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A SURVEY OF THE QUALITY OF MECHANISED LOG-MAKING IN NEW ZEALAND

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Figure 1 - A Denis DM3000 stroke delimber

ABSTRACT

A sample of logs produced from six mechanised delimbing and log-making operations in radiata clearfell was measured for length and small-end diameter accuracy. The percentage of logs within specifications was also determined. The processors studied were : a Denis 3000, Denis 3500, Hahn Harvester (2) and Waratah HTH Model 234. For comparison, logs produced by two manual processing crews were also assessed.

In addition to length and diameter accuracy, delimbing quality and instances of splitting or slabbing of the small-end of the logs were recorded. Included were instances of minor stem surface impacts caused by drive rollers, knives and holding spikes.

Results showed that mechanised log-making is matching manual log-making in the areas of length and diameter measurement, and in delimbing quality.

INTRODUCTION

One of the factors which may be slowing the introduction of mechanisation into the New Zealand logging industry is the quality of the delimbing and log-making achievable by machines. The aspects of quality which have been of concern are:

- accuracy of length measurement
- delimbing quality
- end checking or splitting
- log surface impacts by pineapple rollers or delimbing knives
- ability to achieve optimum value recovery

With an increase in the number of machines being used for clearfell harvesting, the quality aspects, particularly length measurement of such operations are receiving increased attention. Most forestry companies specify a log length within a ± 3 or 5cm tolerance, flush trimming, and SED not smaller than specified diameter. Splitting or checking at the small-end is often allowed if it appears to be outside the perceived square into which the log is to be sawn. No splitting is generally permitted in peeler quality logs. Two recent LIRO studies reported a Waratah HTH234 processor in 1.8m^3 tree size achieving 76% to 88% of logs within ± 5cm of specified length. In 2.9 m^3 piece size, accuracy was reported to be 69% to 82% of logs within ± 5cm of specified length (Evanson, Riddle and Fraser, 1994a, 1994b). Cossens (1991) studied the log- making ability of a Hahn Harvester operator, finding that from 105 logs, 83% were out of specification (± 5cm) for length.

A further study in Australia showed that this problem of poor length measuring ability was not confined to single-grip harvesters, but was a characteristic of other mechanised systems. Evanson, Riddle and Fraser (1994) reported that a Timberline ST 3530 stroke boom delimber working in Australia in 2.2m^3 trees produced 86% to 88% of logs within ± 5cm of specified length. In North America and Europe published results are no better, even when tree sizes and branches are smaller and logs are shorter, with thinner bark. For instance, in a study of a Lim-mit LM2200 log processor, working in a merchantable piece size of 0.26m^3, 89 logs were measured and 52% were found to be within ± 5cm of specified length (Moshenko, 1992).

Cossens (1991) rerported a motor-manual log-maker producing 92% of logs within ± 5cm of specified length.

The study objectives were: to (a) record length and diameter measuring accuracy, (b) delimbing quality, and (c) stem surface and log end impacts, in the logs produced by mechanised log-making systems being used in New Zealand, and to compare that to data from a small sample of motor- manual operations. The issue of value recovery was not addressed.

ACKNOWLEDGEMENTS

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STUDY METHOD

Length Accuracy

Length accuracy was assessed by measuring, to the nearest centimetre, 200 logs from each operation. Only one length measurement was taken from each log. The 200 logs were comprised of 50 logs chosen at random from each of four log types. The log types were chosen to cover a range of lengths (typically, from 3.7m to 11m). No pulp logs were measured.

Small-end Diameter

Small-end diameters (SED) under bark of the 200 logs selected for length measurement were taken. Two measurements, at right angles to each other, were averaged (a+b)/2) to the nearest centimetre.

Splitting and Slabbing

All 200 logs selected for length measurement were checked for splitting or slabbing damage at the small end. The size of the defect was measured as shown in Figure 1 (b-c) and the net average "damage-free" diameter noted (overall SED = (a+c)/2). A "significant" diameter reduction was considered to be greater than or equal to one centimetre.

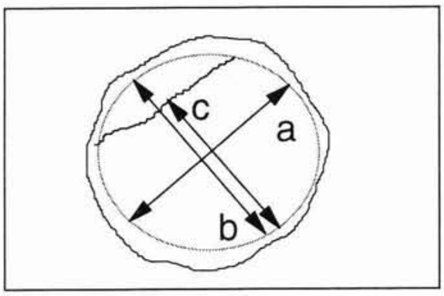

Figure 1 - Measurement of SED and effect of splitting

Delimbing Quality

A total of 60 logs (15 each of four log types) were subjectively assessed for delimbing quality "as they lay" in the stack or on the skid. Only the visible portion of each log was assessed, typically 90° to 180° of circumference. Every visible stub or knot was counted and judged to be either "flush trimmed", or in need of trimming. A heavily frayed end, chamfered cut, or a short "feather" that could be pushed down by hand, was treated as a flush cut.

Stem Surface Impacts

Stem surface impacts clearly identified as being due to the delimbing process were noted and counted. This included roller, spike and knife penetration into the cambial layer, and tearing below the internodal surface at the branch-node intersection, which was termed "branch-tear". The longitudinal pulling of fibres from the branch stub was termed "branch-draw".

RESULTS AND DISCUSSION

The results of each evaluation have been summarised separately. They cannot be directly compared, as many variables affect the results, including:

- a range of operator abilities and techniques
- operators cutting within a zone rather than to the exact specified length
- branch size, condition and frequency
- tree size, weight, form and bark thickness
- mechanical condition of the processor
- the model and technical specifications of the processor
- degree of production pressure.

Length

There was a greater incidence of non-square cutting of log ends in the manual than in the mechanised operations. This, together with misread tape and paint-mark thickness, was considered responsible for most errors in motor-manual length accuracy.

Small-end Diameters

Although many mechanically processed logs were found to be in-specification, the cutting of diameters well above the minimum, can ensure that all logs are in-specification. Splitting and slabbing of

Table 1 - Results

	Denis DM 3000 #1	Denis DM 3000 #2	Denis DM 3500	Hahn #1	Hahn #2	Waratah HTH 234	Motor-Manual #1	Motor-Manual #2
Length spec. (±cm)	3	5	3	5	5	5	5	5
% out of spec. for length	47	8	11	6	4	3	7	2
% out of spec. for SED	0	0	0	8	4	4	8	1
Split : % with SED loss (≥1cm)	25	28	6	6	2	6	4	5
% branches flush trimmed	79	89	92	83	86	88	90	-

small-ends was related to cutting speed and log tension at the time of cutting.

Manual processing damage to the small end included fibre draw, and slabbing due to incomplete cross cutting.

Stem Surface Impacts

Impacts to the log surface were caused by a number of factors, including: drive roller spikes, holding spikes, and delimbing knives. Branch removal itself was a factor, in the case of *branch draw*, where the branch, instead of being cut, was effectively pulled from the stem, leaving sliver-shaped cavities. The other case of branch removal damage was *branch tear*. An incomplete cut through the branch base sometimes resulted in a removal of a slab of wood fibre, which included the branch collar, and extended into the internodal zone.

Concern over stem surface impacts derives mainly from two perceived effects. The first being the intrusion of sapstain or fungal decay. Recent research in Britain (Forestry Authority, 1992) showed that mechanically harvested logs were more susceptible to stain than those from manual systems.

Mechanised systems, however, have the potential to reduce the time between felling and sapstain treatment. The second concern is one of possible physical degrade through defects appearing in sawn or peeled lumber. All mechanised processing was observed to result in loosening and removal of quantities of bark, especially in spring.

CONCLUSIONS

The results show a wide range of performance from mechanised processors. The reasons for this include: a range of operator abilities and techniques, model and technical specifications of the processor, degree of production pressure, and tree characteristics. In terms of length measurement, diameter sensing, and delimbing quality, mechanised processors are starting to match the performance of manual processing.

In all but one case, 90% of logs cut by mechanised systems were within length tolerances and better than 95% were within specification for SED.

Splitting at the small-end of logs was found to be be a problem experienced by motor-manual systems as well as mechanised processors.

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