IRTENZ

Technology 2000

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"THE HEAVY VEHICLE LIMITS PROJECT" AN OVERVIEW

Heavy Vehicle Limits in New Zealand – A New Approach

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ABSTRACT

New Zealand's economy relies heavily on its roading network to move its primary produce to ports for shipping to overseas consumers. The transport and export industry sectors have for some time called for a review of current vehicle weights and dimension limits in an effort to increase transport productivity.

This paper reports on a new project to investigate the safety and economic effects of altering heavy vehicle weight limits, either on the entire road network, or on a selected network of routes. Previous studies conducted by Transit New Zealand (Transit) between 1992 and 1996 and reported to the 4th and 5th Symposia have indicated that it is not feasible to upgrade the whole road network to accommodate substantially longer vehicles. The methodology used in this project has included examining the safety and bridge impacts of a spread of vehicle types and gross weight limits, refining the weight limit options, and ascertaining the costs of the associated geometric, pavement, and environmental impacts. These impacts are currently being included in an overall economic analysis. A final project report is expected in March 2000, and the Symposium presentation will cover the key findings from this report.

Preliminary results indicate that the freight benefits from altering vehicle weights and/or dimensions would outweigh the costs both for the entire road network and for a selected network. However, it appears that the implementation of any changes must be combined with a rationalisation of the charges levied on heavy vehicles together with the promotion of better performing combinations by the introduction of performance based standards.

The views expressed in this paper are entirely personal and should not be relied upon as representing those of Transit New Zealand or Government policy. The Government has not to date considered the issue of changing heavy vehicle mass and dimension limits.

1.0 INTRODUCTION

1.1 Background

New Zealand's economy relies heavily on its roading network to move its primary produce (e.g. timber, dairy, meat and wool) from rural areas to markets and to ports for shipping to overseas consumers. During the last 15 years there has been a noticeable increase in the number and use of heavy vehicles on the road network. Weight limits were last reviewed in 1988 and resulted in the adoption of the 44 tonne gross weight limit. Single axle, tandem, and tridem (triaxle) weight limits still lie somewhat below those of many countries, particularly New Zealand's main competitors for its export markets.

New Zealand has 92,600 km of roads of which 10,677 km form the national state highway system which is managed by the government agency Transit New Zealand (Transit). This roading network has to be supported by a population of only 3.5 million people whose resources are already stretched to provide other essential services such as health and education to a population dispersed over a land area roughly the size of the United Kingdom. However, the economy still has a large rural component which is almost entirely dependent on road transport, so the roading infrastructure has to be preserved.

Much of New Zealand's roading terrain is hilly or mountainous which requires considerable bridging, costly maintenance and construction, and can severely constrain geometric standards.

To meet its roading challenge within the funding limitations, New Zealand has relied on thin flexible pavements and light bridge structures, and acceptance of geometric standards which can sometimes be less than those commonly seen in other countries.

For a number of years the transport and export industry sectors have called for a review of current vehicle weights and dimension limits in an effort to increase transport productivity. Previous studies conducted by Transit between 1992 and 1996 and reported to the 4th and 5th Symposia (Sleath L, 1995 & 1998) have indicated that the potential benefits of raising weight limits nationwide would not outweigh the likely costs incurred in meeting the increased limits. Significant costs were identified for road widening to accommodate longer heavier vehicles. As a result Transit believes that it is not feasible to upgrade the whole road network to accommodate substantially longer vehicles.

1.2 The Two Scenarios

Early in 1998 Transit New Zealand, as the national state highway network provider, agreed on a strategy with the road transport industry to embark upon a new project. The purpose was to investigate the safety and economic effects of altering heavy vehicle weight limits under two scenarios, termed Scenario A and Scenario B.

Scenario A examines the proposal that:

> *the existing vehicle fleet would be allowed to operate at different weight limits than those presently permitted on the road network but there would be no increase in vehicle dimensions.*

No substantial geometric road improvements would be carried out to incorporate the vehicles. The vehicles would meet the New Zealand Land Transport Safety Authority's current swept path specification, and be capable of conforming to internationally accepted dynamic performance standards e.g. rearward amplification, roll stability, load transfer ratio, and high speed off-tracking.

Scenario B examines the proposal that:

> *increases in both vehicle weight and dimension limits would be allowed on selected routes only.*

The new vehicles would operate at higher weights on these selected and possibly upgraded Scenario B heavy transport routes.

1.3 Preliminary Studies

The commercial road transport industry nominated seven issues of particular concern to that industry in New Zealand. The issues raised by the Road Transport Forum New Zealand (RTF) covered gross weight increases, minimum axle spacings, use of single large tyres and issues related to Road User Charges (RUCs). These issues were considered in a preliminary study for Scenario A (Pearsons Transport Resource Centre P/L, 1998). The work was divided into heavy vehicle weight investigations and road user charges investigations. The findings were provided in a report entitled *Scoping Study for Scenario A*. Since the completion of that report, an issue relating to increasing gross weights on 2 axle buses to 17 or 18 tonnes has been nominated for consideration in Scenario A.

Preliminary work on Scenario B for three specific routes (Opus International Consultants/Allan Kennaird Consulting, 1998), indicated that significant benefits would flow from network improvements giving rise to higher weights and dimensions on these routes.

1.4 Progression from Preliminary Studies

Midway through 1998 Transit decided to progress investigations into the two scenarios, leading to the present project. These detailed investigations may lead to:

- revisions to the current weight and dimension limits; and
- roading improvements necessary to establish a set of heavy transport routes.

The Ministry of Transport (MOT) has undertaken a separate review of the model used to charge commercial road users (i.e. RUCs).

Transit intends that any changes arising from the present project and the MOT investigations should be incorporated into the proposed Rule 41001 Vehicle Mass and Dimensions which the Land Transport Safety Authority (LTSA) is currently progressing.

In September 1998 approval was obtained from the government's land transport funding agency Transfund New Zealand for an allocation of $1M with an indicative benefit to cost ratio of between 5 and 15.

The final project report is expected to be available in March 2000. This paper reports on progress to date, which has been significant, and the presentation at the Symposium will cover the project outcomes.

2.0 PROJECT STRUCTURE

2.1 Project Goal

The goal of the present project is:

> *to evaluate the safety and economic effects of altering heavy vehicle weights on the entire road network (Scenario A) and of increasing both heavy vehicle weights and dimensions for selected routes only (Scenario B)*

The 35 routes investigated under Scenario B were developed by Transit from previous studies of freight movement and in discussion with the road transport industry, by utilising the principal state highways to link industrial centres and ports. The routes may require upgrading to accommodate the increased weight and dimensions of Scenario B vehicles.

2.2 General Approach

Increasing allowable weights affects:

- bridges;
- safety;
- pavements;
- environment; and
- industry economics (i.e. changes in the freight task)

These issues are common to both scenarios. In addition, an investigation is required of geometric issues (for Scenario B only) and an overall economic evaluation.

In April 1999 following final project design and consultation with stakeholders and affected parties Transit engaged consultants in the first five parallel investigation contracts covering bridges, pavements, safety, geometrics, and industry economics. Two further contracts were subsequently added to the project covering environmental impacts and overall economics and reporting.

There is considerable interaction between the contracts, and the outputs from some contracts are required as inputs for other parts of the project. Figure 1 illustrates the details of the two stages and the inter-relationship between the seven investigation contracts.

Initially, the bridge and safety evaluations considered the relative effects of selected vehicles against baseline vehicles. The baseline vehicles represented existing vehicles at present legal limits. Three options for different weights on axle sets and three alternatives for wheelbase limits were selected for initial evaluation. This part of the project was called ***Stage 1***.

Transit considered the outcome of the Stage 1 evaluations and determined a series of refined options for consideration in ***Stage 2***. The refined options covered:

- two of the options for weights on axle sets considered in Stage 1 together with;
- two new options which would permit gross weights between these two options; and
- one of the alternatives considered for wheelbase limits.

The optional weights on axle sets considered in Stage 1 were called Options 1, 2 and 3. The alternatives for wheelbase limits were called a, b and c. Therefore, two of the options 1, 2 and 3 together with one of alternatives a, b or c were considered in Stage 2. In addition, three full sized Scenario B vehicles were considered in each of the evaluations.

3.0 VEHICLE OPTIONS

Vehicles in New Zealand usually do not gross out at the sum of the individual axle weights because of the influence of RUCs. The range of possible changes in vehicle mass limits that were evaluated for the two Scenarios in Stage 1 concentrated on increases in gross weight with little increase in axle weights. The vehicles that were used in the Stage 1 bridge and safety evaluations represented a range of 7 and 8 axle truck and trailer units, 6 axle articulated vehicles, and 8 and 9 axle B train combination vehicles, with a variety of axle spacings and overall lengths.

Following the review of Stage 1 results a set of refined options was determined and supplied to the project's seven consultants. The gross weight options selected were 44.5 t, 47 t, 48.5 t and 50 t. A wheelbase alternative based on the formula was also selected. The options are illustrated in Table 1.

4.0 DETAILS OF INVESTIGATIONS

4.1 Bridge Evaluation

This contract covered the estimation of economic impacts of alternative mass limits on bridges, based upon the reduction in the overall service life of the structure caused by the load increase. The reduced service life results in a cost due to the earlier replacement. The analysis was performed using Transit's currently recommended methodology (as contained in the Bridge Manual 1994), and alternatively assuming a bridge testing programme was introduced. In the case of bridges on roads administered by local jurisdictions costs were also obtained under two alternative strategies. Strategy 1 assumes only 15% of bridges carry heavy vehicles. Strategy 2 assumes that bridges not on key routes are posted (i.e. legally protected from higher weight limits) in order to delay replacement.

4.2 Safety Evaluation

The first part of this contract involved determining the vehicle stability and manoeuvrability related performance of 120 different vehicle combinations using computer simulations. In the second part estimates were obtained of the effect of possible changes in weight and dimension upon crash rates. The changed crash rates were then incorporated into the overall economic analysis.

4.3 Industry Economics

This contract estimated the costs and benefits of the changes generated by the users of heavy vehicles. The estimates were based upon predictions made about the changes that would occur to the existing truck fleet and its movement of freight over different categories of roads over a 25 year period.

The consultant firstly obtained and collated data on the present movement of road freight on all roads in New Zealand by vehicle categories and configurations. It was then assumed that a higher weight regime would result in a reduction in vehicle travel and hence reduced fleet operating costs. Noting the current commercial road user charges and vehicle operating costs the consultant predicted the likely take-up rate by truck operators under higher weights and calculated the revised freight task. This was reported in terms of vehicle kilometres of travel and tonne kilometres for the range of vehicles being considered under the two scenarios.

In general, the potential cost savings (Net Present Values) using a 10% discount rate fall in the range $120 million to $145 million or approximately double that using a 5% discount rate. The potential financial cost savings (NPVs) to industry using a 10% discount rate are in the range of $140 million to $427 million or approximately double that using a 5% discount rate.

4.4 Pavement Evaluation

This contract examined the impact of a change in axle loadings upon the cost of maintaining the road network. An increase in the total number of axle loads causes pavement rehabilitation to be brought forward if the standard of service is to be maintained, thus resulting in an additional cost.

The first part of this contract involved the assembly of data on pavement condition, remaining life, and annual rehabilitation costs for both state highways and local roads. The increase in axle loading was obtained from the change in tonne kilometres of travel obtained in the Industry Economics contract. This was then converted into changes in pavement damage which became an input into the overall economic analysis.

4.5 Environmental Evaluation

In this contract an assessment was made of the likely environmental impacts arising under the two project scenarios, with particular emphasis on those impacts identified in Transfund New Zealand's Project Evaluation Manual (PEM). The main input to the evaluation was the Industry Economics data on the changes in vehicle kilometres travelled and vehicle operating costs. Impacts considered included carbon dioxide and particulate emissions, noise, and vibration.

The consultant concluded that both project scenarios would offer minor environmental savings. These annual savings range from approximately $600,00 to $1.2 M for Scenario A options to $5 M by year 2024 for Scenario B.

4.6 Geometric Evaluation

This contract provided an estimate of the impact of longer vehicles on the current road width under Scenario B. There are two principle reasons why longer vehicles take up more road space than the current fleet. Firstly, longer vehicles are likely to have greater off-tracking (both low and high speed) when cornering. Secondly, the trailing unit of a combination vehicle travelling in a straight line may not exactly follow the path of the leading unit (trailing infidelity).

The study used the computer simulation of four candidate vehicles to determine the amount of lane widening for different road geometries. This was then combined with an inventory of road geometry data and site surveys to build up a model identifying the costs for different parts of the road network. A validation trial was conducted to confirm the tracking profile simulations, using a fully loaded 26m B train.

The costs were reported both in terms of curve widening and roundabout modification, and incorporated into the economic analysis. Costs associated with intersection improvements, additional climb lanes, and provision of truck rest areas were regarded as a second order magnitude and excluded from the study.

4.7 Overall Economics

The purpose of this contract is to perform the overall analysis of the benefits and costs obtained elsewhere in the project and provide a final project report summarising the work of the other contracts. The economic analysis, which is currently proceeding, is being performed in accordance with the PEM but using discount rates of 5% and 10%.

5.0 PRELIMINARY FINDINGS

Many of the vehicle options examined in the safety evaluation performed below the level of the current vehicle fleet, with truck trailer combinations significantly poorer on vehicle stability. However, crash rate changes under the two scenarios for all the vehicles considered were quite small and are not expected to be significant in the overall evaluation.

The geometric evaluation has confirmed previous work performed by Transit that indicated that road widening will be the most significant cost impact under Scenario B.

The industry economics study has identified significant but relatively small potential cost savings for the economy and for the road freight industry as a result of the possible weight and dimension limit increases for trucks.

The analysis of take up by truck operators of selected vehicle configurations with more generous weight and dimension limits indicates that certain configurations like B-trains will not prove as popular if the existing structure of Road User Charges is maintained. This structure involves disproportionately high charges for certain productive vehicle configurations, so much so that the potential cost savings of such vehicles would be heavily offset.

Other major findings will be reported to the Symposium in Saskatoon.

It must be stressed that the Government has not to date considered the issue of changing heavy vehicle mass and dimension limits investigated in this project.

6.0 ACKNOWLEDGEMENTS

Thanks are due to Dr R J Dunlop, General Manager, Transit New Zealand for permission to publish this paper. The use of extracts from project reports has been made with the kind permission of the following consultants:

- Transport Engineering Research NZ Ltd, Auckland
- Infratech Systems and Services Pty Ltd, Brisbane
- Roaduser International Pty Ltd, Melbourne
- Saturn Corporate Resources Pty Ltd, Melbourne
- Montgomery Watson NZ Ltd, Christchurch
- ARRB Transport Research Limited, Melbourne
- Commed Associates, Melbourne
- Opus International Consultants Limited, Wellington

7.0 DISCLAIMER

8.0 REFERENCES

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2. Opus International Consultants/Allan Kennaird Consulting Scenario B Preliminary Study of Selected Routes. Opus International Consultants, Wellington, March 1998.

3. Pearson RA & Heywood RW Scoping Study for Scenario A. Pearsons Transport Resource Centre Pty Limited, Melbourne, April 1998.

4. Various consultants. Heavy Vehicle Limits Project Progress and Final Reports. Transit New Zealand, Wellington, January 2000.

Table 1 Vehicle Options considered in Stage 2

(Other options and alternatives were eliminated following Stage 1)

	Allowable weights (tonnes)			
	steer axle	**single axle**	**tandem axle**	**triaxle**
Present	6.0	8.2	15	18
Option 3	6.0	8.8	16	20

Wheelbase alternative	Formula	Gross mass maximum (see note 3)	
		Scenario A	**Scenario B**
Present (see note 2)	M = 3L + 10 to 27 tonnes, then; M = 1.6L + 18	44 tonnes	53 tonnes
Alternative b	M = 3L + 10 to 36 tonnes, then M = 2L + 18	44.5, 47, 48.5 and 50 tonnes	62 tonnes

Notes:

1. M is the allowable mass in tonnes for a distance L metres between any two or more axles that together do not constitute an axle set.
2. The formula for the present limits is an approximation of the actual limits.
3. The maximum gross mass for Scenario B is calculated using an overall axle spacing of 22 metres up to 62 tonnes.

Insert Figure 1 here = RAP Project Structure Flow Chart