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MADILL 171 HAULER

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ABSTRACT

The first of the new Madill 171 skyline haulers was studied logging a Douglas Fir stand in Oregon, USA. Extraction was in log length and average log size was .84 m^3.

Using a three drum, dropline carriage system, the hauler was producing around 274 m^3 in an 8 hour shift. Machine related elements in the 171 operation were nearly twice as fast as a Madill 071 working under similar conditions in New Zealand.

A lack of tower height and limitations on rope capacity and line speeds are considered to be some of the main disadvantages with 071 Madills. The extra power and increased tower height of the 171 make it ideally suited to logging New Zealand's radiata new crop resource.

For Madill 171s to be economically viable in New Zealand, loggers will have to change their systems to minimise landing delays. These changes could include mechanising parts of the operation or delimbing and processing in a separate location, i.e. at the stump or a secondary landing.

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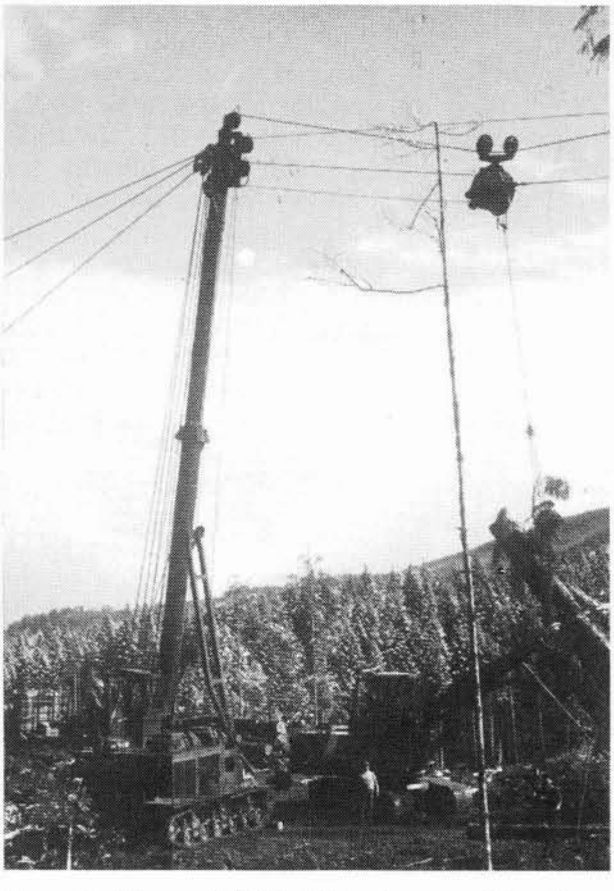

Figure 1 : The new 171 Madill hauler, a machine with potential for logging new crop.

INTRODUCTION

The proportion of cable logging in New Zealand is going to increase dramatically by the mid 1990s (Tustin, 1983; Olsen, 1989). Constraints such as road access, soil and water considerations and the general topography itself are going to narrow the choices a logger has when planning these areas. Skyline systems are likely to be a essential component of most logging plans, particularly in areas outside the Bay of Plenty.

Logging contractors bidding for the work, will tend to look for the lowest cost machinery to be competitive, but is this the right approach to take? The most common mobile skyline hauler with integral tower in New Zealand is the five drum Madill 071 (Donovan, 1978). While these machines are known for their reliability here, recorded productivity has never exceeded 200 m^3 per day on a sustained basis.

Generally, a lack of tower height and limitations on line speeds are seen as the main disadvantages with the 071. In 1988, S. Madill Limited started producing the 171 which has a higher tower, greater rope capacity, faster line speeds and an improved undercarriage. According to the specifications, this new machine overcomes all the deficiencies of the Madill 071, but associated with these improvements is a higher price tag. The New Zealand industry needs to know whether this extra cost is justified over and above the secondhand price of an 071. (The 071 is no longer manufactured.)

A study was conducted on the first of the new Madill 171s which was operating in the Falls City area of Oregon, USA. This Report summarises the data collected and discusses the potential of the machine for logging new crop in New Zealand.

THE HAULER

The Madill 171 is a self-propelled, track mounted machine with 5 drums and a telescoping tower. Basic specifications are as follows:

Engine	298 kW Cummins NTA 855C or 298 kW Cat 3406 BTA
Converter	Twin Disc 11500 MS 340 three stage hydraulic torque converter
Undercarriage	M4A3 army surplus with a footprint area of 4.48 m^2
Gradeability	15% without assistance
Tower	Tubular steel, hydraulically raised and tilted into the 8° operating position

Working height to top of skyline fairlead - 15.4 or 21.4 m

Gears	Helical cut from heat treated 8637 steel

Drum Capacities and Performance

Drum	Rope size (mm)	Operating Capacity (m)	Mid drum Line pull (kg)*	Mid drum Line speed (m/m)**
Skyline	28	610	46,989 (2nd wrap)	-
Mainrope	22	610	21,565	532
Tailrope	19	1220	14,092	567
Tagline	13	653	6,456	766
Guylines (4)	28	69	2,960	34

* At stall on the torque converter ** With no load

Clutches and Brakes

Drum	*Clutch*	*Brake*
Skyline	*218 Pancake Wichita*	*Wichita 244 water cooled, 37" x 6" Band brake*
Mainrope	*26 x 5 BF Goodrich*	*Wichita 218 water cooled, 30" x 4" Band brake*
Tailrope	*26 x 5 BF Goodrich*	*Wichita 218 water cooled, 30" x 4" Band brake*
Tagline	*218 Wichita water cooled*	*30" x 4" Band brake*
Strawline	*216 Wichita*	*23.5" x 2.5" Band brake*

Controls	low pressure air system	Length	Carrier only, 7.1m, with tower lowered 16.5m
Operating weight	46,300 kg	Price as at December 1988 $US375,000	

LOGGING SYSTEM

The Madill 171 was rigged with a dropline carriage system using an Interstate I-DLC 36 carriage (see Figure 2). It was working in a clearfell operation of 70 year old Douglas Fir. The trees had been felled and processed into log length at the stump by contract fallers. Three log sorts were being cut with a preference for one main sawlog type. The trees were considered representative of smaller new crop radiata stands in New Zealand with an average processed log size of .84 m^3.

For most of the study three 4 m long strops were attached to the dropline, but occasionally an extra one was added to pick up smaller pieces. Generally two people were breaking out, but for about a third of the time, the hook tender(1) also assisted. No pre-stropping was done in this operation.

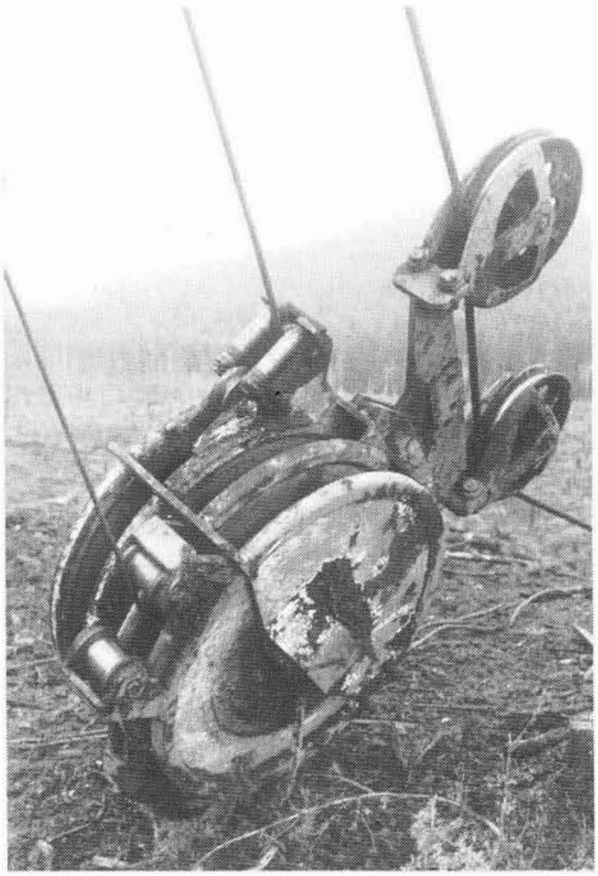

Figure 2 : The Interstate I-DLC 36 carriage used on the 171 Madill

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(1) *A hook tender is basically the crew boss (employed by the contractor) and his responsibilities are to plan operational details such as machine moves, which system to use, manpower deployment etc. He also pre-rigs line shifts and guyline extensions.*

Two landings were worked on during the study, both of them small at around .06 of a hectare. Unhooking and general landing work was carried out by a chaser[2]. The loader was a 30 tonne track mounted Koehring 366L with a live heel. Logs were being stacked in a radial pattern around the landing.

STUDY METHOD

Using a continuous time study technique, 127 hauling cycles were recorded. Ground profiles were run to establish outhaul and inhaul distances. The number of pieces per cycle was recorded and the average log volume estimated by converting actual scaled board-foot piece size per truckload to metric volume and dividing this by the number of pieces. Typical ground profiles are shown in Figure 3.

Loader and landing activities in this operation were also studied and these have been reported on separately (Prebble, 1989a).

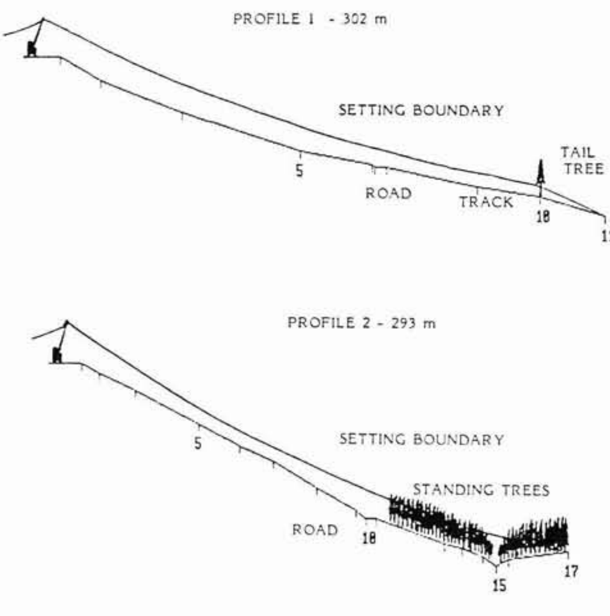

Figure 3 : Typical ground profile of the area being logged

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(2) *The chaser is similar to a New Zealand skiddy and his job is to unhook the incoming drags, brand the logs (when required) and assist with rigging. He also has to do a final trim and carry out any re-processing that is necessary.*

RESULTS

The results from the study data are summarised in Table 1. The two breaker-outs were assisted by the hook tender for 47 cycles.

Table 1 : Cycle Times for Madill 171

Element	Time, mins
Sample size	127
Raise rigging	.20
Outhaul	.50 (200m)
Position(1)	.44
Lateral out	.21 (5.5m)
Hook on	.80 (3.83pcs)
Breakout(2)	.26
Inhaul	.76 (200m)
Lower rigging	.15
Unhook	.36
Delay free total	3.68 (SD =.76)
Production delays	.04
Landing delays	.08
Rigging(3)	1.69
Other	.09
Total cycle time	5.58
Pieces/cycle	3.83
Ave piece size	.84m^3
Ave drag size	3.22m^3
Production/hour	35m^3 (41 pcs)

(1) Position includes untangling strops
(2) Lateral in to the carriage is part of breakout
(3) Includes machine shift to a new landing
SD= Standard deviation, an indication of the range of 67% of the data around the mean.

Outhaul and inhaul times have been standardised to a common 200m distance by the equations:

Out = .127 + .00185 (dist), r^2 = .82
Inh = .173 + .00292 (dist), r^2 - .77

Hourly productivity of 35 m^3 , is high given the relatively small average log size, and is much higher than current New Zealand cable productivity (Galbraith, 1987).

While cycle times were fast with quick outhaul, hook on and inhaul elements, the small average drag size of 3.22 m^3 was well below the capacity of the machine. Even with this relatively small payload, the 171 was more productive than a Madill 071 working under similar conditions in a New Zealand Douglas Fir clearfell operation (Mythen and McConchie, 1987). Times for machine related elements were 94% slower in the 071 study but average drag size 1 m^3 larger. More pieces per drag, even with longer hook on times, would undoubtedly have increased the productivity of the Madill 171.

There was a marginal improvement in productivity when three breaker-outs were hooking logs on. Cycle times were actually longer but more pieces per cycle were attached. The maximum distance the breaker-outs pulled slack from the carriage was 30 m, but the average was only 5.5 m. Being able to hook logs on from either end is one of the advantages of log length extraction. Log loss, i.e. logs coming off the rigging during breakout or inhaul, was less than 2%.

It should be noted that included in the rigging delay is 76 minutes for a complete machine shift (to a new landing) which would normally only occur once in a 10-12 day period. As a result the average cycle time is longer than usual although very brief smoko breaks (included in "other" delays) have partially compensated for this.

Set-up time during the machine shift took longer than usual because the skyline had to be anchored through 100 m of standing trees and during the process, fog closed in, impeding vision of the tower.

When moving from one landing to the next (a distance of approx 60 m) the tower of the hauler was tilted from the inclined position to the vertical and telescoped down to 15 m.

In extending the results to a daily production level, some allowance is necessary for mechanical delays which are not necessarily picked up in a short term study. Modern cable haulers typically have very high availability - in the order of 98%. The expected daily production for an eight work hour day therefore would be 35 m^3 x 8 x .98 = $\underline{274m^3}$.

In this study the hauler utilisation was only 65%, which is low by PNW standards. One of the reasons for this was the full machine shift recorded, which reduced utilisation by an estimated 7%. Daily production would have been approximately 304 m^3 at an utilisation level of 72%.

COSTS

Based on new prices for the Madill 171 and a 30 tonne loader, the daily cost of this operation with a nine man crew would be around $NZ3,600 (see Table 2). The unit cost for the range of expected daily production would then be: (on truck)

274 m^3/day - \$13.10/m^3

304 m^3/day \$11.80/m^3

Table 2 : Estimated Daily Cost of a Madill 171 Operation

Item	Cost ($NZ)
Hauler	1060
Loader	525
Labour	1375
Operating Supplies	230
Overheads	65
Profit	325
Total	3580

DISCUSSION

Compared to similar New Zealand operations, daily productivity of the Madill 171 was high at 274 m^3. A machine shift during the study resulted in longer than usual rigging delays which reduced overall production.

The cycle times recorded were fast but average drag size was well below the capacity of the hauler. Productivity could have been increased with more pieces per cycle. Machine related elements were nearly twice as quick as a Madill 071 working under similar conditions in New Zealand. While some of this difference could be attributed to operator skill, most of it appeared to be due to the improved machine capabilities. The added advantages of extra power, higher line speeds, larger rope sizes, along with increased capacity and more tower height make the Madill 171 ideal for logging radiata new crop.

To achieve the high production levels necessary for the Madill 171 to be economic, changes to the existing New Zealand logging practices may be necessary. Currently, landing activities are limiting productivity in most of our cable operations. Prospective 171 owners will have to either:

- Process trees into log length at the stump and introduce a heelboom loader, or
- Mechanise delimbing and processing at the landing, or
- Two-stage trees away to a separate landing

to make daily production of around 300 m^3 sustainable.

The Madill 171 should not be introduced into New Zealand cable logging operations in isolation. A whole systems approach will be necessary to make the operation economically viable.

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