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EXTRACTION WITH LONG REACH STANDING SKYLINES

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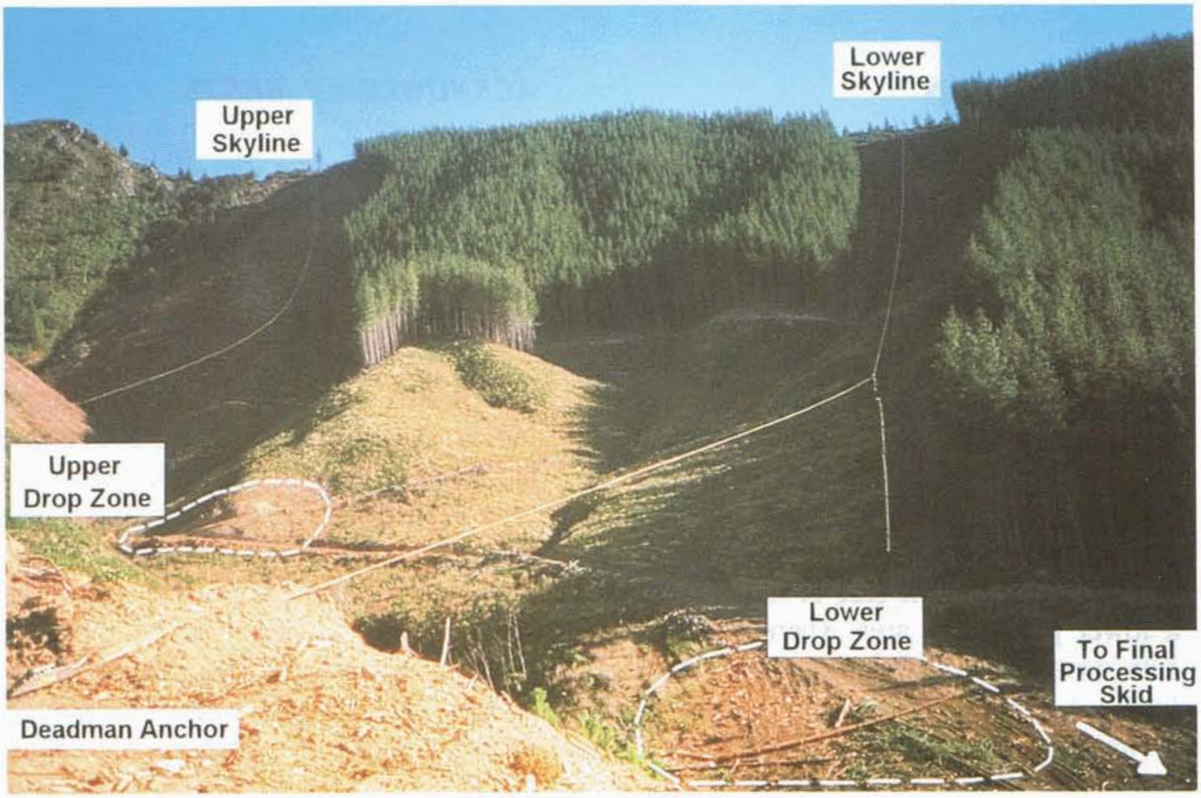

Figure 1 - Gantner HSW 80 extraction setting

ABSTRACT

A short time study was made of two standing skylines extracting over spans up to 1,275m. Continuous time study data indicated a delay free cycle time of 12.0 minutes for a single working skyline. The average volume extracted was 1.37m³, giving a productivity estimate of 7m³/productive machine hour. Volumes were estimated using a relationship developed between collected tension data and a number of measured load volumes for each skyline. The combined production for the two skylines averaged 90m³/day. Important planning and operational factors are identified and discussed.

Figure 2 -Gantner HSW 80 with rigged tail spar

INTRODUCTION

During the past two years, a small forest located at Onepua Bay within the Marlborough Sounds has been harvested.

The initial system used a swing yarder to extract tree lengths to a midslope track, followed by secondary extraction by skidder or tractor to one of a number of small processing decks, where they were partially processed. They were then transported by one of two standing skylines rigged either side of the deck, to a lower processing area where final log cuts were made (Robinson, 1993). The logs were then loaded and barged to Picton.

While harvesting the last part of this forest, the two standing skylines were used as extraction units in their own right. This report summarises the results of a case study describing this operation and its productive capability.

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OPERATION DESCRIPTION

The two skylines were rigged independently of each other, 500m apart at the top of the hill and 50m apart at the bottom (Figure 1). Both skylines were anchored using deadman anchors at each end, and were supported by radiata tail spars rigged as intermediate supports. The lower skyline had an additional intermediate support rigged toward the upper end of the corridor. A multiple block purchase was used to pre-tension each 28mm skyline. Single drum Gantner HSW 80 winches (Figure 2) were located at the top of each extraction corridor and the trees were broken out to 2.5 tonne Koller carriages and then moved downhill using gravity. The winches used fan governors to restrain the loads as they travelled down the skyline. The loads were lowered in a drop zone located about 300m in front of the lower anchor for each skyline.

The skyline was positioned over the middle of the extraction corridor, with the trees laid out across the slope below it. Three breakerouts were used at each skyline and one of them spent much of his time doing a light trimming and occasionally making pre-emptive cuts into a butt section and top piece, to ease the hook up and breakout process. Most pieces were pre-stropped. The first pieces extracted were taken from directly beneath the skyline, followed by timber on the downhill side (steep sideslope present) because of the ease of butt presentation, and finally timber from the uphill side. Pre-emptive cuts on trees upslope from the skyline reduced the need for lateral hauling. Trees could not be hooked at the small end as they would inevitably break off and slide away out of reach.

As the timber arrived at the drop zones, it was unstropped by a man located at each site. A chunk of wood was hooked on at the drop zone before returning the strops, to avoid them flying over and fouling the skyline, which may have required the skyline to be lowered. Slovens and branches were removed at this landing before secondary extraction by either a grapple skidder or tractor with arch. Final cutting to length took place at a lower processing landing, located 300m and 550m from the lower and upper skylines respectively.

STUDY METHOD

A continuous time study was made of the longer (upper) skyline span over a four-day period. Extraction distances were recorded to the nearest 25m and the number of tree lengths, butts and tops were recorded for each cycle. Tension data was collected for each skyline during the above period. A sample of loads for each skyline was scaled, with the volume related to the tension in the skyline just prior to the release of the fully suspended load above the drop zones. Tension data was then used to estimate load volumes. An activity sample of the two operating skylines and the secondary extraction was included.

RESULTS

Primary Extraction

The detailed time study was focused on the longer span, upper skyline, that had a maximum rigging distance of 1,275m. However, records of loads extracted by both skylines were collected (Table 1).

Table 1 - Summary of timber extracted

	Upper Skyline	Lower Skyline
Loads recorded	126	85
Trees	121	106
Butts	59	28
Tops	62	30
Total pieces	242	164
Pieces/cycle	1.9	1.9

The above data indicates that 33% and 21% of trees received a pre-emptive cut prior to extraction, for the upper and lower skylines respectively. Additional pieces due to felling or extraction breakage were minimal. For most loads, the peak tension was recorded and used to estimate haul volume. The average haul volume for the upper Gantner was 1.4m^3 and for the lower Gantner 1.8m^3, with approximately 28% and 37% of the loads giving peak tensions above the safe working load of the skyline respectively. Peak tensions were reached during the breakout phase of the operation. The 1.9 pieces per cycle for the upper skyline is equivalent to 1.4 full tree lengths, which indicates that the average merchantable tree size was about 1.0m^3.

Detailed times for the extraction of 126 loads by the upper Gantner were collected and summarised (Table 2).

Table 2 - Cycle time data summary (n=126)

Element	Av.Time (mins)	Min	Max
Raise strops	0.73	0.38	1.88
Travel empty	2.38	0.57	2.98
Lower	0.41	0.15	1.78
Hook up	2.61	0.92	9.21
Breakout	1.23	0.28	7.26
Travel loaded	2.54	0.63	4.00
Drop	0.81	0.38	2.99
Unhook	0.56	0.13	2.20
Other work	0.75	-	-
TOTAL	12.02		

Average haul distance was 740m, with 90% of all cycles extracted between 750m to 850m from the drop zone and the remaining 10% from between 150m to 200m out. Haul volume averaged 1.37m³ (range 0.5 to 2.5m³).

Travel empty and travel loaded times observed were similar, and together accounted for 41% of the productive cycle time. Choosing the most appropriate fan brake to match the terrain and expected load size is important. A smaller fan paddle was fitted after the first 13 cycles timed, resulting in an improvement in loaded travel speed.

Hook up was the single longest element, taking 22% of the total time. Wire rope strops were used, although chains were obtained for the lower Gantner part way through the study. Most pieces were pre-stropped. Lateral hauling out to 40m was observed although most cycles were hooked on within 15m of the skyline.

Productivity for the upper skyline has been estimated at 6.84m³/productive machine hour (PMH), assuming the above cycle time, haul distance and haul volume. Based on a day of 6.5 productive hours, this equates to a daily production of 44.5m³. Production data from the lower skyline was based on tension information. Production from this skyline averaged 45m³/day over a similar distance, which gave a system average (both skylines) of 90m³/day. This estimate should be regarded as conservative, due to the limited experience of the crew in setting up and operating the Gantners for extraction, and poor deflection on part of the setting.

Discussion

- Productive cycle times for this setting should increase or decrease by approximately 0.33 minutes/cycle for a corresponding change of 50m in average haul distance. Note that operator skill, fan brake size, and profile characteristics together with load size, will all affect travel times.

- The time taken to set up the Gantners on each corridor may take several days. The time required depends on accessibility and the number of support trees to be rigged. This time is offset by the large area accessible within each corridor.

- Difficulties associated with the hook up and breakout of trees around the guylines of the tail spar and intermediate supports, led to longer cycles and reduced load size.

- Hydraulic clamping Koller 2.5 tonne manual slackpulling carrriages were used on the skylines. Time spent waiting for the carriage to clamp the skyline and release the locking device or vice versa, prior to "travel empty", "lower" and "drop" elements, averaged 0.65 minutes per cycle (>5% of the productive cycle time). This aspect warrants closer attention in looking for an overall improvement in cycle times.

- Log loss during extraction of 2% was recorded, mostly the result of breakage. A further 6% of logs had bits broken off during breakout or loaded travel.

- Full suspension was not reached until the load was about 450m out from the drop zone. Up slope from this, clearance and deflection on the whole was poor, with a significant sideslope across the extraction corridor in the area where most of the extraction occurred during the study. A number of observations were made of difficulties in the system that could be attributed to these factors:

  1. Manual slackpulling uphill requires hard work. In this situation, when the loads were pulled clear for extraction, they tended to race off down the slope resulting in breakage as they struck low stumps or other felled timber.

  2. Manual slackpulling downhill was considerably easier, but as the distance increased it took longer to breakout the load back to the skyline, as there was no available lift. Sideslope and ground irregularities should be considered when planning extraction corridor spacing and skyline location.

  3. When the skyline ground clearance was low, the loads would drag along the ground during extraction. This was the cause of some breakage. Operating with limited ground clearance led to increased damage and associated repair of the hydraulic carriages. This was believed to be due to a transfer of dynamic loads into the carriages from the dragging load. Skyline tensions recorded during this study indicate an increased dynamic loading of the skyline compared to tensions recorded when transporting logs. In an effort to minimise this, the heavier loads would be lowered down the hill using both the fan governor and the transmission of the winch to provide extra braking which resulted in slower travel speed. This could not be done with lighter loads due to the increased likelihood of the load coming to a stop on the hillside, which was difficult to remedy.

- When yarding a long distance laterally, particularly with poor deflection, it is possible to jump the skyline off the support jack, especially when the jack is pulled up against the support tree. This problem occurred twice with the upper skyline on the final study day, and took about three hours to reset on each occasion.

Table 3 - Summary of log length transport (Robinson, 1993)

	Single Skyline / Log Length
Mean Cycle Time (min)	10.4 ± 1.4 (87)
Mean No. Pieces/Cycle	4.9 ± 0.5 (32)
Mean Load Volume (m^3)	2.5 ± 0.1 (85)
Productivity (m^3/PMH)	14.4

Note: Error term is the 95% confidence interval. Number of observations shown in brackets.

Table 4 - Secondary extraction - time and piece data

	Skidder	Tractor
Sample size	18	27
Cycle time (mins)	13.2 ± 3.3	19.6 ± 2.0
Pieces/cycle	4.8 ± 0.7	6.2 ± 0.9

Comparison with Log Transport

Extraction with the Gantners is quite different from transport as there is likely to be less control over the terrain than with a planned transport skid location and corridor. The two skylines had earlier been studied working in conjunction with a swing yarder and operating as transport units for partially processed logs (Robinson, 1993) (Table 3). Productivity for a single skyline operating in this mode over a span distance of 780m was 14m³/PMH. Production was noticeably lower for extraction than for transport, due to two main factors. Cycle times were 15% longer for extraction, mainly from an increase in time taken to 'hook up' on the steep slopes amongst logging debris. Load volume per cycle was 45% lower for extraction, which may be attributed to the difficulty breaking out large loads due to poor deflection and a greater dispersal of pieces in comparison with the processing skid used in the transport system.

Secondary Extraction

This part of the operation was studied by activity sampling and the collection of a sample of total cycle times and the number of pieces per load. Due to mechanical difficulties with the grapple skidder, a tractor and arch combination was used during most of the study. Cycle times and load size for the skidder and tractor are shown separately in Table 4. Secondary extraction often involved the machine accumulating its load at both drop zones, enabling the opportunity to maximise the load size. At the upper drop zone a Bell Logger was used to accumulate loads for both the skidder and tractor. The maximum distance from the upper skyline drop zone to the processing area was 550m.

Activity sampling showed the time breakdown for the two machines (Table 5). The differences between the productive times for the two machines reflect their inherent operating differences. The tractor has a greater component of its time in travel, hooking and unhooking, relative to the grapple skidder. Interference to the secondary extraction machine arose primarily from the lower skyline under which it had to pass in order to access to, or from, the upper skyline drop zone. In this situation, the skyline extraction had precedence over the secondary machine. The amount of time waiting for work (44% for the grapple skidder and 12% for the tractor) indicates that the secondary extraction clearly had excess productive capacity and was easily keeping up with the relatively low production from both Gantners. When the skidder or tractor were not working, the operator assisted the log maker at the processing deck.

Table 5 - Secondary extraction activity sample results

	Grapple Skidder	Tractor and Arch
Travel empty	17%	21%
Position	5%	10%
Hook/grapple	11%	26%
Travel loaded	16%	18%
Unhook/drop	1%	9%
Interference	6%	4%
Not working	44%	12%

CONCLUSIONS

Two standing skylines were observed extracting both trees and partially processed logs downhill over a maximum distance of 850m. A conservative daily production estimate for the two skylines combined was 90m³. Lower production from extraction compared to a transport system study, was attributed to a combination of longer cycle times and reduced payload. These factors may be due to the increased difficulty of accessing and accumulating each payload.

The secondary extraction working up to 600m, had no difficulty keeping pace with the primary extraction productivity. The tractor and arch combination, with 12% of its time not working, was closer to operational maximum, than the grapple skidder with 44% of its time not working.

Careful planning of extraction corridor width is important in order to minimise problems associated with both manually pulling slack and the initial 'breakout' phase during extraction. Planning the actual location of the skyline itself, is also important, to ensure as much skyline clearance as possible in order to avoid the potential for fouling of payloads during extraction.

REFERENCE

Robinson, D. (1993) : "Transport With Long Reach Skylines". LIRO Report Vol. 18, No.20.

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