ISSN 0111-6711

LOGGING INDUSTRY RESEARCH ASSOCIATION
NEW ZEALAND

REPORT

Vol. 15 No. 9 1990

ROADLINE SALVAGE WITH AN EXCAVATOR LOG LOADER

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ABSTRACT

A roadline salvage operation using a 20 tonne hydraulic excavator loader to log and load out is described. Three fallers were cutting the trees to length at the stump. In the first pass, the loader swung logs off the roadline into partially sorted stacks. Average tree size was 2.5m^3.

A separate roading crew followed forming a pilot road before the loader sorted the logs into stacks for loadout. Productivity over the six hours of study was 137m^3.

The 20 tonne loader was considered to be too small and inadequately equipped for efficient loader logging. Further trials with a larger machine are recommended. The relationship between logging capacity and roading capability should also be investigated.

Figure 1 - The Hitachi EX200 used for Roadline Salvage

INTRODUCTION

There is growing interest in the use of hydraulic excavators as log loaders in New Zealand (Kellogg, 1987; Duggan, 1989). Their versatility as alternative logging machines has been exploited for some years in the Pacific Northwest of the USA, (Timber Harvesting, 1983; Hemphill, 1986; Harder, 1988) but has only recently been tried in this country (Moore, 1990).

Most of the literature cited indicates that this method of logging is more efficient over short extraction distances. Loader logging should therefore be effective in roadline salvage operations where extraction distances are short and no landing formation is necessary.

Recently a Hitachi EX200 log loader was used to log and load out wood from roadlines in Mangatu Forest. A brief study was conducted on the operation and this report summarises the results.

ACKNOWLEDGEMENTS

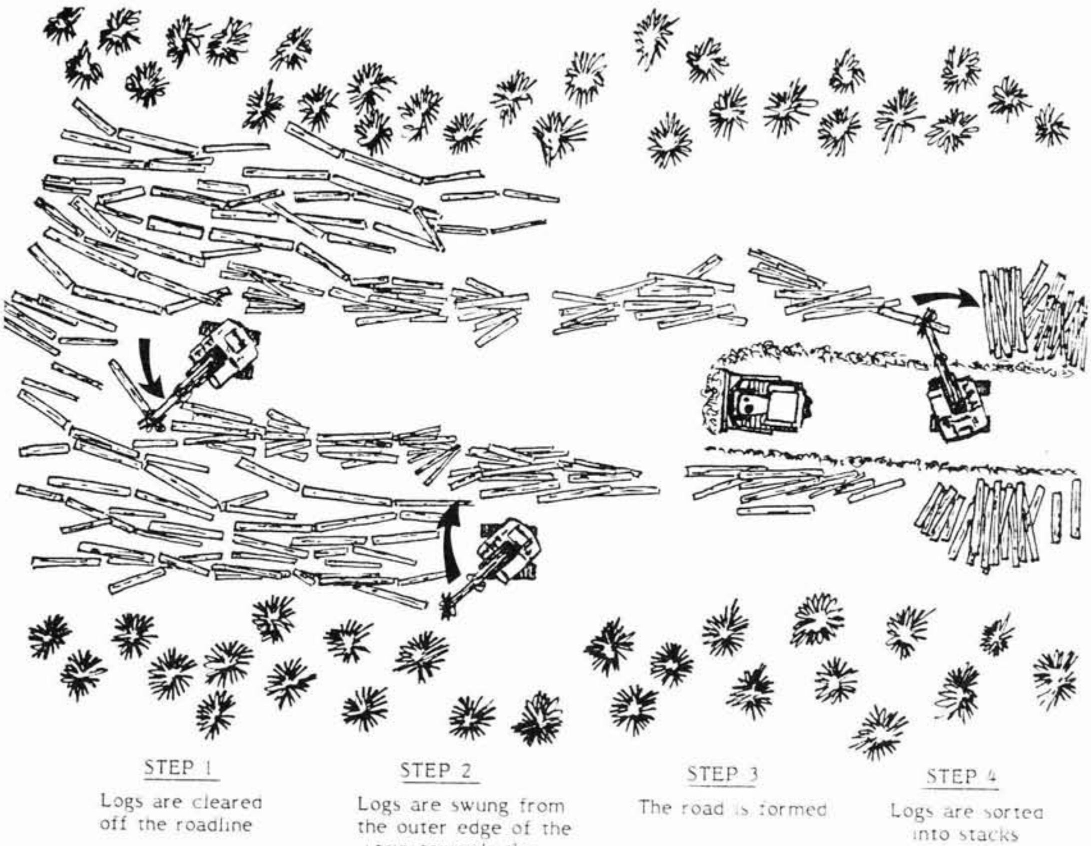
LIRA acknowledges the cooperation of contractor Rob Hehmeyer and crew, and the assistance of N.Z. Timberlands Limited, East Coast in setting up the study.

SYSTEM DESCRIPTION

To use an excavator to log and load out in a roadline salvage operation, the trees must be cut to length at the stump. In Radiata pine, a crew of three to four fallers is necessary to keep far enough ahead of the loader. Only three fallers were working in the operation studied. One faller was cutting a pilot strip (two to three trees wide) through the bush following the marked roadline. The remaining two fallers were two tree lengths behind widening the strip out to approximately 50m, felling and trimming the trees concurrently. Four log sorts were being cut with two to three length segregations within each sort. The average tree size was approximately 2.5m^3 and branching was heavy.

Once the trees had been fallen and processed, the loader moved through the strip, clearing the logs off the actual roadline. Logs from the outer edge of the strip were swung in towards the middle (Figure 2). During this process, the logs were generally laid out parallel to the road in partially sorted stacks. The loader could easily handle the production from the three fallers. When sufficient roadline had been cleared, a tractor and an excavator moved in to stump and form the road (Figure 3). The log loader then moved back along the road, re-sorting the logs into stacks perpendicular to the road. One of the fallers periodically walked back to the stacks to do a final trim. In stable, well drained soils, the pilot road surface would generally be good enough to allow truck access but in Mangatu Forest it was necessary to surface the

Figure 2 - Diagram of System used to loader log in Roadline Salvage Operation



road with river run metal. Trucks had to back in to load the wood out. The average slope of the roadline during the study was 8%.

Figure 3 - The Roading Crew Move into Stump and Form the Road

STUDY METHOD

A continuous time study was conducted on the loader, recording all activities and the number of logs handled per swing. It was not possible to record individual log volumes but an estimate of average log volume was derived from logs in the stacks.

RESULTS

The distribution of the loader's productive time is shown in Figure 4. The total observation period was 360 minutes and of that 164 minutes (46%) was spent actually loader logging The remainder was taken up with truck loadouts and delays.

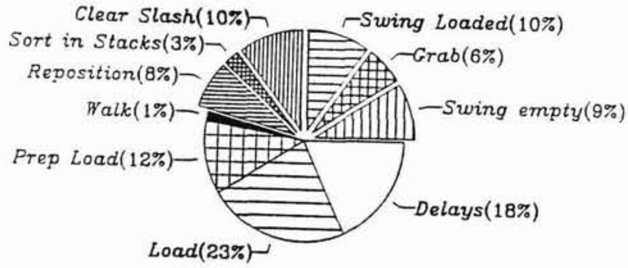


Figure 4 - Distribution of Hitachi's Productive Time

The principal function of moving logs from the stump to the log stacks is carried out in the three elements: "Swing empty", "Grab" and "Swing loaded". Most logs however were handled more than once before being stacked. A closer examination of the loader logging elements is shown in Table 1.

Table 1 - Work Cycle Elements when Loader Logging

Element		*Observations*	*Total time, min*	*Time/cycle, min*
Swing empty		*233*	*20.97*	*.17*
Grab	*On cutover*	*233*	*13.97*	*.11*
Swing loaded		*233*	*23.31*	*.19*
Clear slash		*94*	*37.41*	*.30*
Sort in stacks		*27*	*9.15*	*.07*
Reposition		*98*	*27.93*	*.22*
Swing empty		*125*	*11.25*	*.09*
Grab	*Into stacks*	*125*	*7.51*	*.06*
Swing loaded		*125*	*12.49*	*.10*
Total loader logging time			*164.00*	*1.31*

An average of 1.14 logs were handled with each swing and the mean log volume was $.96m^3$. Total production over the 164 minutes of loader logging therefore, was $137m^3$, i.e. $((164 \div 1.31) \times 1.14 \times .96m^3)$.

Table 2 - Truck Loading Times

Element	*Observations*	*Total time, min*	*Time/load, min*
Walk to stacks	*5*	*5.22*	*1.30*
*Prepare to load**	*4*	*42.41*	*10.60*
Load	*4*	*83.37*	*20.84*
Total time spent loading		*131.00*	*32.74*

** Prepare to load included unloading trailer and writing the docket.*

Truck loading occupied a significant proportion of the loader's productive time (36% overall). Table 2 shows load out times in more detail.

The distance the loader had to walk to load trucks depended on truck arrival times. If two trucks arrived in quick succession (as happened during the study), walk times were significantly less. Over the four loads observed, the loader walked an average of 75m per load.

Mean loading times were long at 20.84 minutes for 23 pieces. The lack of a live heel and restricted visibility hindered loading performance. Valuable time was lost finding the point of balance of each log before it could be lifted on to the truck. Only one log was handled per loading cycle.

Production and mechanical delays accounted for 18% of the loader's time (Table 3). No time was lost to personal delays.

Production delays included minor interruptions where the loader operator had to issue instructions to truck drivers or communicate with the contractor. The mechanical delays comprised major stoppages, one to try and repair a track roller in the undercarriage, and the other to fix a blown hose on the boom. High repairs and maintenance costs must be expected if machines are not correctly equipped and adequately guarded for loader logging.

Table 3 - Delays Recorded

Element	*Observations*	*Total time, min*	*Time/cycle, min*
Production delays	*12*	*32.56*	*.26**
Mechanical delays	*2*	*33.18*	*.27**
		65.00	*.53*

** Delay time expressed as a proportion of loader logging cycles (125).*

DISCUSSION

Over a period of six hours, $137m^3$ was loader logged into stacks ready for loadout and four trucks (approximately $104m^3$) loaded out. Assuming the loader would work for seven productive hours (not six as recorded in the study), extra time could have been spent loader logging and at least one additional truck could have been loaded out.

The Hitachi EX200 loader is a 20 tonne machine and it was not considered ideally suited to loader logging. It had a Prentice 8-48 grapple fitted to the standard excavator boom which limited the machine's reach. To correctly equip the Hitachi for loader logging it would have needed:

(i) A purpose built logging boom to increase reach.

(ii) A live heel to improve truck loading.

(iii) Strengthening and guarding to the tracked undercarriage.

(iv) A raised cab to improve operator visibility when loading.

A heavier 30 tonne machine would have been better suited to the size of wood being handled.

This study did not consider roading costs or the relationship between logging capacity and roading capability, i.e. area cleared versus road formed. A subjective assessment would suggest that the roading machines were well under-utilised. This needs to be investigated further.

COSTS

Using the LIRA costing format (Wells, 1981) an indicative daily cost can be established assuming a five man crew (four fallers and a loader operator), a capital cost of $184,000 for the loader and higher than normal repairs and maintenance on the loader (150% of average capital invested). Table 4 shows the distribution of these costs over a eight hour shift (seven machine hours).

Table 4 - Daily Costs of Roadline Salvage with a Loader Logger

Cost Centre	*Cost*
Loader	*$ 445.00*
Labour (5 men)	*$ 785.00*
Operating supplies	*$ 150.00*
Overheads	*$ 30.00*
Profit (10%)	*$ 140.00*
Total	*$1,550.00*

Factors that could influence loader logging productivity are:

- Average log size
- The width of the strip
- Slope
- Ground conditions
- Loader size
- Mechanical availability of the loader

Truck loading productivity in roadlining operations may be influenced by log size and loader availability plus:

- Truck access
- Number of log segregations
- Weather conditions (and its influence on road formation)
- The timing of road construction
- Demand for different product types
- Restrictions on the length of time that logs can remain in the stacks

Any of the above factors could alter productivity substantially. A larger more appropriately equipped loader would be less sensitive to increasing log sizes and wider strips but would cost over $100,000 more to purchase. The extra cost however may be justified if mechanical availability can be improved and loading times reduced.

CONCLUSIONS

The use of an excavator log loader to log and load out in roadline salvage operations can be cost effective on easy terrain. A larger, purpose-built loader would cost more but should increase productivity and have higher availability.

Tree size, terrain and ground conditions will have a big influence on loader logging performance, but overall productivity is likely to be affected most by truck access. When truck loading falls behind the logging operation, the loader will spend more non-productive time walking between stacks and the degrade of logs due to sapstain will become more prevalent.

It is recommended that the productivity of a larger, purpose built loader be evaluated in roadline salvaging. The effect of steeper slopes and their influence on logging and roading performances should also be considered.

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The costs stated in this Report have been derived using the procedure shown in the LIRA Costing Handbook. They are only an indicative estimate and do not necessarily represent the actual costs for this operation.

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