LOGGING INDUSTRY RESEARCH ORGANISATION
NEW ZEALAND
ISSN 1171-6932
REPORT
Vol. 20 No. 10 1995

THE TRINDER STATIC DELIMBER IN A GROUND-BASED CLEARFELL OPERATION

Spencer Hill
Tony Evanson

Figure 1 - Trinder static delimber

ABSTRACT

A Trinder static delimber was evaluated in a ground-based, clearfell logging operation. A Bell Ultralogger was used to pull tree-lengths through the delimber. Other components of the logging system were a John Deere 648 grapple skidder, a Bell Superlogger, and a Komatsu rubber-tyred loader.

Estimated delimbing productivity was 34 trees, or 64 m^3 per productive machine hour, in an average extracted tree size of 1.88 m^3.

Possible advantages accruing from the use of a static delimber include lower accident risks and increased crew morale through elimination of tedious motor-manual delimbing.

INTRODUCTION

A research study into hazards associated with motor-manual felling and delimbing (which account for approximately half of logging- related accidents (Parker, 1994)) has shown that for 100 trees felled by the sample group, 31 felling hazards and 86 delimbing hazards were faced (Parker and Kirk, 1993). Delimbing has, therefore, been identified as being the most hazardous aspect (in terms of number of hazards faced) of the felling and delimbing phase of a logging operation.

With the introduction of the Health and Safety in Employment Act (1992) has come an increased emphasis on minimising exposure to work-related risks. One method for achieving this aim is to reduce the number of workers exposed to risk of injury in a logging system. The mechanisation of the delimbing phase would assist this aim.

Mechanisation of the delimbing function can be achieved through either high or low capital cost systems. A static delimber is a low cost delimbing unit requiring a separate machine to pull trees through its delimbing knife assembly. Typically, this machine is a three-wheeled grapple-loader (for example, Bell Ultralogger), excavator loader, or a grapple skidder.

Static delimbers (of the closing-knife design) have been part of the New Zealand logging scene for some years, an early one being the Hunt Processor (Gleason, 1985). In 1991, Bell Equipment (N.Z.) Limited introduced a static delimber that was first designed in Czechoslavakia in 1976. The use of a Bell static delimber in a cable logging operation was investigated by LIRO in 1992 (Jones and Evanson, 1992) and in a ground-based operation, logging Pinus nigra and Douglas Fir (Wright, 1992).

Both reports indicated the effect of branch size class and malformation on delimbing time. For instance, Jones and Evanson found that malformed and large-branched trees took 102% longer than normally formed radiata pine of 1.0 m^3 mean piece size.

A recent entrant to the market has been the Trinder static delimber. The Trinder delimber has been designed for use in both thinnings and clearfell operations. A trial was arranged to evaluate the Trinder static delimber in a ground-based clearfell operation. The objectives of this study were to evaluate the productivity, assess possible safety gains, and assess the delimbing quality.

ACKNOWLEDGEMENTS

LIRO acknowledges the assistance of A. W. Trinder Limited and contractor, D. Hignett.

THE MACHINE

The Trinder delimber has been designed and manufactured by A. W. Trinder Limited, a Nelson-based engineering firm (Figure 1). The total weight of the Trinder delimber is 1.8 tonnes (within the lifting capacity of the Bell Ultralogger). The overall height, with knives closed is 1.15 metres, length is 2.1 metres and width is 1.2 metres.

The six movable knives are opened and closed hydraulically by remote control radio link (in this trial, controls were mounted in the Bell Loggers). The two large knives are designed to encompass at full closure, a tree with a diameter of 50cm.

Power to the hydraulic system is provided by a 9 h.p. Yanmar air-cooled diesel motor, and is equipped with an electric start. A maximum pressure of 550 psi is supplied by the unit. Other features of the Trinder delimber are hydraulic selfcentering and optional use of two large stabiliser arms.

OPERATION DESCRIPTION

Location and Stand

The trees delimbed were from a 28 year old stand of radiata pine with a stocking of 284 sph in Tarawera Forest. Total extracted volume per hectare was 533 tonnes, giving a mean extracted piece size of 1.88 tonnes. Malformation levels were considered low. Skids on which the system worked were mostly flat and dry.

Logging System

The logging system comprised : a John Deere 648E grapple skidder, a Bell Ultralogger, a Bell super logger, a Trinder static delimber, a Komatsu rubber-tyred loader, three operators, three fallers, one log-maker and three skid workers.

The fallers felled the trees for butt-first extraction and cut off the slovens. Trees were extracted by grapple skidder and cold decked at the landing edge where the Bell Ultralogger could reach the butts. Stacks numbered from 20 to 30 trees. The skidder also extracted to another hot-deck skid separate from the static delimber-based system.

The Bell Ultralogger picked up cold decked trees, loaded and pulled them through the delimber, then laid out the delimbed trees on the skid for motor-manual processing. Processed logs were then fleeted to stacks ready for load-out by the Bell Super logger and rubber-tyred loader.

STUDY METHOD

The Bell Ultralogger was timed for defined elements of the work cycle using a continuous time study technique. In addition, non-time variables were recorded. These included: tree butt diameter, length and small-end diameter; tree form (straight with small branches and straight with large limbs, for example edge trees, and malformed trees). Bell Ultralogger travel distance was also recorded.

A critical assessment was made of delimbing quality of a sample of delimbed trees. Every visible stub or branch was measured and recorded under four criteria: flush trimmed, length <10cm, 10 > length <20cm, and length >20cm.

RESULTS AND DISCUSSION

The delimbing system was timed for 12.5 hours, during which a total of 265 delimbing cycles were timed. Delay-free cycle time of the delimbing system was 1.55 minutes per tree. Estimated delimbing productivity was 39 trees or 73 m^3 per productive machine hour (PMH). During the time study, machine availability was 95% and machine utilisation was 62%. Results of the time study are summarised in Tables 1 and 2.

Effect of Delimbing Method

Placement of a bearer log at the butt position, and at right angles to the stack, enabled easier breaking out of trees to be delimbed, because the grappled tree slid easily over the bearer. This refinement was advantageous because of traction difficulties with large trees in the sandy soil.

Table 1- Summary of the Bell Ultralogger/Trinder delimber work cycle (minutes)

Element	No. of cycles	Mean time per occurrence	Mean time per cycle	Range (+/-)*	% of total cycle time
Load	259	0.43	0.42	0.02	27
Process	259	0.36	0.35	0.02	23
Layout	262	0.31	0.31	0.01	20
Travel to load	258	0.30	0.29	0.01	19
Clear slash	81	0.56	0.17	0.02	11
Relocate trees	5	0.46	0.01		
Delay-free total			**1.55**		100%
Move delimber[1]	*8*	*7.02*	*0.21*	*0.09*	

* 95% Confidence limits [1] Operational delay

Table 2 - Summary of Non-time Variable estimates

Non-time data	Average	Range (+/-)*
Butt diameter (cm)	34.2	0.6
Length (m)	23.7	0.3
Small-end diameter (cm)	12.1	0.4
Distance travelled delimbing (m)	24	
Travel empty distance (m)	35	

* 95% Confidence limits

Load time was observed to be affected by tree presentation. Trees stacked so that the tree top was in-line with the path taken by the Bell appeared to enable faster loading of the delimber.

Machine travel time comprised a large portion (39%) of the productive cycle time. To maximise delimbing system productivity, travel distance should be minimised.

The clearing of slash from the delimber knife-set was observed to be important in maintaining adequate delimbing quality. During the study, the delimber was cleared of accumulated slash once every 3.3 trees. A recommended clearance rate would be once every two trees. If this were practiced, hourly delimbing system productivity would be reduced to 34 trees ($64m^3$)/PMH

Effect of Operators/Machines

Two different machines and two operators were used to pull trees through the delimber. One operator, more skilled, using a less powerful Bell Superlogger, was 17% more productive than the other operator, using a Bell Ultralogger.

However, delimber loading times were similar. The stability of the delimber (not fitted with the optional stabiliser bars) while pulling trees through was of concern to both operators.

Effect of Tree Form

Malformed or double leader trees took 19% longer to delimb than trees of good form. This difference was not statistically significant ($p>0.05$) due to the large variation in times. Only 8% of observed trees were classed as malformed and few large-branched trees were observed. Use of a static delimber with a much higher percentage of malformed trees would probably necessitate the selective use of manual delimbing, and cutting of forks or crutches. This would ideally take place in the cutover.

Delimbing Quality

Assessment of delimbing quality showed that 63% of the tree's branches were flush trimmed, with 27% of the branches trimmed to a length of less than 10cm. Most of the branches requiring further trimming were "feathers or slivers " in shape, and would be easily removed by chainsaw. Tree size had no appreciable effect on delimbing quality. Recent LIRO studies (Evanson, 1995) of mechanised processors such as stroke delimbers and grapple processors, have indicated flush trim percentages (of the total number observed), ranging from 79% to 92%.

Operational Considerations for Static Delimber Systems

Cold-deck systems for static delimbers should be considered because productivity is enhanced if interference with other machines is minimised. There are, however, successful operations using static delimbers under hot-deck conditions.

Skids should be flat or sloped to favour downhill tree pulling through the delimber.

Butt first delimbing is a necessity, so head-pulled trees should be stacked to facilitate this. Butts should be aligned to enable the delimber to be used with minimal subsequent re-location. As the delimber is unable to delimb the bottom two to three metres of the tree (this is required to enable gripping by the grapple of the machine pulling through) branches in this zone should also be removed by the faller. All crutches or malforms likely to hinder delimbing should be removed following felling, or malformed trees segregated for manual processing.

COST ANALYSIS

A comparison between a manual trimming system, and a static delimber system was made (Table 3) with the following assumptions:

A manual delimbing system :

- A John Deere 648E grapple skidder
- Komatsu rubber-tyred loader
- Bell logger
- Manual falling and delimbing (four fallers)
- Two log-makers
- Manual processing (four skid workers)
- Extracted tree size is 1.88 m^3
- Machine utilisation is 6 PMH/day

Static delimbing system (as above, except)

- Add a Bell logger and operator
- Slash is cleared once every two trees
- Delimber system productivity 34 trees/PMH
- With delimber systems half the number of fallers (two) are required

Table 3 - A comparison of costs between a static delimber-based system and a manual system

	Manual trimming system	+ Bell logger and Trinder delimber
Daily Cost	$3,817	$3,909
Estimated Production	384 m^3	384 m^3
On-truck cost/m^3	$9.94	$10.18
Difference		**+ $0.24 (2%)**

Average cost is similar for the static delimber option considered. However, the system removed chainsaw operators from the hazardous job of delimbing felled trees in the cutover.

In the medium to long term, a logging system featuring mechanised delimbing may result in additional efficiencies not apparent from a short trial.

CONCLUSIONS

Estimated productivity of a Bell Ultralogger pulling trees through a Trinder static delimber was 39 trees (73 m^3) per PMH in a mean extracted tree size of tree size of 1.88 m^3 (8% malformation). Estimated daily production (6 PMH) is 438 m^3. However, if slash were cleared every second tree, daily production would be reduced to 394 m^3/day, but delimbing quality would also have improved.

The delimbing of significant numbers of malformed trees has the potential to reduce delimber productivity. Malformed stems should be delimbed manually or prepared to a standard which would not impact the static delimbing process. Delimbing quality was such that 63% of all limbs were cut flush, with a further 27% cut to a length of less than 10cm. This compares favourably with mechanised processors, which have been observed flush trimming from 79% to 92% of limbs.

The trial showed that with experienced operators, mechanised delimbing in this tree size can be achieved for a similar cost to an equivalent motor-manual system.

REFERENCES

Evanson, T (1995) : "A Survey of the Quality of Mechanised Log-Making in New Zealand". LIRO Report, Vol. 20 No. 6.

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

Jones, G. and Evanson, T. (1992) : "The Bell Static Delimber in a Cable Clearfell Operation". LIRO Report, Vol. 17 No.21.

Parker, R. (1994) : "Analysis of Lost Time Accidents - 1993 Logging (Accident Reporting Scheme Statistics)", LIRO Report, Vol. 19 No. 9.

Parker, R. and Kirk, P. (1993) : "Felling and Delimbing Hazards". LIRO Report, Vol. 18 No. 22.

Wright, S. (1992) : "A Productivity Analysis of a Modified Bell Static Delimber and Bell Ultralogger in a Small Piece-sized Minor Species". B. For. Sc. Dissertation, School of Forestry, University of Canterbury.

For further information, contact:

LOGGING INDUSTRY RESEARCH ORGANISATION
P.O. Box 147,
ROTORUA, NEW ZEALAND.

Fax: 0 7 346-2886 *Telephone: 0 7 348-7168*