LONGER BUSES IN NEW ZEALAND – UNLOCKING INNOVATION

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ABSTRACT

In 2004 Transit New Zealand reported on a small study to consider the economics of possible limit changes to passenger service vehicles, with two scenarios being considered. These included a possible length increase from the current 12.6 m maximum to 14.5 m. The study indicated that this was a feasible option provided no axle mass increase was involved.

In March 2004 the New Zealand Minister of Transport advised transport sector agencies of a new initiative to consider relatively minor changes to heavy vehicle limits. He suggested that by unlocking innovation, different limits for passenger service vehicles could be considered that would improve passenger transport. Government transport agencies then set about developing a process for evaluating applications against the objectives of the New Zealand Transport Strategy. Bus and coach and tourism operators were invited to propose specific concessions, and proposals were processed for longer tour and inter city coaches that would provide benefits to tourism. These vehicles would be 3 axle rigids up to 14.5 m long, featuring a steered rear axle to reduce off-tracking. Use was made of internationally recognized performance-based measures to assess the impact, including both desktop comparisons and physical trials. Consultation with affected road controlling authorities took place. It was concluded that increased length could be permitted by exemption up to 13.5 m, and up to 14.5 m with prior approval from affected road controlling authorities.

Approvals to import and build have been granted for new 13.5 m tour and inter-city coaches. These vehicles will incorporate low emission engines, advanced braking systems, electronic stability and traction control, spray suppression, speed limiters, and driver training.

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1 INTRODUCTION

At the 8th International Symposium in March 2004 Transit New Zealand (Transit) reported on a small study to consider the economics of possible limit changes to passenger service vehicles, with two scenarios being considered (Sleath and Pearson, 2004). These included a possible length increase from the current 12.6 m maximum up to 14.5 m. The study indicated some merit in increasing length, particularly in urban areas, but signalled the substantial negative impact of higher axle mass limits on the entire road network. It was known that local government in New Zealand was particularly concerned about proposals to increase axle mass limits.

1.1 Government Initiative

In March 2004 the New Zealand Minister of Transport advised transport sector agencies of a new initiative to consider relatively minor changes to heavy vehicle mass and dimension limits. He expressed a desire to encourage passenger transport and multi-modal freight journeys, while at the same time unlocking innovation and productivity gains and improving the use of road infrastructure.

The Minister indicated his support for some relaxation of the current limits where outcomes favourable to the New Zealand Transport Strategy (NZTS) (New Zealand Government, December 2002) were indicated, and suggested different limits for passenger service vehicles.

Government transport agencies then set about developing a process for evaluating applications against the objectives of the NZTS. Those objectives include: assisting economic development; assisting safety and personal security; improved access and mobility; protecting and promoting public health; and ensuring environmental sustainability. An overall positive contribution to the NZTS was a condition of approval.

1.2 Mini Review

Road transport industry groups were advised of the government's initiative, which became known as the "Mini Review", and proposals were invited that could comply with the Minister's outline. A template was developed to objectively assess possible options against government policy and screen candidate vehicles, and a short list of possible vehicles was identified. Industry association representatives were then invited to propose specific concessions. In the case of passenger service vehicles, the Bus and Coach Association New Zealand (BCA) presented three generic proposals including:

- heavier mass for school/charter buses;
- higher axle mass and overall length for urban buses; and
- increased length for tour and inter-city coaches.

1.3 General Approach

The general approach was innovative in that strict adherence with the generally accepted suite of performance based standards (PBS) levels was not required. The use of PBS as a 'toolbox' to assess the safety risk and infrastructure impacts that might ensue from increased limits was suggested by the agencies. However, of greatest importance was the overall impact on achieving the objectives of the NZTS.

Therefore, for the purpose of the initial analysis it was accepted that there would be some reduction in the safety margin associated with the cases of increased length and/or wheelbase and/or rear overhang on passenger service vehicles, but this was not necessarily a debilitating factor. It was also acknowledged that the requirement of other safety initiatives could offset that reduction in safety, and consequently there could be a net safety gain.

A detailed evaluation methodology was developed and documented as an information circular by the government agencies (Kalasih and Sleath, 2004). This covered the process and assessment that would lead to the formal granting of exemptions.

2 INDUSTRY PROPOSALS

In its initial submission to the Mini Review, the BCA presented an argument that longer buses and coaches should be permitted to operate on New Zealand roads, perhaps up to the European length limit of 15 m with three axles. This would allow the latest European chassis to be used by local coachbuilders, and permit extra luggage space and/or more legroom for tour parties of up to 53. Coaches would be 3 axle 6 x 2 with a single large steer tag axle. The tag axle would be steered by hydraulically monitoring and transferring movement off a front steer wheel whenever it exceeded a deflection of 5º. Coaches would not exceed the legal width limit of 2.50 m, or the legal mass limits on any axles.

Currently New Zealand regulations allow a maximum overall length of 12.6 m, and a maximum rear overhang of 4.25 m if the rear axle is steering (4.0 m if not steering).

With the addition of the steer tag axle, the industry suggested that vehicles would comply with the Land Transport NZ swept path requirement of 25 m wall-to-wall turning circle, and the EC standard for tail swing. The additional length would be mainly in the inner wheelbase (up to 7.02 m compared with 6.255 m for typical 12.6 m coach), and some minor increase in front and rear overhang.

Vehicles would feature Euro 3 compliant engines (this was not a requirement in NZ at that time), electronically controlled braking (EBS), electronic stability program (ESP) that minimizes the risk of skidding and overturning, and traction control to prevent drive wheels from slipping during acceleration. Speed limiting to 90 km/h was also suggested. The industry also indicated its willingness to provide additional safety features such as seat belts, and to introduce driver training covering the special features of these vehicles.

3 ASSESSMENT METHODOLOGY

In the case of longer passenger service vehicles, government officials made it clear that the chief issue of concern was the impact of the additional length/wheelbase on cornering in urban areas by encroaching into adjacent traffic lanes (“low speed off-tracking”), and the performance of the vehicle at bus stops and transport termini due to increased rear overhang (“tail swing”). Officials suggested a desktop simulation, together with road tests using a vehicle mock-up with the appropriate axle configuration and rear overhang, and paint and video techniques. The study and tests would need to examine the pros and cons of differing axle spacing and overall length (e.g. 13.5 m and 14.5 m) and configuration (e.g. with/without steering tag axle).

The BCA, together with representatives from manufacturers Volvo, Scania, and MAN, combined to engage Dr John de Pont of Transport Engineering Research New Zealand (TERNZ) to assess the risks and impacts of operating overlength buses on public roads.

The proposal was to allow 14.5 m overall length and a maximum rear overhang of 5.1 m with a rear steering axle, and the testing programme was primarily aimed at determining the implications of changing to these dimensions limits. However, because the industry was unable to determine in advance what would constitute satisfactory performance, a second option of increasing the overall length to 13.5 m was also considered.

Testing, both on and off road, was performed and observed by industry representatives, government officials, and road controlling authorities in Auckland in April 2005 (De Pont, 2005).

4 DESKTOP SIMULATION AND OFF ROAD TEST

Titan Plant Services (the New Zealand distributor for Volvo) made available a computer package developed for calculating the path of a vehicle through a turn and hence compliance with regulatory requirements. The two proposed configurations were evaluated using this software, and compared with various configurations that are allowed under the current New Zealand regulations.

An off road test in a parking area was undertaken to validate the computer simulation by replicating the standard manoeuvre that was used in the software package. The main aim of this test was to show that the software accurately reflected the performance of the actual vehicle. A 3 axle rigid truck that closely approximated to the proposed wheelbase and rear overhang was utilized, with a frame fitted to replicate the additional dimensions as shown in Figure 1. The vehicle was driven around a marked 12.5 m radius turn at low speed, and the paths of the front and rear corners marked by two sprayer units using water-based paints.

Figure 1. Test Vehicle.

Measurements were taken of tail swing as defined by the maximum separation between the two spray trails (Figure 2). This procedure was performed with rear overhang at 5.1 m (14.5 m bus) and at 4.1 m (13.5 m bus). It was then repeated using two 12.6 m coaches (a Scania with fixed tag axle and a Volvo with steered tag axle).

Figure 2. Tail swing measurement.

The tail swing measurements from the off road test were then compared with the desktop simulation, and the match was found to be very good (maximum difference 6.5%). This confirmed the accuracy of the computer programme to predict low speed turning behaviour of these vehicles.

Table 1 shows the results from the computer simulations of the various vehicles.

Table 1. Results of computer simulation

Vehicle type	Overall length	Wheelbase	Rear overhang	Tail swing	Street width
Scania 3 axle test vehicle – no rear steer	12.6 m			176 mm	4875 mm
Volvo 3 axle test vehicle – rear steer axle	12.6 m			165 mm	4897 mm
Current max. length 3 axle with rear steer	12.6 m	6.2 m	4.2 m	273 mm	4728 mm
Simulated test bus #1	13.5 m	7.6 m	4.1 m	237 mm	5083 mm
Design bus #1	13.47 m	7.02 m	4.14 m	246 mm	5061 mm
Simulated test bus #2	14.5 m	7.6 m	5.1 m	449 mm	5083 mm
Simulated test bus #3	14.5 m	8.1 m	4.6 m	323 mm	5246 mm
Design bus #2	14.5 m	7.1 m	5.1 m	449 mm	5077 mm

Street width is equivalent to the sum of the low speed off-tracking and the vehicle's width, and reflects the kerb-to-kerb performance. A 12.5 m radius wall-to-wall turn was used.

5 ON ROAD TEST

Stakeholders were invited to observe and comment on the road test. This involved a non-quantitative test where the mock-up vehicle was compared and observed with the two legal length buses during a set of four typical manoeuvres over a 4 km bus route in urban South Auckland (Figure 3) involving 90 degree turns, a small radius roundabout, and exiting a bus stop. This was recorded on video. One of the manoeuvres is shown in Figure 4.

Figure 3. Road test route.

Figure 4. Exiting a bus stop.

6 CONCLUSIONS

6.1 Computer simulation

The 14.5 m simulated bus has a tail swing of about 450 mm that compares with values between 160 mm and 180 mm for some existing coaches. The existing coaches tested were not at the legal maximum dimensions and a simulated maximum dimension bus has a tail swing of just over 270 mm. Thus the proposed 14.5 m bus with a 5.1 m rear overhang will have a tail swing that is about 180 mm greater than the largest existing buses. Reducing the overall length to 13.5 m and the rear overhang to 4.1 m reduces the tail swing to just less than 240 mm that is less than the existing maximum dimension vehicle. In practice a 13.5 m long bus may require a greater rear overhang than this in order to achieve the correct axle weights. From the results it can be seen that a rear overhang of, say, 4.6 m would be likely to generate a tail swing of around 300 mm.

As the buses are 2.5 m wide the street width requirement can be converted to low speed off-tracking by subtracting 2.5 m. For the 14.5 m simulated test bus and for the 13.5 m simulated bus with the shorter rear overhang, this means that the low speed off-tracking is just less than 2.6 m. For some of the larger combination vehicles allowed on New Zealand roads such as 18 m tractor semi-trailers and 20 m B-trains the typical values of low speed off-tracking are in excess of 4m. Thus the road width requirements of these longer buses are still significantly less than the largest vehicles currently allowed on New Zealand roads.

6.2 On road test

Whilst the road test was only qualitative, it did serve to demonstrate that the longer vehicle could be accommodated reasonably well on a typical bus route without encroachment into adjacent lanes. Although the longer bus required a small amount of additional road space on the left turn compared to the standard vehicles, this was still well within the space available. On the right turn and the roundabout traverse there was no obvious difference between the space requirements of the longer bus and the standard vehicles. The slightly increased tail swing observed at the bus stop exit partly reflected the severity of the manoeuvre that was not normal driving practice. In normal circumstances the additional encroachment across the kerb would be smaller than was observed.

7 IMPLEMENTATION

7.1 Consultation

The decision to allow a length dispensation was dependent upon satisfactory consultation with affected road controlling authorities. These included Transit itself for the 10,500 km of state highways, and the Road Controlling Authorities Forum (representing the majority of local government agencies) for the remaining 82,000 km of local roads. There was no objection to travel upon main roads, however, some concerns were expressed about bus parking areas and roadside furniture in urban areas. It was decided to make any approvals for 14.5 m buses contingent upon the applicant obtaining prior approval from affected road controlling authorities. In the case of 13.5 m vehicles it was concluded that no such restriction was necessary.

7.2 Policy Paper

A policy paper covering the results and conclusions from the trials was developed by Land Transport NZ and Transit (Kalasih and Sleath, 2005) and circulated to bus and coach industry specialists (importers, body builders, and operators) in April 2005. The purpose of this initial consultation was to capture and agree the scope of possible concessions, including any limitations and conditions.

In particular, the coach would have three axles with the rearmost axle a steering axle to mitigate the effects of the length increase on manoeuvrability, and ensures the vehicle has superior performance compared to a freight truck towing a trailer. The style of coach proposed aligns to those used in Australia and Europe i.e. lower emissions, lower fuel use per passenger kilometre travelled, together with added comfort levels to boost tourism, and higher levels of safety due to speed limiting, ABS braking, traction control, stability control, seat belts and rear vision equipment. These features would be included in any formal exemption.

The policy paper received a favourable response from the industry, and was supported by the Ministry of Transport because it met the Minister's desire for this type of innovation to be unlocked as it fitted well under the NZTS. Most interest was with coaches going to 13.5 m. The demand was estimated to be in the order of 10 new coaches per year.

7.3 Approval Mechanism

The findings from the assessments, including the field trials, were presented to the Director of Land Transport NZ in July 2005, and delegation to officials to approve length increases was obtained. A pro-forma document covering formal application to operate a longer bus was produced and distributed to the industry in August 2005 (Land Transport NZ, 2005). The Vehicle Certification Unit of Land Transport NZ will process applications for increased overall length and rear overhang under Section 166 (1) of the Land Transport Act 1998.

7.4 Industry Response

Since the announcement of the decision to grant length dispensations in August 2005 there have been two applications both covering 13.5 m tour coaches. The relatively narrow window of opportunity for construction prior to the 2005/06 summer tour season has probably limited the uptake somewhat, and the bus and coach industry may well be adopting a conservative approach until the commercial benefits have been fully evaluated.

8 EXAMPLES

The first vehicle approved and built under this project is shown in Figure 5. This 13.5 m Volvo B12 tour coach entered service in December 2005. Kiwi Bus Builders of Tauranga built it for Reesby's Motors of Rotorua. It seats 49 people with legroom that has been described as "like aircraft business class". With the steerable rear tag axle it operates on tight turns like a conventional 12.6 m vehicle, but with less pavement scuffing and tyre wear. It also features the latest low emission diesel engine, ABS braking, traction control, seat belts, and rear vision equipment.

A second coach with similar specification is currently completing construction for Hayward Coachlines.

Figure 5. Example of new longer tour coach.

9 ACKNOWLEDGEMENTS

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