

# FOLDING BAILEY BRIDGE TRAILERS IN NEW ZEALAND

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## ABSTRACT

*The combination of versatility and good economic performance in a log transport unit is difficult to achieve. The latest innovation in this field in New Zealand is the folding Bailey Bridge trailer. This report compares its economic performance with two other units capable of carting both long and short logs.*

*Folding Bailey Bridge trailers are not the cheapest way to transport logs, but they are the most versatile through a combination of:*

- *new weight saving materials and manufacturing techniques*
- *improved gradeability*
- *improved manoeuvrability on skids*
- *quicker turnaround times.*

## INTRODUCTION

In the mid 1970s the introduction of Bailey Bridge trailers (skeletal semi-trailers) provided a logging configuration with the versatility to transport either long or short logs. However, their heavy tare weight and reduced allowable GVW kept their payload lower than conventional long or short log units. In recent times refinements to Bailey Bridge trailers, such as higher strength - low weight steels, sections of chassis web cut out, improved axle spacings

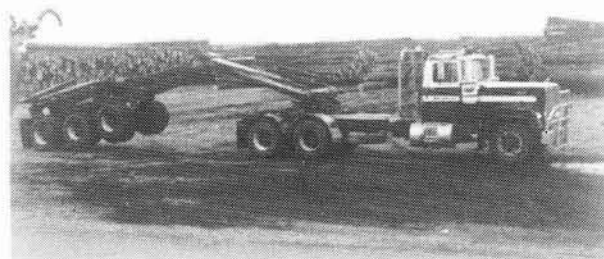


Figure 1 : Folding Bailey Bridge trailer

and suspensions and other tare weight reducing accessories, have brought it close to being economically viable.

The latest innovation is the folding Bailey Bridge trailer. These trailers have been popular for transporting logs in Australia for the past five years. They have only become a realistic option in New Zealand however with the recent increase in the forward length dimension on large semi-trailers.

Furthermore, with Road User Charges accounting for as much as 18% of total costs, the value of being able to piggyback the trailer when travelling empty cannot be underestimated.

## NEW WEIGHTS AND DIMENSIONS LEGISLATION

Prior to the introduction of the new weights and dimensions legislation, which aligned New Zealand more closely with the Australian transport laws, the folding Bailey Bridge trailer was an almost unworkable option in this country. Previously, the maximum forward length<sup>1</sup> of large semi-trailers was 7.4m; and operating a 13m semi meant, in most cases, having two axle groups, requiring either a castoring axle or heavy self-steering bogie. The sheer weight and awkward bulk of this type of axle layout made the folding Bailey Bridge trailer difficult to engineer.

From February 1989, the new approach to 13m semi-trailers in New Zealand is a close spaced triaxle configuration which lends itself perfectly to the folding Bailey Bridge trailer. The new legislation has also increased the gross operating weight of close-spaced triaxle groups by 1/2 tonne, to 18 tonnes.

## CONSTRUCTION

With the exception of some minor road-going details, the main difference between the folding Bailey Bridge trailers currently operating in this country is in the construction of the main chassis beams. Some manufacturers fabricate "I" beams whereas others prefer folded plate chassis beams, with another plate welded along the bottom edge for added strength.

### "I" Beams

"I" beams are constructed by welding a top and bottom flange to a web. The depth of this web largely dictates the characteristics of the beam. The welding process joins the two metals by electric arc which is shielded

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1. *The distance between the fifth wheel and the rear axis.*

by an inert gas. This process sets up internal stresses in the beam which can be relieved by heating and then slowly cooling the structure. The type and degree of heat treatment received by the beam after construction has a major bearing on its overall strength and durability.

### Folded Plate Beams

Cold pressing requires large forces, but results in:

- a high degree of dimensional accuracy
- a smooth, clean surface with no oxide or scale finish
- a structure with a combination of strength, hardness and toughness due to the elongation of the metallic grain structure during the pressing process.

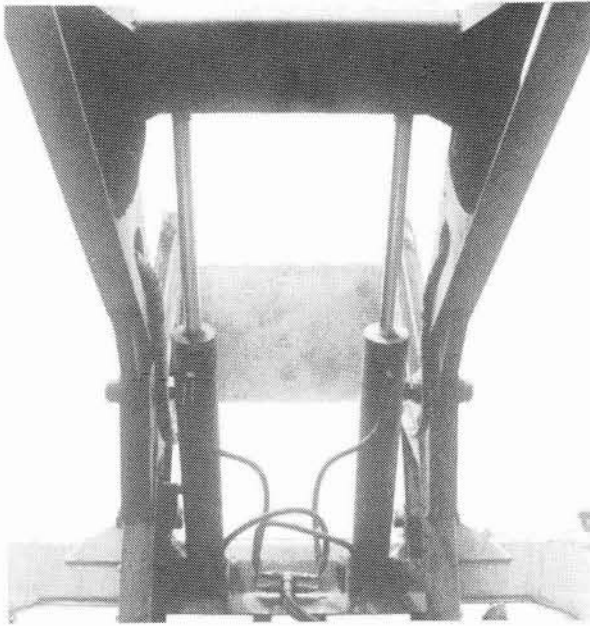
Other weight saving refinements include super single tyres and aluminium rims, high tensile steel or aluminium stanchions and bolsters, carbon fibre or single leaf springs and sections of the chassis web cut out.

These weight saving gains can be partly offset on the tractor unit by substantial cab and rear wheel guarding for the trailer to sit on and a hydraulic oil reservoir. The latter, however, can be of minimum capacity when double acting rams are used.

## OPERATIONAL PROCEDURE

The most important feature of the folding Bailey Bridge trailer is its ability to mount and dismount the tractor unit unaided. This process is controlled by hydraulic rams positioned at the pivot point of the trailer (Figure 2). The rams are powered by an auxiliary P.T.O. pump which is mounted on the tractor unit.

To open the trailer ready for loading, the hydraulic rams are activated, causing the trailer to 'kick back' until the rear wheels touch the ground. The next stage of the opening process is determined by the amount of available hydraulic ram travel.



*Figure 2 : Hydraulic rams control the opening and closing process*

Where ram travel is limited, a slot cut in the cylinder mounting bracket enables the hydraulic unit to travel freely and the trailer to be almost completely opened out under the influence of the tractor unit. When the free ram travel runs out, the last stage of the opening process is done under hydraulic influence to avoid the chassis beams snapping shut and over-stressing the pivot pins and bushes.

Where ram travel is not a limiting factor, this opening process can be done completely under hydraulic influence by using a two stage hydraulic system (Figure 3). Both processes take a similar amount of time and prevent vital pins, bushes and chassis members from being overstressed.

In Australia it is common for folding Bailey Bridge trailers to dismount the tractor unit by gravity. The process is started by an air ram on the cab guard which gives the trailer its initial momentum. A leg mounted near the centre of the trailer stops the chassis snapping shut. The trailer is reloaded on to the tractor unit by backing up to a bank causing it to "kink" in the middle and fold up.



*Figure 3 : Opening trailer by two stage hydraulic system*

## **COSTING COMPARISON**

In this section the economic performance of three of the most versatile logging configurations has been compared (Table 1):

- the truck and trailer convertible unit, described by Kemp (1988)
- a conventional Bailey Bridge unit
- the new folding Bailey Bridge.

Each configuration has been paid the same rate to transport its payload. The purchase prices and running costs are based on current market values and historical data respectively. Road User Charges, repairs and maintenance costs and payloads have been calculated according to the configuration. In each case the owner has had \$120,000 to start with and has borrowed the remainder according to the purchase price of the configuration.

Cash flow analysis is a good way of determining a vehicle's long term economic viability.

*Table 1 : Comparative Financial and Operating Details of the Three Most Versatile Logging Configurations*

<i>Costing Data</i>	<i>Truck- Trailer Convertible Unit</i>	<i>Bailey Bridge Trailer</i>	<i>Folding Bailey Bridge Trailer</i>
<u><i>Financial Details:</i></u> <i>Trucking Rate (\$/tonne)</i>	\$11.40	\$11.40	\$11.40
<i>Truck/tractor unit Capital Cost</i>	225,000	225,000	225,000
<i>Trailer Capital Cost (GST incl)</i>	50,800	40,150	71,500
<i>Owner's Investment :</i>	120,000	120,000	120,000
<u><i>Operational Details:</i></u> <i>Repairs &amp; Maintenance Costs (\$/km)</i>	.30	.23	.28
<i>Road User Charges - Truck-tractor (\$/km)</i>	.37	.27	.27
<i>Road User Charges - Trailer (\$/km)</i>	.31	.23	.23
<i>Average haul distance (km)</i>	75	75	75
<i>Trips/day</i>	3	3	3
<i>Productive days/annum</i>	230	230	230
<i>On highway GVW (tonnes)</i>	42	39	39
<i>Tare Weight (tonnes)</i>	14.9	15.1	13.9
<i>Distance travelled annually (km)</i>	112,700	112,700	112,700
<i>Distance travelled on highway (%)</i>	60	60	60
<i>Distance travelled on seal (%)</i>	75	75	75
<i>Legal Payload on highway</i>	26.08	23.4	24.6
<i>Average payload carried</i>	28.08	25.4	26.6

Table 2 : Five Year Cashflow Analysis for  
Folding Bailey Bridge trailer

TRUCKING FINANCIAL PERFORMANCE	Year 1	Year 2	Year 3	Year 4	Year 5
Trucking Rate (\$/Tonne-km)	.169	.169	.169	.169	.169
(\$/Tonne-trip)	11.40	11.40	11.40	11.40	11.40
Trucking Income (\$)	209236	209168	209167	209242	209405
Costs (No Depreciation) \$	209687	209176	208665	208153	207642
Depreciation (Straight line)	20718	20718	20718	20718	20718
Depreciation (Tax)	59300	47440	37952	30362	24289
Tax (\$)	-10337	-15827	-16807	-13413	-5586
Funds (\$)	-451	-459	43	1131	2894
Operator's Capital in Truck (Excludes tyres) (\$)	112214	119338	130455	153249	183011

Operator's Total Assets (\$) 111763 118878 130498 154380 185905  
(Figure 4)

REVENUE UTILISATION	\$	\$	\$	\$	\$
Overheads	8745	8721	8697	8672	8648
Finance	56114	56114	56114	56114	56114
Insurance	6968	6481	5994	5507	5020
Registration	400	400	400	400	400
Wages	30000	30000	30000	30000	30000
Fuel and Oil	41969	41969	41969	41969	41969
Tyres	5999	5999	5999	5999	5999
R & M	33458	33458	33458	33458	33458
Road User Charges	26034	26034	26034	26034	26034
Funds (Current Year's Income only)	-451	-8	502	1089	1763
Tax	0	0	0	0	0
Total Income	209236	209168	209167	209242	209405

Table 2 shows a summary cash flow analysis using LIRA's TCOST program, Goldsack (1988) for the folding Bailey Bridge. Similar analyses were carried out for the other two configurations.

Figure 4 compares the operator's total assets over five years for the three most ver-

satile logging configurations - truck/trailer convertible unit, folding Bailey Bridge trailer and Bailey Bridge trailer. The folding Bailey Bridge operator's total assets over the five years are slightly less than those of a truck/trailer convertible operator. However the folding Bailey Bridge trailer is a better investment than a Bailey Bridge.



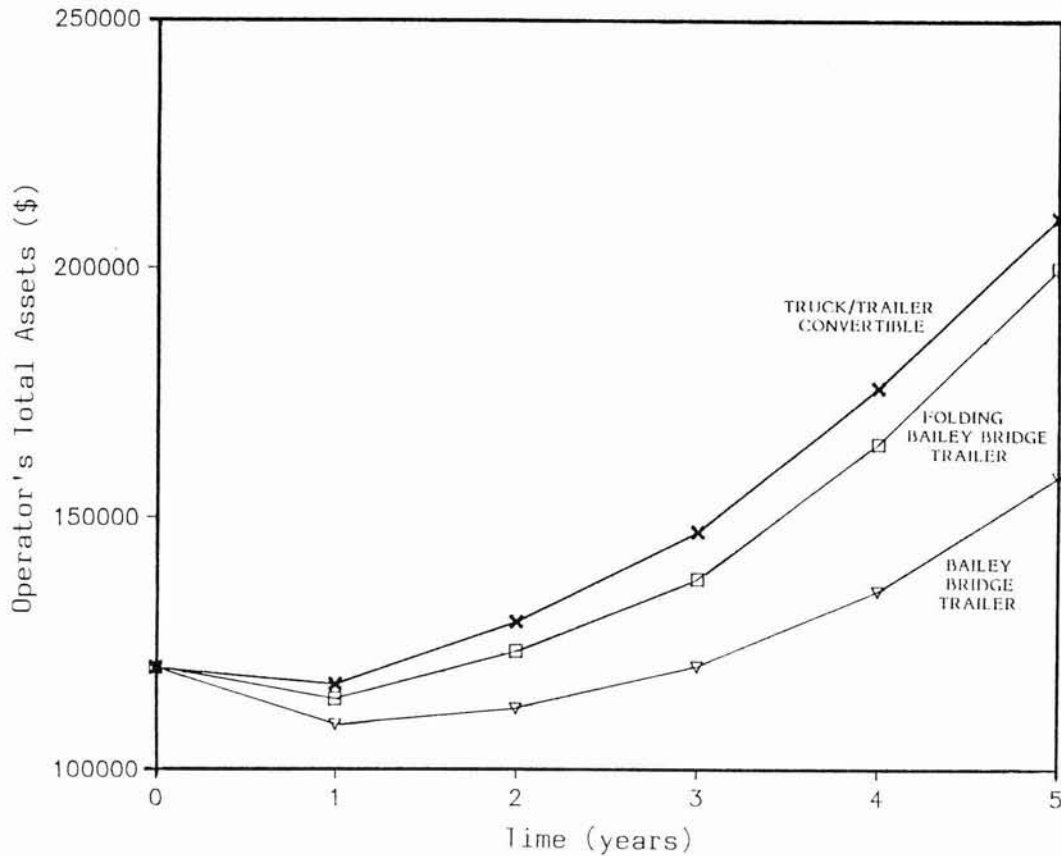


Figure 4 : Comparison of financial performance of three most versatile logging configurations.

These results are sensitive to repairs and maintenance costs. The R & M costs used in Table 1 are considered a fair estimate of relative costs given the additional complexity and moving parts of the convertible and folding units. However, as an example, a further five cent per km increase in the R & M cost of a folding Bailey Bridge trailer would remove its advantage over a conventional Bailey Bridge trailer.

These three cost components have been compared because individually they have a large influence on the financial perfor-

mance of these three configurations.

## RESULTS AND DISCUSSION

### Truck/trailer convertible units :

While truck/trailer convertible units are very versatile, their utilisation is limited due to their reliance on bush loaders to lift the trailer off the truck. Those convertible units that can carry 8m logs operate at less than optimum GVW due to their restricted overall length.

Table 3 : Comparison of Three Influential Cost Components  
(From Year 3 of the 5 year cashflow analysis, \$ p.a.)

	Truck/ Trailer Convertible	Bailey Bridge Trailer	Folding Bailey Bridge Trailer
Finance	49533	46147	56114
Repairs and Maintenance	34338	26414	31521
Road User Charges	35501	33801	26034

### Bailey Bridge Trailers :

The biggest cost component affecting the economic performance of a Bailey Bridge trailer is Road User Charges. The trailer incurs road tax while travelling empty on-highway.

Other performance influencing factors include tare weight. It has been common for Bailey Bridge trailers to be solidly constructed, in fact most current Bailey Bridge trailers have tare weights around 6 tonnes. This large tare weight problem was further complicated under the old dimensions laws by a short forward length, necessitating heavy steering bogies or castoring axles. A heavy trailer places greater emphasis on the need for a light tractor unit which can create repairs and maintenance problems and 'in-bush' gradeability limitations.

### Folding Bailey Bridge Trailers :

The folding Bailey Bridge trailer seems to be the ultimate solution to versatile log transport. Its design and construction enable it to overcome all of the operational and economic limitations posed by the two previous most versatile log transport units.

**Tare Weight:** The use of high strength, low weight steels and better design and construction techniques have had a positive effect on tare weight. Two factors which have forced the tare weight down are:

1. The introduction and relative success of other versatile log transport configurations which have challenged Bailey Bridge rates and put more emphasis on increased payload capacity.
2. Folding Bailey Bridge trailers rely on hydraulics to initiate the folding and unfolding process. There is a direct relationship between tare weight and hydraulic size and capacity.

**Utilisation:** Increased 'in-bush' availability without the need for a loader to lift the trailer down.

**Manoeuvrability:** Better manoeuvrability

on skids. The unit requires only enough space to turn a tractor unit around.

**Gradeability:** Improved 'in-bush' gradeability with the majority of the trailer weight being over the driving axles of the tractor unit when the trailer is in its "travel empty" position.

**Versatility:** Bailey Bridge trailer can be disconnected and the tractor unit used for other work.

**Turnaround:** Quicker turnaround times without the need to use gantries at mills and log yards.

## **CONCLUSION**

Folding Bailey Bridge trailers are not the cheapest way to transport logs. However, they are the most versatile through a combination of :

- new weight saving material and manufacturing techniques
- improved gradeability
- improved manoeuvrability on skids
- quicker turnaround times

Another important feature of the folding Bailey Bridge trailer is the flexibility it gives to the despatch personnel, enabling them to send this configuration to any skid for any length of log. Resulting from this flexibility is the potential for more back-loading which is more loads carried per day giving improved truck utilisation and increased cash flow.

## **REFERENCES**

Goldsack, R.W. (1988) : TCOST, Truck Costing Program, LIRA.

Kemp, O. (1988) : "Trucking Long and Short Logs with the Same Rig", LIRA Technical Release, Vol. 10 No. 1.

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