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EXCAVATOR HIGH LEAD LOGGING

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Figure 1 - Komatsu PC400 with winches

ABSTRACT

Short, steep slopes in settings that are predominantly suited to ground-based operations are causing concern, in that logging these areas by tractor or skidder may be unacceptably hazardous and may cause excessive soil disturbance. One alternative to the use of a tractor or a skidder is an excavator with a dual winch installation which is able to utilise high lead, scab or shotgun cable systems to log these slopes. This evaluation is of a Komatsu PC400 working in Tasman Forestry Limited's Tarawera Forest in 1.7m^3 trees. An estimated 415m^3 was extracted in 115 cycles over two days. Extraction was downhill over an average haul distance of 78m.

INTRODUCTION

Many of the short steep slopes currently being logged by tractors and skidders are causing forest owners and logging contractors concern as they try to minimise

the environmental impacts of such logging, and as the implications of the Health and Safety in Employment Act 1992 are understood. In the period 1985 to mid-1993 there were 63 reported logging machine rollovers on slopes, and of these, six resulted in the operator suffering fatal injuries (Sullman, 1994). There are parts of many ground-based settings that are too steep to safely operate skidders or tractors but these areas are often very small and the cost of bringing a hauler in may not be operationally feasible. Tracking such slopes may improve safety but cause high ground disturbance, whereas a cable system will cause minimal environmental impacts and does not compromise operator safety.

Stephen Dewes, a Gisborne contractor, has a Komatsu PC400 hydraulic excavator with two hydraulic winches added. This machine was recently studied when roller crushing scrub in the Gisborne area (Riddle 1993). The two main winches are Pullmaster HL25-4s and each holds 450m of 16mm swaged wire rope. The machine is capable of cable logging using high lead, scab skyline and shotgun systems. A strawline drum is used to assist in initial set up. The main and tail drums have full hydraulic interlock capacity. Unlike the American examples (Skurdahl 1990), this machine can operate the drums with the bucket in the ground as a brace and no guylines are used. The winch blocks are hung from a small extension permanently mounted at the top of the boom. This means that line shifts are easily carried out and the machine can actually move sideways during outhaul to help the breaker-outs or inhaul to move drags around obstructions.

Some potential logging options for this unit include :

(1) PC400 as extraction unit both shovel logging and cable logging, plus loader and crew doing the full job through to log-making and loading.

(2) Ground-based crews do all easy country and leave the steep sections. The PC400 moves from crew to crew - when they arrive, the ground-based crew use their skidder for two staging.

(3) Woodlot logging - this concept has enormous potential for woodlot logging as the one machine can road, cable log, shovel log, fleet and load trucks. For very small woodlots and shelterbelts, transporting and using one machine may be a sensible option. The PC400 at 52 tonnes is too heavy to shift easily on public roads for reasons of bridge weight restrictions and transport availability - a machine of under 40 tonnes may be more convenient.

The first two systems need careful planning by harvest planners to identify all those areas and volumes which can be harvested with such a machine. The second system would require operations managers to co-ordinate the two contractors.

NOTE

This machine should not be compared with a purpose-built hauler and should not be used instead of a hauler on a cable setting. Its advantage lies in its mobility around a setting and its ability to cable log small awkward corners that involve frequent line shifts and machine movements. Harvest planners should be able to use purpose-built haulers where they can work to their full potential, knowing that the odd corners can be logged with the excavator. The flexibility of an excavator means that if there is no suitable cable logging available, the machine could be used for a number of jobs which can be performed by an excavator.

ACKNOWLEDGEMENTS

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THE MACHINE

Machine Specifications

- Komatsu PC 400
- Operating weight : 52 tonnes
- Engine: 206 kW
- Boom and arm reach : 12 metres

Winch Specifications

- Two Pullmaster HL 25-4s with variable line speeds and strawline winch.

- Drum capacities 740m 13mm swaged wire rope
  or 450m 16mm swaged wire rope
  or 320m 19mm swaged wire rope

  Low speed: Line pull 11 tonnes
  Line speed empty drum 42m/min
  Line speed full 90m/min

  High speed: Line pull 2.5 tonnes
  Line speed empty drum 198m/min
  Line speed full 420m/min

Excavator conversion packages are available through Stephen Dewes of Gisborne and Trackweld Group Limited of Rotorua. These involve adding one to three winches and a strawline drum with the hydraulic interlock control package.

The approximate price for a two drum and strawline conversion is currently $115,000 which includes wire rope. Another $20,000 would purchase butt rigging and shotgun carriages, tail blocks and a talkie tooter system.

OPERATION DESCRIPTION

The PC400 was working in Tasman Forestry Limited's Tarawera Forest in a setting where a ground-based contractor, Chris Jensen, was logging the flat areas, but not a steep face (maximum slope distance 200 m) that stretched along the setting boundary. The PC400 first shovel logged along the bottom of this slope reaching up slope as far as possible and bunching for Chris Jensen's cable skidder, a Valmet Ranger F65. The PC400 then used a high lead cable system to haul wood to the bottom of the slope. It gradually moved along the slope leaving a stockpile of logs for the skidder to two stage. Steve Dewes also provided two men to breakout and one to unstrop. When studied, this crew had only three weeks' experience with the cable logging operation so was on a steep learning curve. The PC400 production was two staged and processed by the Jensen operation which was solely dedicated to the excavator while it was on site.

The slope was even, with some small gullies, and lift was only obtained by moving the PC400 away from the base of the slope. There would have been no extra lift obtained by using a scab system and line shifts would have taken longer. The trees were small, with a large number of multiple leaders. When felled down slope these gave a number of heads from which to choose when stropping a load, and led to a high incidence of breakage and loss on inhaul. Average merchantable volume estimated by a MARVL assessment of the study area was 1.7m^3.

STUDY METHOD

A continuous time study of the PC400 was undertaken for defined elements of the work cycle over two days. Haul distance for each drag was estimated to the nearest 5m. The number of tree lengths and short pieces in each drag were recorded. An

Table 1 -Summary of basic extraction cycle data

Element	Average Observed Time (min)	Std. Dev. (±)	Freq. (%)	Average Time / Cycle (min)	%	Comments
Outhaul	0.51	0.20	100	**0.51**	9	78m AHD (max 160m)
Strop	2.46	0.84	100	**2.46**	41	2 breakerouts
Inhaul	1.29	0.56	100	**1.29**	21	
Unstrop	1.04	0.55	100	**1.04**	17	Av.2.2butts / 0.7tops
Other Work	1.65	1.89	23	**0.37**	6	
Move	0.91	0.60	27	**0.24**	4	
Shovel	0.44	0.32	26	**0.11**	2	
TOTAL				**6.02 ± 2.04**	100	Av. 3.60m³

NOTE: Based on 115 Timed Cycles

indicative total volume was estimated from tree lengths and top pieces extracted and MARVL data. An activity sample of all parts of the operation (breaker-outs, PC400, unhook and two stage machine) was undertaken every minute.

RESULTS

Production

A total of 115 full extraction cycles were recorded (68 Day 1/47 Day 2). Based on MARVL data, an estimate for the average tree length extracted was 1.60m³. Additional merchantable top pieces were estimated to average 0.15m³. The ratio of "tree-lengths" to "top pieces" extracted was 252 : 75 or 3.6 : 1. The total volume extracted was estimated to be 415m³, or an average 3.6m³ per cycle. Forty nine per cent of cycles had no top pieces included, while 5% of cycles were composed entirely of merchantable top pieces.

A summary of all observed times, variation and frequency, together with an average cycle time and details of haul distance and load size are shown in Table 1.

During the study the mechanical availability was 97% and the machine utilisation was 62%. Production per productive machine hour (PMH) based on 6.02 minutes per cycle and 3.6m³ per drag was 35.9m³ / PMH.

Special Features

The machine was able to move freely because of the absence of guylines, and was also able to use the grapple to assist the unhooker or clear the chute. All track movement by the PC400 was recorded as "move" time. The PC400 was able to move with relative ease even during inhaul or outhaul, and this was done to: improve log control down-slope by selecting a more suitable extraction corridor, avoid potential obstacles, reposition the strops at the break-out site to improve lateral reach, and to help land logs on the pile. The PC400 would at times move twice for a single haul. Having no guylines saved a considerable amount of time when shifting lines.

All use of the grapple was recorded as "shovel". This included clearing and rearranging the log pile and assisting unstropping, but did not include any *shovel logging* as such during this study, as logs were shovelled off the lower slopes along the front before starting cable operations.

Delays

No unusual delays were recorded during the study, although it was clear that time taken for rope shifts could be reduced significantly by improved preparation and crew skill. This system is limited to relatively short hauls, so rope shifts will

always be an important component of daily times.

Activity Sampling

The activity sampling of the four elements of the operation: the hauler and skidder, breaker-outs and unhooker, showed no interference between hauler and skidder. The two machines kept at least a tree length between them. The unhooker spent 3% of his time stropping logs for the skidder and 53% of his time waiting for work. If the landing could have handled more work, he could have spent more time pre-stropping logs for the skidder. Two stage distance was 70m.

COSTING

Capital Costs Used for Estimating Daily Costs

PC400	$500,000
Winch conversion	$115,000
Total	$615,000

Assume depreciation to $250,000 over 10,000 hours, and 220 days per year.

Daily costs

A costing for the excavator and four men was carried out using the LIRO costing format (Riddle 1994). A daily cost is derived as follows:

Four workers	$660
Operating supplies and Overheads	$ 98
Transport	$ 57
PC400 with winches	$875
Profit - 10%	$170

= Total $1,860 per day

CONCLUSIONS

The Komatsu PC400 with winches extracted an estimated 415m^3 in 115 cycles over two days using a high lead cable system. Extraction was downhill over an average haul distance of 78m. The PC400 with operator, two breaker-outs and an unhooker were used to extract a steep area in a ground-based setting. The ground-based unit's skidder was used to two stage wood extracted by the PC400. An indicative costing linked with the production rate showed that this operation extracted wood at a reasonable cost. The machine should not be compared with a purpose-built hauler, but should be viewed as an alternative to bringing in such haulers to log the steep areas that are causing environmental and safety problems in predominantly ground based settings.

REFERENCES

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The costs stated in this report have been derived using the procedure shown in the LIRO "Business Management for Logging" Handbook. They are only indicative estimates and do not necessarily represent the actual costs for this operation.

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