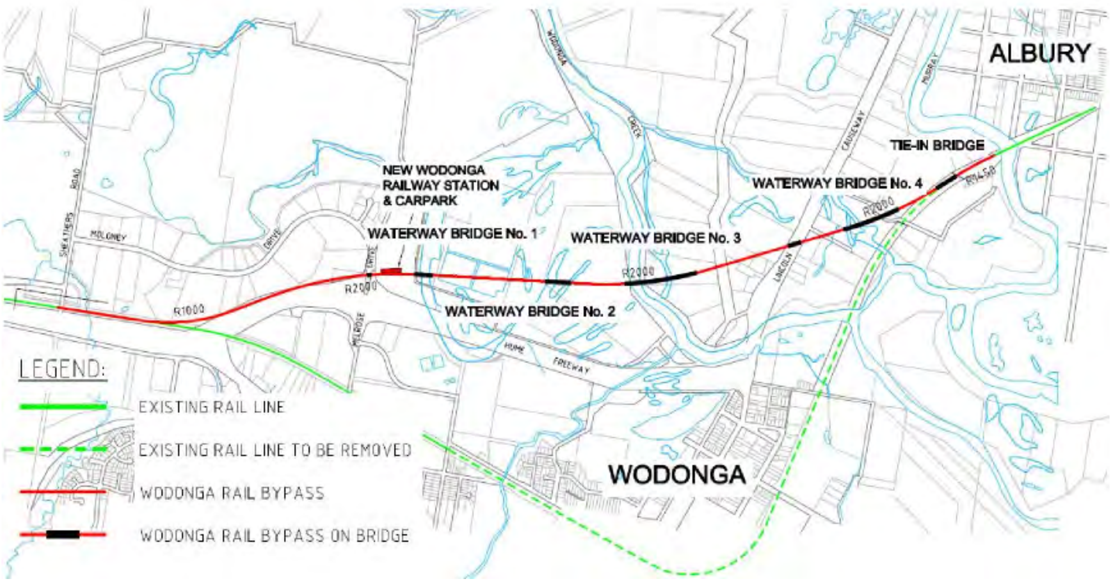


Figure 3.1: Wodonga Rail Bypass Site Plan

4. Track Structure and Materials

Eastern Line

The track structure for the new standard gauge mainline was to include 60 kg rail on 30 tonne rated concrete sleepers with resilient fasteners. The minimum ballast depth was set at 250 mm minimum with 300 mm depth on bridge decks. The operating speeds for the design were 130 kph for

T1traffic class (XPT) and 80 kph for T3 traffic class (freight trains with an axle load less than or equal to 23 tonnes), as set by ARTC.

Western Line

The track structure for the new dual gauge mainline included 50 kg rail on 25 tonne rated dual gauge concrete sleepers (canted type) with resilient fasteners. The minimum ballast depth was 250 mm minimum with 300 mm depth on bridge decks. The operating speeds for the design were 130 kph for T1traffic class (XPT) and 80 kph for T3 traffic class (freight trains with an axle load less than or equal to 23 tonnes) and 80 kph for all broad gauge movements, as set by ARTC.

Station Loop

The track structure for the new broad gauge rail loop included 50 kg rail on 25 tonne rated gauge convertible concrete sleepers (canted type) with resilient fasteners and 250 mm minimum ballast depth over formation and 300 mm depth on bridge decks.

Turnouts

The following ARTC type approved turnouts were used in this design:

Dual Gauge 1in 8 Turnouts

ARTC 50 kg HH (Head Hardened) designs for 1in 8 Types 29, 39 and 40 respectively on concrete bearers with modified cant reducing sleepers.

Standard Gauge 1in 9 Turnout

VAE 60 kg HH design for standard 190:9 Tangential Turnout on concrete bearers.

Crossover InfillPanel

10m curved track panel (200m Radius) consisting of 60/50 kg HH welded rail junctions on concrete flat ties with cast-in shoulders and HDPE pads.

5. Dual Gauge Design on Concrete Sleepers:

Unlike previous dual gauge designs, this design was not permitted to be built on conventional timber sleepers. ARTC specified that the dual gauge component of the track was to be constructed using the Austrak type approved concrete sleeper as shown in Figure 5.1. The Austrak sleeper was originally designed as a gauge convertible sleeper. It was intended for use in areas where the broad gauge network could be upgraded to concrete sleepers with the option of converting the track to standard gauge at a later stage. The sleeper has the flexibility of holding a single rail or double rail configuration as shown in Figure 5.1. The sleeper contains a unique "wine glass" locking system which is imbedded in the coplanar 1in 20 rail seat. The locking system enables a Pandrol E-Clip (E1821) to be used when two rails are held in position, or a Pandrol Fast Clip (FC1501) to be interchanged when the sleeper is to be used as a gauge convertible sleeper. This system is very different to the conventional dual gauge sleeper design on timber sleepers. The conventional design can only be used as a dual gauge sleeper, as the rail feet are staggered in a saw tooth arrangement as shown in Figure 5.2.

The sleeper, although quite attractive for gauge convertible application, has limitations when used as a dual gauge sleeper. As demonstrated in Figure 5.1 the rail seat is coplanar, whereby both rails are seated on the same 1 in 20 grade, placing the broad gauge rail 8.7 mm proud of the standard gauge rail when the sleeper is flat. The sleeper is arranged in such a way that the deficiency of the 8.7 mm is spread between the two gauges. This means that when the sleeper is flat the standard gauge rail sits 4.35 mm lower than the common rail and the broad gauge rail sits 4.35 mm higher than the common rail. This positive and negative deficiency did not create any significant issues on straight track, however issues surfaced when designing tight radii curves (less than 1500 m) on the mainline sections.

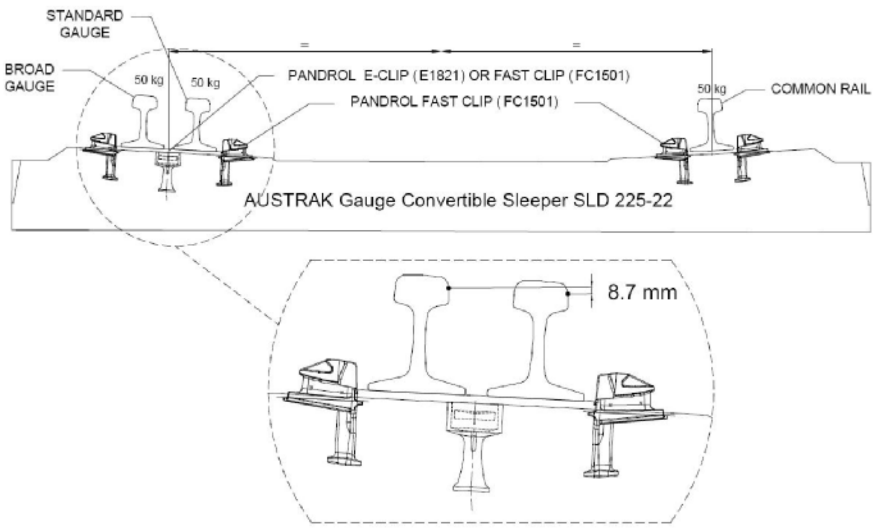


Figure 5.1: Austrak Dual Gauge/ Gauge Convertible Sleeper with zero Superelevation

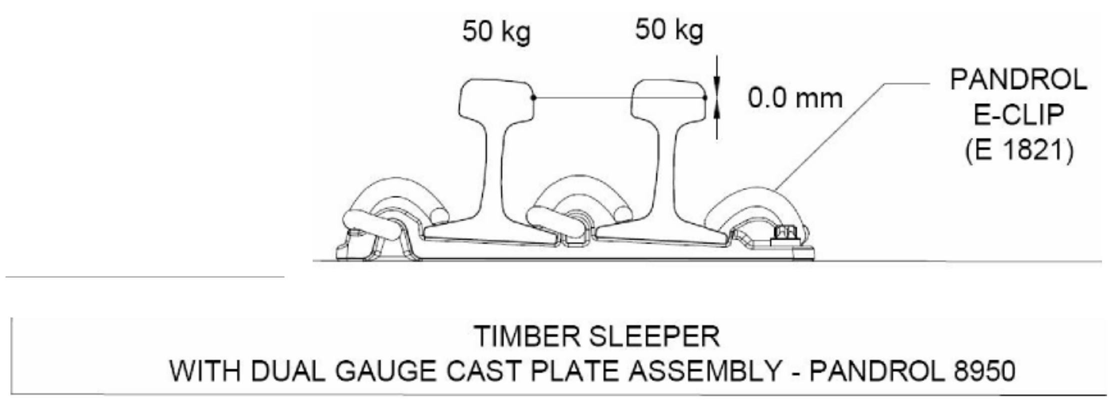


Figure 5.2: Conventional Tiber Sleeper with Dual Gauge Base Plate

Tight Radii Design on A ustrak Sleepers

The Austrak gauge convertible sleeper, in a dual gauge arrangement, causes some difficulties when used in tight radii design. The alignment corridor for the Wodonga Rail Bypass was determined in the year 2001. At that time, the design was to consist of a single standard gauge track with a station loop and the provision for a second standard gauge track which would be

added at a later stage. The corridor required a 1000 m radius at the west end of the alignment and 1500 m radius at the east end of the alignment. The dual gauge alignment was required to cater for the operating speeds of 130 kph for standard gauge movements, and 80 kph for broad gauge movements. Speed on the broad gauge component of the dual gauge track was limited to 80 kph by ARTC, as there were concerns that if a brake block was to dislodge from a train, it could become wedged between the broad and standard gauge rails. This obstruction could potentially derail a broad gauge train if travelled upon at speeds greater than 80 kph (as noted in the risk assessment by ARTC).

The superelevation and transition length design was based on the ARTC Track and Civil Code of Practice (CoP) (1) for the standard gauge track and the PTC Standards (2) for the broad gauge track. Based on the ARTC CoP deficiency limit, a minimum of 90 mm superelevation is required over the standard gauge rails to maintain a speed of 130 kph around the 1000 m curve on the west end of the project. The 90 mm superelevation on the standard gauge line provided a deficiency of 109 mm, 1 mm below the maximum of 110 mm. As demonstrated in Figure 5.3 below, when 90 mm superelevation is applied between the common rail and the standard gauge rail it equates to 109 mm superelevation on the broad gauge rails. This level of superelevation was of concern as the PTC Standards specify a maximum applied superelevation of 100 mm over the broad gauge rails. This meant that we could not apply the 90 mm to the standard gauge rails as it exceeded the broad gauge superelevation requirements.

There were two ways in which the issue could be resolved, as described in the two options outlined below.

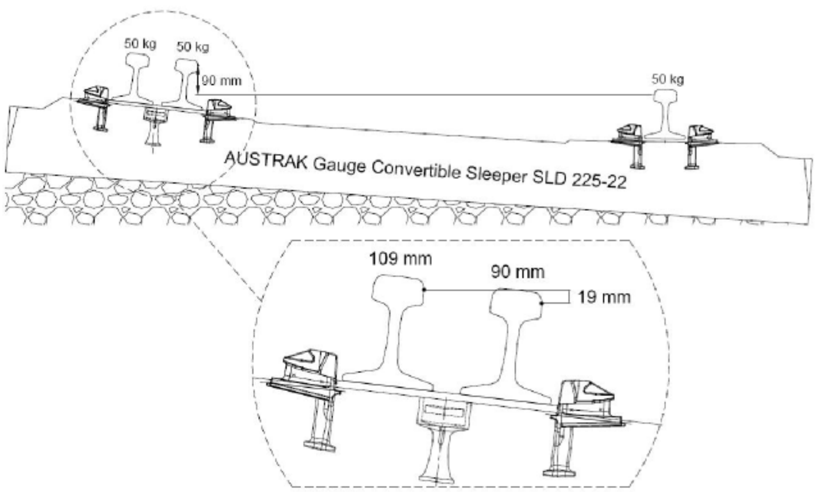


Figure 5.3: Austrak Dual Gauge/ Gauge Convertible Sleeper with 90 mm Superelevation Over the Standard Gauge Rails

Option 1

Option 1 looked at transferring the common rail to the opposite side, and was considered as it would favour the direction of the curve. Due to the coplanar rail seat, when the common rail is raised above the dual gauge rails, the difference in levels is offset. At 90 mm superelevation this results in the dual gauge rails sitting virtually flat (0.52 mm difference). In order to change the side of the common rail, a kinematic analysis based on the rolling stock outline F (1) had to be conducted on the Murray River Bridge. An additional survey was obtained to show the extent of the bridge structure and track centres. The survey confirmed that the existing track centres over the bridge were at a minimal spacing of 3600 mm and the bridge structure was within the kinematic envelope. As shown in Figure 5.4 if the common rail is shifted from one side to the other it reduces the track centres by 160 mm (1600 mm – 1435 mm) to 3440 mm over the bridge, which is

unacceptable by all standards.

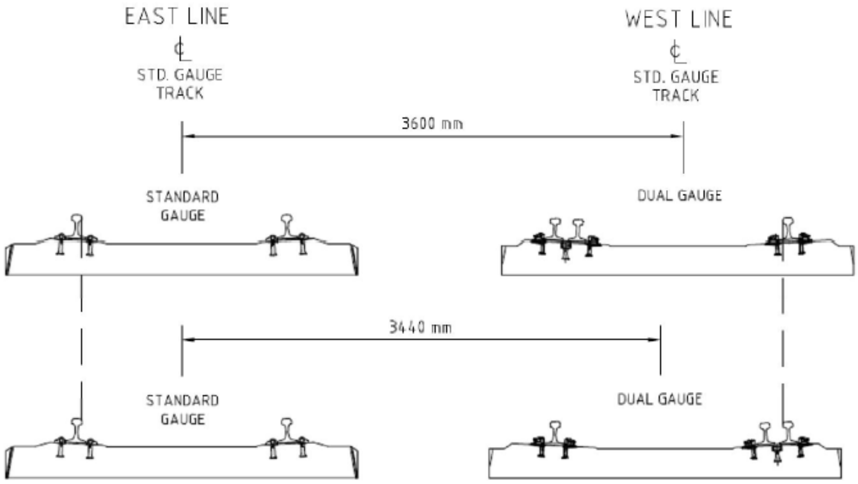


Figure 5.4: Track Centre Comparisons over the Murray River Bridge

Option 2

The second option looked at reducing the speed through the 1000 m radii curve to 125 kph for standard gauge trains. The superelevation design could then be altered to 80 mm of superelevation over the standard gauge rails, which proved satisfactory. This reduction in superelevation over the standard gauge rails corresponded to 98 mm of superelevation over the broad gauge rails, 2 mm within the PTC maximum. Option 2 proved to be the only viable option due to close track spacings over the Murray River Bridge. The detailed design incorporated the reduced speed limit with appropriate speed boards to ensure standard gauge trains on the dual gauge track did not exceed 125 kph.

6. Dual Gauge Turnouts Design on Concrete Sleepers

The Wodonga Rail Bypass was to be one of the first projects to incorporate the ARTC type approved dual gauge turnout on concrete sleepers. All previous applications of dual gauge turnouts in Victoria had been constructed on timber bearers. The first issue, which was discovered with the turnout, occurred over the cant reducing plates. The turnout design current at the time of design contained three cant-reducing sleepers with cant reducing plates in a saw tooth arrangement as demonstrated in 5.2 above.

The issue arises when incorporating the concrete sleeper with the saw tooth cant reducing plates. As discussed above, the concrete sleeper contains a coplanar rail seat which places the two gauges at different heights. Over a recommended sleeper spacing of 670 mm (1500 sleepers per kilometre) the broad gauge rail is required to drop 4.35 mm and the standard gauge rail is required to lift 4.35 mm to fit into the saw tooth arrangement. This creates a twist in the two rails and effectively creates a very steep superelevation ramp. The ARTC CoP (1) specifies a maximum superelevation ramp of 1 in 300. The current cant reducing design was encouraging a superelevation ramp of 1 in 154 which was not acceptable. Two options were developed to cater with the 4.35 mm step, as discussed below.

Option 1

After discussions with Austrak it was clear that the current sleeper seat design could be re-designed for application in the cant reducing sleepers. It was proposed to ARTC that Austrak could modify the current sleeper design and produce three new sleepers with a coplanar rail seat with an angle of 1 in 30, 1 in 40, 1 in 80 and flat as demonstrated in figure 5.5 below.

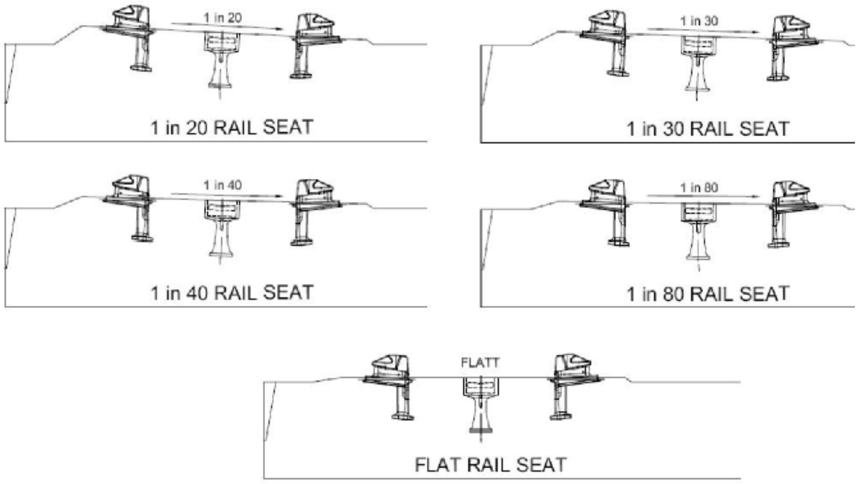


Figure 5.5: Proposed Cant Reducing Sleepers at Turnouts Option 1

Option 2

The second option, as shown in Figure 5.6 below, involved manufacturing a plate which could be bolted to a flat concrete sleeper or timber sleeper. It involved the same theory as option 1above, whereby the rail seat would be made coplanar and not saw tooth as seen in the original design. The transition rates were also to be 1in 30, 1 in 40, 1 in 80 and Flat.

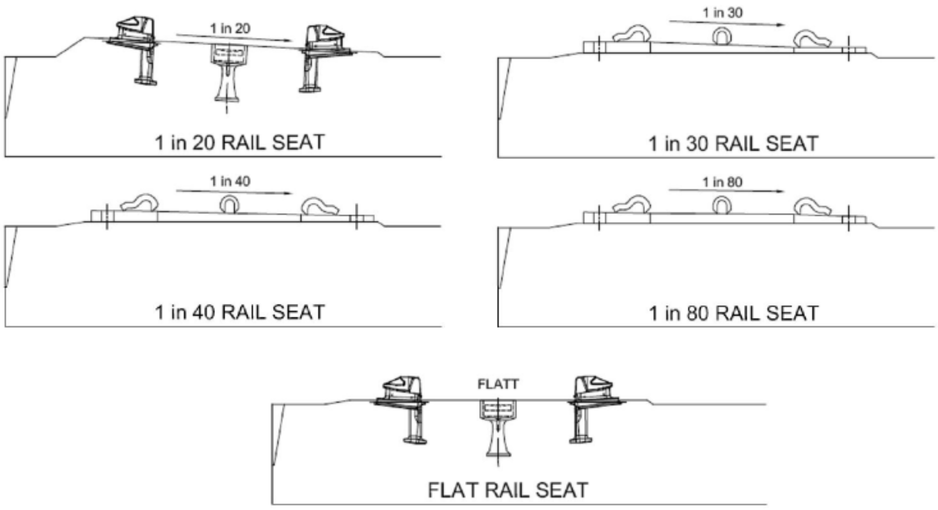


Figure 5.6: Proposed Cant Reducing Sleepers at Turnouts Option 2 (TKL Design)

The design of the cant reducing plates in the dual gauge turnouts has now been modified, as a result of these findings. Option 2 was adopted and the ultimate configuration for this design, as shown in Figure 5.6, was detailed by TKL.

7. ARTC Type Approve Dual Gauge Turnouts:

At the time of the design only four dual gauge turnouts were type approved by ARTC for use in the Victorian network. These turnouts were the 1in 8 Type 29, Type 30, Type 39 and Type 40. There are several general limitations to the current dual gauge turnout design. Unlike modern single gauge turnouts, dual gauge turnouts do not have the physical room to use tangential points and as a result there is no option but to construct the turnout using pivot heels. This creates a series of maintenance issues which are not discussed in this report. One major issue related to the turnouts was revealed when mixing standard and dual gauge turnouts in crossovers, and is discussed in detail below.

The design scope included one crossover located at the west end of the alignment. Unlike conventional crossovers, which consist of two similar turnouts and an infill panel, this crossover consisted of a 200 m 1in 9 standard gauge turnout (60 kg HH) and a 1in 8 dual gauge turnout (50 kg HH). This meant that the 1 in 9 angled turnout had to match tangentially to a 1 in 8 angled turnout over a track spacing of 4.5 m. The difference in turnout angles equates to a 0.785° kink when the turnouts are butted up to one another. This change in angle was considered too severe, and thus a solution had to be found to overcome this problem in the design. The 4.6 metre track spacings gave the design some flexibility by providing a sufficient length of straight rail between the turnouts to allow a large enough radius to be filleted between the changes in angle. The final design consisted of a 200 m radius in the centre of the infill panel. As the design was proposed on concrete sleepers, a new set of shop drawings would be required to position the fasteners in the correct position on the long bearers, catering for the 200m radius and junction rails (50 kg to 60 kg) located on the infill panel.

Since the design of the Wodonga Rail Bypass, GHD (including the author of this paper) has been working with ARTC to type approve several further combinations of the dual gauge turnouts. These include the Type 24, 27, 28, 34, 82 and 82A turnouts.

8. Conclusion

In conclusion, this reporthas given an assessment of the practicalities of dual gauge design when using concrete sleepers as opposed to the traditional timber sleepers. In particular, issues such as speed restrictions and superelevation deficiencies demonstrated the degree of difficulty in designing on the Austrak Concrete sleeper. The report also emphasises the complexity of dual gauge design, and demonstrates the difficulties of working with two different standards of operating conditions over the same section of rail. As such, while it may be sometimes necessary to incorporate a dual gauge design, in future rail projects it would be of benefit to consider gauge standardisation in order to avoid such design issues and the potential for derailments and maintenance problems that could arise.

9. References

1. "ARTC Track & Civil Code of Practice (CoP)" Track, Civil and Electrical Infrastructure Issue 1, Revision 3, 2007
2. "MetRail Track Design Manual", PTC Track Design Standard, January1986

APPENDIX F: TECHNICAL PRESENTATION

CLIENTS | PEOPLE | PERFORMANCE

Dual Gauge (Standard and Broad Gauge) Turnouts

Presenter: Damian Brizzi

CLIENTS | PEOPLE | PERFORMANCE

Overview

- History of Broad and Standard Gauge in Victoria
- Recent Project - Wodonga Rail Bypass
- Dual Gauge Design on Concrete sleepers
- Independent Design Check on Dual Gauge Turnouts for the Victorian Network
- Dual Gauge Turnout Maintenance
- Summary

In his visit to Australia in the late 19th Century Mark Twain made his famous comment on experiencing at first hand the difference in rail gauges between NSW and Victoria:

“What paralysis of intellect came up with this!”

This presentation looks at approaches that address these issues.

CLIENTS | PEOPLE | PERFORMANCE

History of Broad and Standard Gauge in Victoria

- 1857 - Broad Gauge Network developed (Geelong line)
- 1942 - Broad Gauge network reached a maximum size of 7668 route km
- 1962 - Albury to Melbourne standard gauge railway opened
- 1995 - Melbourne to Adelaide, Portland, Hopetoun and Yaapeet lines converted to standard gauge
- 2001 - Attempt to standardise 2000km of broad gauge network failed
- Present - There is currently 3675 km of broad gauge regional network and 454 km of standard gauge regional network in Victoria (not including interstate lines and metropolitan lines)

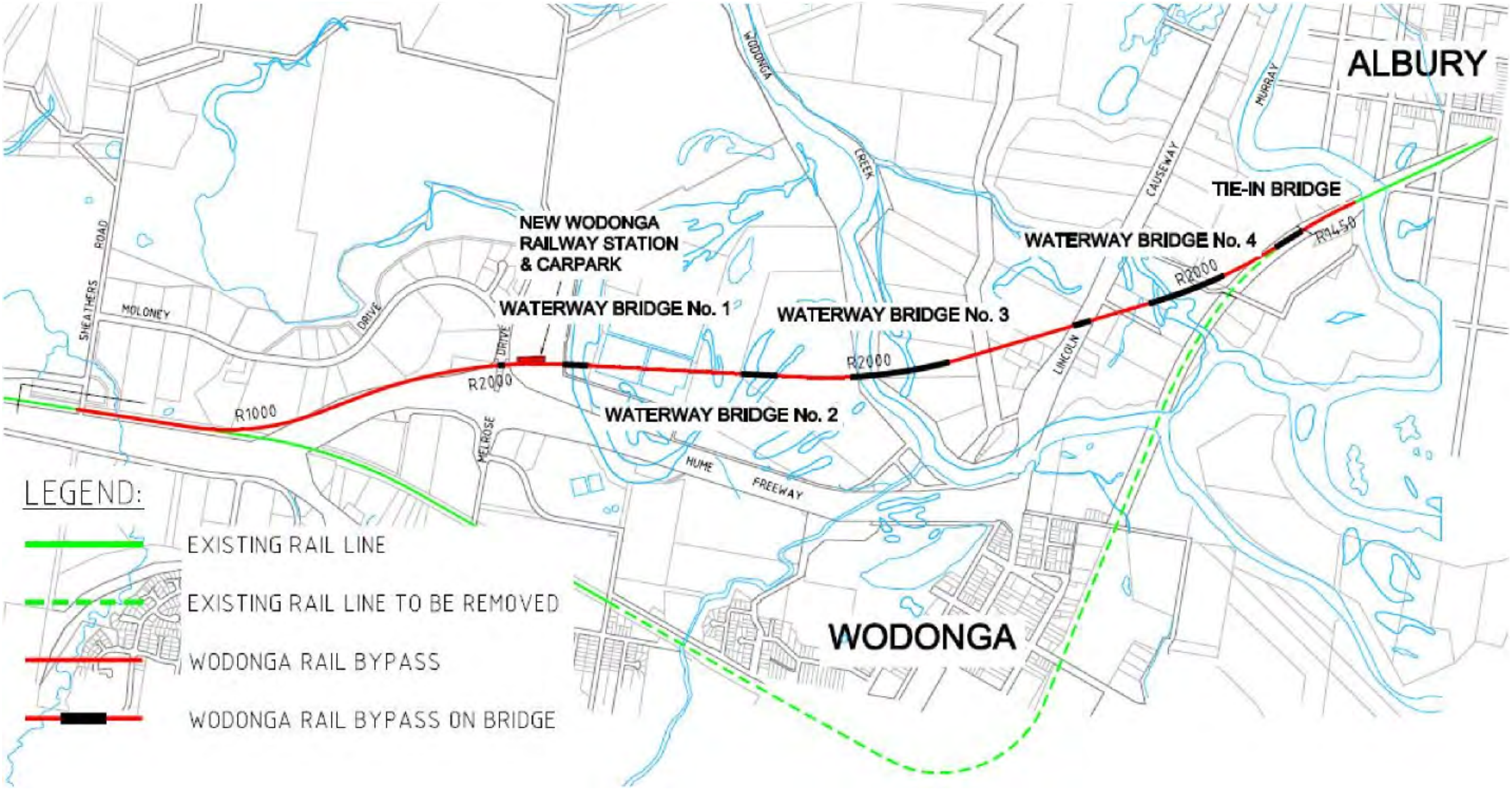
Future –Gauge standardisation wherefeasible

Recent Project - Wodonga Rail Bypass

Major deviation of the main railway at Wodonga to bypass the central business district.

- 5.2 km of new dual gauge track
- 9 km of new standard gauge track
- broad /standard gauge cross over
- dual gauge turnouts

Wodonga Rail Bypass Site Plan



CLIENTS | PEOPLE | PERFORMANCE

Wodonga Rail Bypass

Dual Gauge Design on Concrete sleepers

Austrak Dual Gauge Sleepers were to be used in the design (the only ARTC type approved D/G Sleeper)

Sleepers originally designed as gauge convertible sleepers

Unlike dual gauge timber sleepers, the rail seat is co-planar

Due to minimal spacing between rail feet (19mm) only 50 kg rail or smaller canbeused on the concrete sleepers

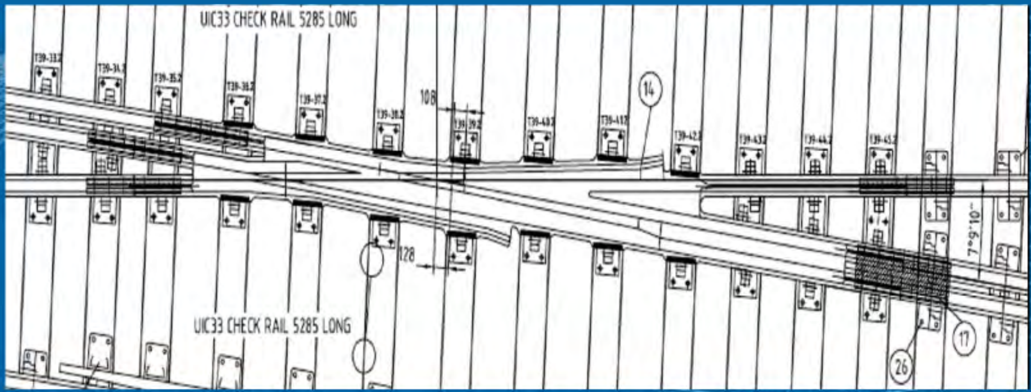
Design constrains included:

- Broad gauge trains limited to 80 kph, standard gauge trains 130 kph
- Cant deficiency issues between the two gauges –standard gauge at 90 mm cant equals 109mm on the broad gauge
- Additional cant reducing plates required in transition zones at turnouts (5 as opposed to 3 on single gauge

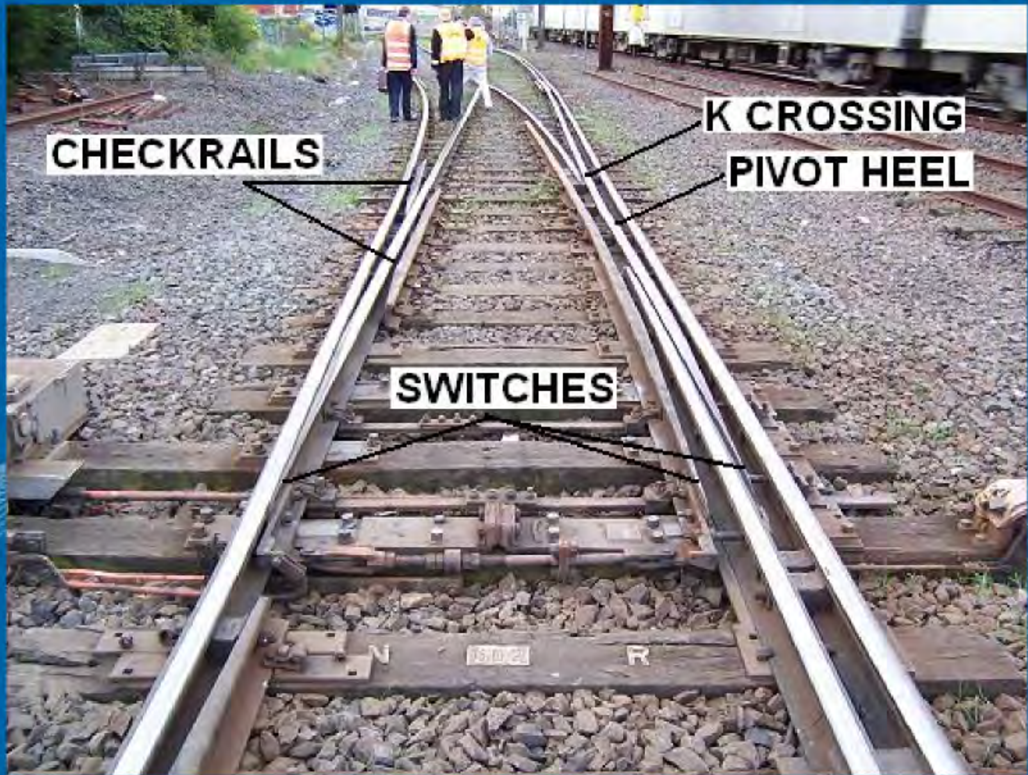
Crossovers

- Currently ARTC has only one type of dual gauge turnout type approved (At present gauge splitters are not type approved)
- They are the 1in 8 Type 29,30,39,40 AN Design (50 kg)

  At crossovers, 1in 8 dual gauge turnouts are required to match a 1in 9 standard gauge turnout
- This is achieved through 4.5 m track centres and a intermediate radius of 200 m



Independent Design Check on Dual Gauge Turnouts for the Victorian Network



The turnout used in the case study has caused 3 derailments in recent times

– Study was undertaken and found that worn standard gauge wheels strike the nose of the “K”crossing on the straight movement

– Independent check demonstrated that line speed was not safely achievable through the turnout

GHD CLIENTS | PEOPLE | PERFORMANCE

Dual Gauge Turnout Maintenance

- Unlike single gauge turnouts you have 3 blades to maintain
- Dual gauge turnouts contain pivot heels which get nocked and wear out quickly
- Pivot heels prevent smooth entry into "K"crossing resulting e nose of the "K" crossing being hit
- Check rails guide the broad gauge movement through the straight and diverge causing excessive wear on the entry to check rails
- Normal wear on check rails limited to 3mm, this results in the broad gauge wheel fouling the nose of the "K" crossing

Very experience maintenance personnelrequired to undertake any work on the dual gauge turnouts

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Summary

Gauge difference in Australia has been an issue since the early 18 hundreds

There are ways in which dual gauge can be managed

Dual gauge components (standard and broad) result in speed and operating restrictions

The future of heavy rail in Victoria will rely on gauge standardisation