

## SHOVEL LOGGING

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### INTRODUCTION

"Shovel logging" is a system of short-distance logging in which logs are moved from the stump to the landing by repeated swinging with a hydraulic loader (Figures 1 and 2).



Figure 1 - Swinging logs from the stump with a hydraulic loader

It takes its name from the American term "shovel" meaning an excavator-type log loader. Shovel logging has undergone an explosion of popularity in the last few years in the western part of Washington state, U.S.A. It has been found to be a competitive system on suitable terrain where the timber is of a uniform size suited to cross-country handling by a hydraulic loader.



Figure 2 - Second swing moves the logs closer to the landing

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### SYSTEM OPERATION

Shovel logging is the ultimate in simplicity. A log loader, such as a Cat 225, travels to the back of the setting to be logged. It swings logs toward the truck road, working along a strip parallel to the road, windrowing logs as it goes (Figure 3). Then it starts on a new strip parallel to the first one, repeating the process, moving all of the logs one more swing closer to the road. The process is repeated for as many swings as are required to reach the road. The usual American practise is to

deck the logs at the roadside, without landings being constructed. When all the logs from the setting are decked at the roadside, the loader moves on to the road and loads out.



Figure 3 - Loader windrowing logs

Some operators log distances of 150 m or even more in this fashion, but most find that conventional systems are cost-competitive beyond a distance of three swings, that is, about 45 to 60 m. While slopes as steep as 60% have been logged with this system, 50% is the usual practical limit, with 40% preferred (Figure 4). The loader boom must be used frequently to assist in stabilising the loader while it is travelling on ground over 40% slope.

No tracks are constructed for this system.

Shovel logging is not suited to large timber, where the loader would not be stable handling the larger pieces cross-country. In small timber, under about 35 cm average diameter, conventional skidding systems are likely to be more economic. American loggers usually cut all trees over 60 cm butt diameter into logs at the stump. Smaller wood is shovel logged tree length by some operators, and log length by others. The advantage of log length handling is that the entire piece is swung, thus gaining one log length in distance toward the landing. Tree lengths, on the other hand, are dragged (Figure 5) so that the average distance gained per swing is less.



Figure 4 - Loader working a 40% sideslope

Typical production rates per 8-hour shift are 140 m<sup>3</sup> in small timber averaging 1.2 m<sup>3</sup> per tree, logged tree length, and 230 m<sup>3</sup> in timber averaging 1.7 m<sup>3</sup> per piece, logged log length. These rates are achieved if most of the timber is within 3 swings of the road. The best operators using large loaders achieve better production.



Figure 5 - Loader dragging tree length

Loaders used for shovel logging have included Cat 225, 235 and 245; Hitachi UH12, and Komatsu 300 and 400. Other brands would

also be suitable. It is important to have sufficient clearance under the undercarriage. It is essential to add guarding to the underside of the machine. Most operators use 19mm T1 steel plate, ribbed inside, with 50 mm x 100 mm T1 steel bars outside, under the car body; and 8 mm T1 steel plate on the underside of the upperworks. The loader can then safely travel over stumps. Guarding around the sides and front is also recommended.

Conventional live-heel log grapples perform satisfactorily in shovel logging. An 8000 hour life is experienced for grapples.

High undercarriage maintenance costs are experienced in shovel logging. For a machine operated full time off-road, one operator has found that a set of tracks will last about 4000 to 6000 hours, compared to 16000 hours for a loader not traveling off-road. Cross-country travel causes the links to stretch and ultimately break at one of the pins. Operators find that, after the second break has occurred, more will happen in rapid succession, and the second break is therefore regarded as the time for a new set of rails.

Limited additional maintenance is experienced for the upperworks. Extra fatigue can occur to the boom with an inexperienced operator or in tree length logging.

Good operators are able to remove the limbs from Douglas fir and from lightly limbed logs of other species, by turning the log into a vertical position and running the grapple down it. This permits easier handling by the loader. Heavily limbed trees are limbed by the fallers on three sides, at the stump area.

Soil disturbance is much less with shovel logging than with conventional skidders, since the only travelling is done by the unloaded machine, and even then there are only two passes on each track.

## POTENTIAL FOR NEW ZEALAND

With suitably modified loaders and competent operators, there is no reason why production rates similar to those quoted should not be achieved in New Zealand plantation conditions by average efficient operators.

Using the LIRA costing procedure (Ref. 1), the daily cost of owning and operating a Hitachi UH123 loader (costing \$300,000 with a 20% salvage value after a 7 year life) is calculated at \$691 per day, including the operator.

Higher than normal repair and maintenance costs and a 21% return on investment are assumed. This is a slightly lower daily cost than would be anticipated for a 104 kW tractor and arch including the labour cost of a breakerout and operator. While a conventional skidding machine is likely to achieve better production, it must be remembered that it requires a loading machine in addition. Shovel logging accomplishes both skidding and loading. Therefore the economics are likely to be favourable for shovel logging in a large number of cases.

Certain changes to conventional New Zealand practices would be required.

In first crop radiata pine, it would be necessary to cut trees into log lengths and limb on 3 sides at the stump area. On the slopes accessible to shovel logging, this can be easily done, at total falling, limbing and crosscutting costs approximating those achieved with present tree length skidding systems.

A live heel is strongly recommended, since by grappling the log at one end (Figure 6) it increases the distance gained per swing. It also facilitates loading from behind log trucks, enabling the loader to work easily without constructed landings.



Figure 6 - Live heel and grapple is recommended for swinging

Ref. 1 Wells, G.C. "Costing Handbook for Logging Contractors", N.Z. Logging Industry Research Assn, 1981

While landings could be constructed, it would be more economic to operate without them, instead decking logs on the forest floor perpendicular to the roadside. Where the logs have already received most of their processing at the stump area, it is practical and safe to operate without landings.

For the road densities common in central North Island tractor logging, it is found that about one-third of the total area logged is within 50 m of a truck road, and could therefore be considered for shovel logging. It could well be economic to operate with a greater density of low standard roads, at a 100 m spacing, accessing entire compartments for shovel logging.

Sorting can be accomplished by decking sorts across the truck road. Again, present practices, calling for neat log decks on large landings, would have to be abandoned.

It is necessary to be able to schedule trucks to arrive on an irregular basis where shovel logging is practised on a continuous basis. Obviously, while the loader is working off-road, it cannot be loading trucks. When it is loading, it requires a continuous string of trucks.

## CONCLUSIONS

Shovel logging has obvious potential for New Zealand, particularly for first crop radiata pine and Douglas fir, and perhaps also for small timber. It is well proven in the United States and under suitable conditions it is found to be the cheapest logging system. It could be applied as a primary logging system on a major portion of the easy terrain in the central North Island and as a supplemental system, for odd corners and to occupy spare time, in most areas of New Zealand. Shovel logging is a productive part-time activity for a loader that has greater production capacity than the skidding machines it is servicing.

It is strongly recommended that shovel logging be tested on a small scale by all operators of suitable machines equipped with heeling grapples, to acquaint themselves with the system, its limitations, and its requirements. It is essential that these operators are prepared to make the necessary changes in bush practices, especially processing into logs at the stump area in first crop timber.



*Figure 7 - Adequate guarding of the loader is essential*

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