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THE BELL STATIC DELIMBER IN A CABLE CLEARFELL OPERATION

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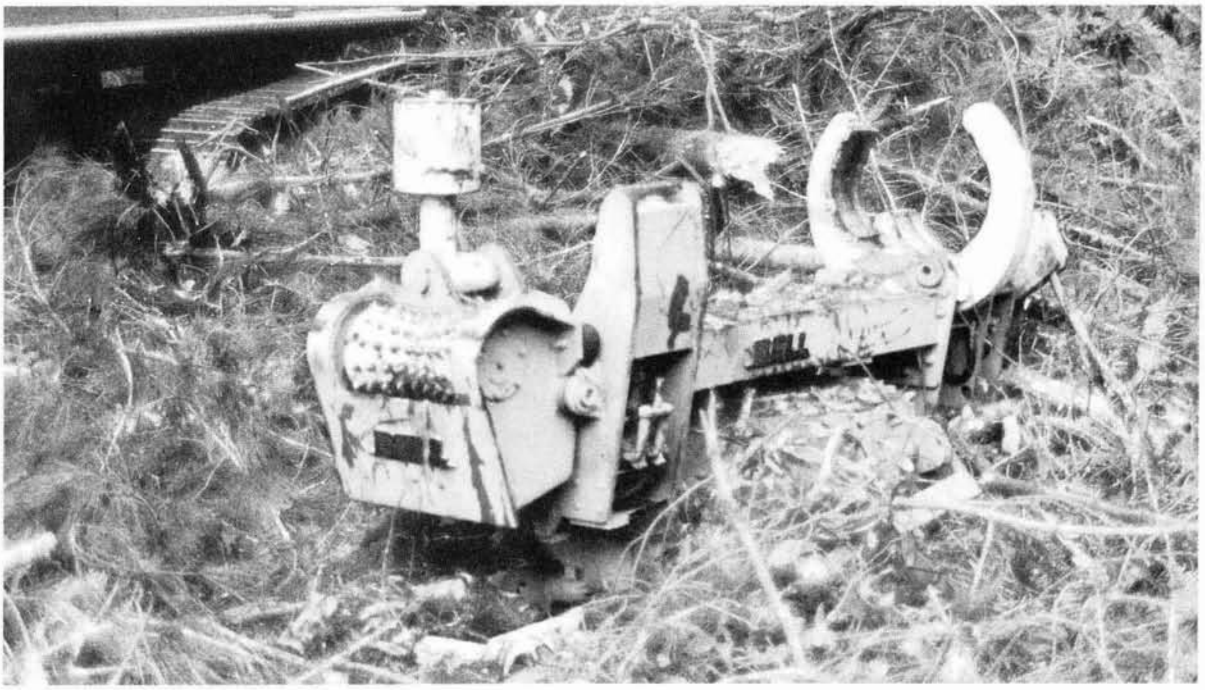

Figure 1 - The Bell Static Delimber

ABSTRACT

A Bell Static Delimber was studied in a clearfell radiata pine, cable logging operation in Golden Downs Forest. A Bell Superlogger was utilised to pull trees through the delimber.

The average piece size was 1.0 m^3 with good form and medium branching habit. The average delimbing cycle time of the combination was 1.12 minutes, or 53 trees per productive machine hour (PMH). Combined with the other non-delimbing tasks of the Superlogger, the gross productivity of the combination was 28 trees per PMH. Overall system production for the two day study was 235 m^3/day.

Delimbing quality was good, and tree form and volume had little effect on the delimbing cycle time.

INTRODUCTION

Over the past few years, many mechanical delimbing systems have been trialled and studied in New Zealand (Hill 1990 and 1991, Duggan 1988, Raymond 1989, Gleason 1985, Moore 1989, Vaughan 1990, Raymond et al 1988). These have mainly been high cost, high technology harvesters or processors with length measuring capability. The Bell Static Delimber is, in contrast, low in capital cost, simple in design and consequently should have low maintenance costs. Although a separate machine is required to pull trees through the delimber, this machine will generally have time available for other tasks.

The Bell Static Delimber was originally designed in Czechoslovakia in 1976, and has had wide usage throughout Eastern Europe. Bell Equipment (N.Z.) Limited has the franchise to sell it in New Zealand as the Bell Static Delimber.

Since being introduced into New Zealand in the middle of last year, the delimber has been trialled in many different situations with varying success, and at the time of this study thirteen units were operating throughout the country.

This Report presents the results of a study on the Bell Static Delimber in a clearfell radiata pine operation. The objectives of the study were to evaluate the productive capability and delimbing ability of the delimber, and to examine the factors that control its performance.

ACKNOWLEDGEMENTS

LIRO acknowledges the co-operation of logging contractor, Jeff Hamilton, and Tasman Forestry Limited during this study.

THE MACHINE

The Bell Static Delimber is a stationary unit with the ability to delimb trees of 10 to 50 cm diameter (Figure 1). The delimber is approximately two and a half metres long, and one metre wide, and weighs about 1500kg. A separate machine is required to lift the trees into the delimber, and then pull them butt first through four moveable, and one fixed, delimbing knives. In Europe, either cable or grapple skidders are generally used for this, while in New Zealand, the Bell Logger is commonly being used. A stump or deadman is normally required to secure the delimber against the force of the pull.

The spiked roller on the front of the delimber drives a hydraulic pump as the tree is pulled through, and this charges a hydraulic accumulator. The four moving wrap-around knives are operated by rams driven off this accumulator.

The spiked roller is pivoted and spring loaded into an "up" position. As the tree is dropped into the delimber, the roller is pushed down and this operates a control valve to close the knives. When the tree is pulled through and the weight comes off the roller, the knives are opened ready for the next tree.

To enable easy and correct loading of the trees into the delimber, the first three metres of the tree needs to be trimmed, particularly on smaller trees. The delimber needs to be set up on reasonably flat ground to enable a straight pull through the knives.

Since its introduction, there have been some modifications made to several of the delimbers, both by contractors and by Bell Equipment (N.Z.) Limited. An optional modification is the addition of a small petrol motor to drive the hydraulic pump, as in short trees (less than 10-12 metres) insufficient charge is built up to fully open and close the knives for one cycle. Standard modifications include the re-design of the mounting system to make the delimber more stable, and hydraulic piping, which has been prone to cracking, has been replaced by hydraulic hose.

OPERATION DESCRIPTION

The study was undertaken in Compartment 190 of Golden Downs Forest. Stand details provided by Tasman Forestry

Limited and data from the scaling of individual trees during the study are shown in Table 1.

Table 1 - Stand details

Stand Age (yrs)	**24**
Stocking (sph)	**426**
Mean Tree volume (m³)	**1.0**
Mean LED (cm)	**34**
Mean Tree Length (m)	**21.0**

The operation studied used a modified Dispatch hauler for extraction. A Bell Superlogger pulled one or two trees from the chute directly to the delimber. In the case of pulling two trees, one was dropped next to the delimber for processing in the next cycle, while the other was loaded and delimbed directly.

After delimbing, the Bell Superlogger loaded the trees on to bearers in a processing area where a logmaker and one skiddy cut to length. The Bell cleared slash from around the delimber, as required, on the way back to the chute. A diagram of the landing layout is shown in Figure 2.

Apart from these tasks associated with delimbing, the Bell also assisted with fleeting, unhooked drags, and cleared the chute to a stockpile when necessary. A Caterpillar 950 loader did most of the fleeting and loaded trucks. The crew consisted of the three machine operators, two fallers, two breaker-outs, a logmaker and one skiddy.

STUDY METHOD

A continuous time study was carried out on the Bell Superlogger for two full days operation during which a total of 470 trees were delimbed.

Each tree delimbed was assessed for form according to the following classifications:

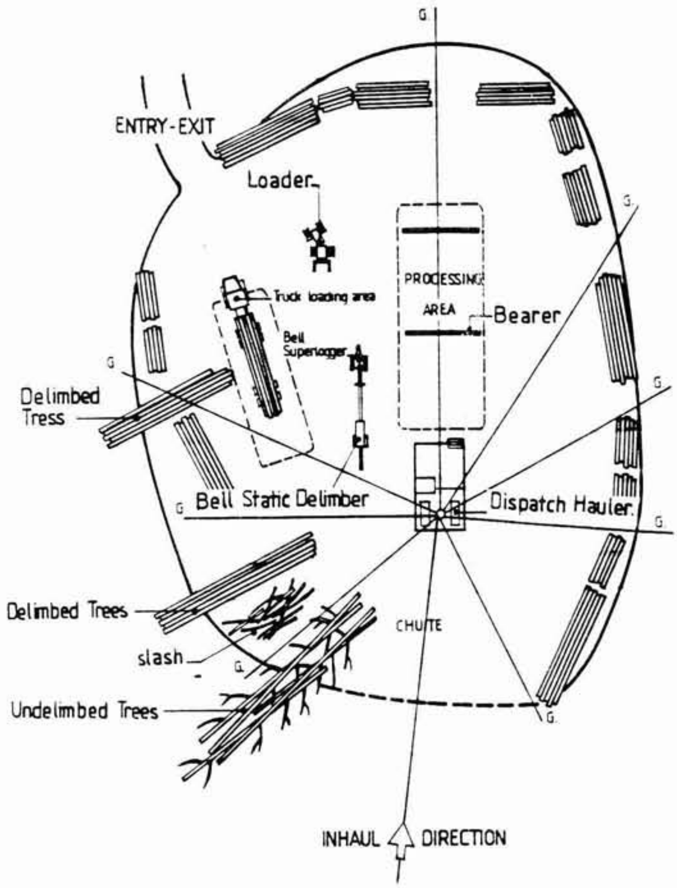

Figure 2 - Landing layout

Form Class 1 - Straight, all branches less than 6cm diameter

Form Class 2 - Straight, slight sweep, some branches greater than 6cm diameter

Form Class 3 - Malformed, double leaders, heavy branched, etc.

Trees delimbed on the first day of the study were also assessed for delimbing quality according to the following classes:

Quality Class 1 - Flush trimmed or all <u>visible</u> stubs less than 1 cm length

Quality Class 2 - Largest visible stub between 1 and 2 cm length

Quality Class 3 - Largest visible stub between 2 and 5 cm length

Quality Class 4 - At least one stub of greater than 5 cm length

Table 2 - Time distribution for Bell Superlogger

Element	No. Observations	Mean Time per Observation (min)	95% Confidence Interval	Mean Time per Cycle (min)
Drag from chute and load delimber	440	0.37	±0.02	0.37
Pull through delimber	440	0.21	±0.01	0.21
Stack on runners	440	0.39	±0.01	0.39
Clear slash	149	0.44	±0.03	0.15
Productive Delimbing Cycle				**1.12**
Non-delimbing Elements				
Fleet	80	3.31	±0.82	0.60
Clear Chute	27	0.71	±0.20	0.04
Wait for hauler (to unhook)	22	1.16	±0.39	0.06
Unhook	32	0.91	±0.16	0.07
Total Delays				0.22
Average Total Cycle Time (min)				**2.11**

The LED of each tree delimbed was measured to estimate volume, and the length of 160 trees was also measured.

In addition to the time study on the Bell Superlogger, activity sampling of the men and equipment on the landing was carried out on the second day of the study.

RESULTS AND DISCUSSION

At the average piece size of $1.0m^3$, the average daily production of the system was $235m^3$. Of the trees delimbed, detailed timing was obtained for 440 full cycles. Separating out the work elements directly associated with delimbing, gives an average delimbing cycle time of 1.12 minutes, or 53 trees per productive machine hour (PMH). The delimbing elements accounted for 53% of the total recorded time for the Bell. The time distribution for the Bell is shown in Table 2.

The drag from chute element shown in Table 2 is the average of three different drag elements that were recorded. Each of these drag elements had significantly different averages, depending on whether one or two trees were dragged from the chute to the delimber, or whether a tree was loaded into the delimber from a stack on the landing next to the delimber.

It can be seen from Table 2 that the slash was cleared on average every third cycle. As a result of the delimbing of trees in one location, and disposal of the resulting slash off the landing working area, the landing was much cleaner than would have been the case with manual trimming. This has a positive safety effect.

The Caterpillar 950 loader was unable to keep up with the fleeting and loading of trucks, and this resulted in the Bell having to periodically spend up to 16 minutes fleeting when the bearers became flooded with processed logs. At times, the delimbed stems were stockpiled to the side when the bearers were full. The longer periods of fleeting were often followed by a period of clearing the chute to a stockpile as several drags built up in the chute.

Adding in the non-delimbing work elements, including delays, the total cycle time was 2.11 minutes, or 28.4 trees per PMH.

Delay Analysis

Of the total time recorded for the Bell, 10.4% was taken up by delays. Figure 3 shows a breakdown of the total delays recorded.

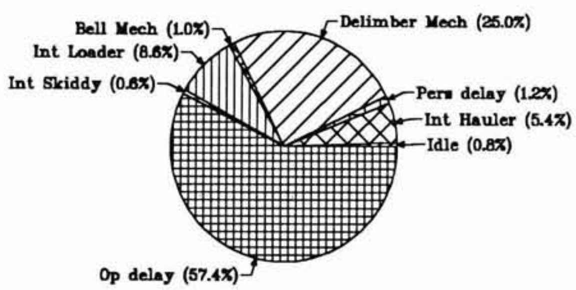

Figure 3 - Breakdown of delays for Bell Superlogger

In general, there was very little interference to the delimbing operation by the machines and men on the skid. Interference to the Bell by the loader accounted for 8.6% of the total delays. This occurred when the loader was either loading trucks or fleeting in the Bell's line of pull from the delimber (Figure 2). There was a very small amount of interference by the skiddy and the logmaker, and a small amount by the hauler, as the Bell waited for a drag to be landed before removing logs in the chute from previous drags. This low level of interference can be attributed in part to the large size of the skid. The use of the delimber on smaller landings would require careful planning of the layout and operation.

Operational delays accounted for most of the delay time. These included such things as landing clean-ups, discussions, and interference from a fuel tanker.

The mechanical delay to the delimber was to fix a hydraulic leak which had developed. In reassembling the delimber, a fitting was not properly tightened and this resulted in a second mechanical delay.

Effect of Tree Form, Length and Volume on Delimbing Time

The time to pull a tree through the delimber was significantly different (by T-test) for the three form classes. The mean time to pull through was 0.18 minutes for form class 1 (318 trees). Trees of form class 2 (73) took on average 35% longer, while form class 3 (54 trees) took an average of 102% longer than form class 1. The difference in pull time between the form classes had an insignificant effect on the overall cycle time.

Malformed trees were delimbed as much as possible in the delimber, with the Bell operator adept at lifting the trees up and past leaders or kinks, and then loading back into the delimber to delimb the remainder of the stem. Eighteen trees were classified as having an unsuccessful delimb, due to a significant proportion of the tree not being delimbed, or a large branch or leader stopping the Bell and the delimb being abandoned. All of those trees were of form class 3. A few trees that were too malformed were diverted past the delimber for the skiddy to delimb. In general, the ability of the delimber to remove heavy branches was limited by the pulling capacity of the Bell Superlogger.

The tree volume and length (over the range of trees measured) also had no discernible effect on the delimbing cycle time. There was a good relationship (R^2=0.70) between the piece size and productivity (m^3/hr) for this operation due to the relatively constant cycle time.

Delimbing Quality

Seventy percent of delimbed trees had visible stubs of less than 2 cm, while 75% of trees had stubs of less than 5 cm. Delimbing quality was markedly affected by the tree form, with malformed trees resulting in poor delimbing. Table 3 summarises the delimbing quality.

From the activity sampling on the skiddy, it was found that he spent only 11% of his time in tidy up trimming. Prior to purchasing the delimber, the contractor commonly used three to four men on the skid, in contrast to the two men used now.

Table 3 - Summary of delimbing quality

Stub Category	Percentage in Category
Quality class 1	38%
Quality class 2	32%
Quality class 3	5%
Quality class 4	25%

CONCLUSIONS

The Bell Static Delimber, in conjunction with the Bell Superlogger, had a delimbing productivity of 53 trees per PMH in average piece size of 1.0m^3. This rate of production was relatively independent of the tree form, length and volume.

The Bell Supperlogger proved to be well suited to pulling trees through the delimber in this operation. Approximately half of the Bell's time was spent in delimbing work elements.

The level of delimbing quality was good, with the one skiddy spending only 11% of his time in tidy up trimming. The introduction of the delimber into this operation significantly reduced the manpower required on the landing.

REFERENCES

Duggan M. (1988) : "Evaluation of the Waratah Processor in Radiata Thinnings", LIRA Report Vol 13, No. 12.

Gleason A.P. (1985) : "Delimbing Radiata Pine with the Hunt Processor" LIRA Report Vol 10, No. 1.

Hill S. (1991) : "The Hahn Harvester in Radiata Thinnings" LIRA Report Vol. 16, No. 7.

Hill S. (1990) : " The Hahn Harvester in Clearfell", LIRA Report Vol. 15, No. 8.

Moore T. (1989) : "The Denis Stroke Delimber in Radiata Windthrow", LIRA Report Vol. 14, No. 10.

Raymond K. (1989) : "The Waratah DFB Harvester", LIRA Report Vol. 14, No. 1.

Vaughan L. (1990) : "Thinning with the Waratah DFB" LIRA Report Vol. 15, No. 10.

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