

HYDRAULIC EXCAVATOR-BASED LOG LOADERS

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Figure 1 - Loading trailer with excavator-loader

INTRODUCTION

Since the 1970's, there has been a trend away from tracked rope operated cranes to rubber tyred front-end loaders (RTFEL). In 1978, 61% of the population of 250 log loaders were RTFEL type, and this trend has continued. From 1990 onward as harvesting moves into regions of steep, wet, and environmentally sensitive terrain, landing sizes will decrease resulting in an increased need for crane type loaders. Loader requirements are expected to rise to a population of over 500 by the year 2000. (Donovan, 1982).

Hydraulic excavators modified for log loading have gained popularity in the last five

years, particularly in areas with difficult ground conditions. There are now twenty such machines in use in New Zealand. This report presents a list of loaders in use, with details of machine type, grapple type, and machine location. Notes on applications and equipment modifications carried out are included. This Report summarises a LIRA Project Report of the same title, P.R. 25, copies of which are available to LIRA members on request.

APPLICATION

There are twenty known excavator-based log loaders, ten in each of the North and South Islands. The main areas of use are Southland and Otago, with groups of machines also in Wairarapa, Coromandel, and North Auckland. Table 1 shows the brands of excavators in use and their locations.

Excavators are used in areas with difficult winter ground conditions, where stationary tracked machines are better suited to loading than mobile rubber tyred loaders, which cut up skidsites and require a heavily metallised surface in the wet. Excavator loaders are able to work on smaller skids than RTFEL, and are competitive in terms of purchase price and operating costs. Fuel use is approximately half that for a mobile loader of similar capability. Operation of excavator loaders is very easy, and operator comfort is good. The large number of excavators used in a wide variety of applications means that good parts and service back-up exist.

Most loaders in use are in the 18-20 tonne excavator size range. This size loader has the ability to handle most log diameters and lengths and can usually unload 3 axle trailers weighing up to 5 tonnes. Four loaders in the 12 tonne size range are also used.

Table 1 - Excavator log loaders in New Zealand

EXCAVATOR	WEIGHT (tonnes)	GRAPPLE	REGION
JSW Nikko RH6	17.5	-	North Auckland
Kobelco K907B	18.9	"Cashmore"	North Auckland
Hitachi UH07	18.3	Mar	Coromandel
Warner & Swasey	37.0	Harricana	Coromandel
JSW Nikko 45	12.0	-	Rotorua
JCB 8D	23.5	Poclain *	Rotorua
Hitachi UH07	18.3	Bell *	Taranaki
Hitachi UH083	18.5	"Havard"	Wairarapa
IHI IS 190	18.8	Hiab	Wairarapa
Kato HD 750	20.0	Palfinger	Wellington
Mitsubishi 110	12.0	Hiab	Otago
Hitachi UH063	12.0	C & R 1000	Otago
Hitachi UH07	18.3	Hiab	Otago
JSW Nikko RH4	12.0	Hiab	Otago
Caterpillar 225	21.5	C & R 1500	Southland
Massey Fergusson 450S	15.6	Grab	Southland
Komatsu PC200	18.8	C & R 1500	Southland
Hitachi UH081	18.5	C & R 1000	Southland
Hitachi UH081	18.5	C & R 1000	Southland
JSW Nikko RH 6	17.5	"Carran"	Southland

* This denotes a live heel attachment.

Changes made to convert from excavator to log loader involve installing cab guarding, replacing the bucket with a fully rotating grapple, and hydraulic modifications to suit the grapple. The grapple is the key to successful operation of this type of loader due to the limited availability of grapples in New Zealand.

In most cases the loaders are used in small contract crews with annual production around 20,000 m³. Most loaders were purchased second-hand and commissioned at a 1985 equivalent cost of \$50,000 to \$100,000. Modification and grapple costs account for \$10,000 to \$25,000 of this total.

EQUIPMENT OPTIONS

Factors to be considered when selecting an excavator for log loading include :

- (1) Undercarriage type. Long track frame and wide track shoes give the machine additional stability. In most cases, lift capacity is limited by stability. This can be increased by up to 15% by longer track frames, and 7% by widening the shoes from 600 m to 800 m.
- (2) Main Boom type. Single or two piece booms are available. Lift height is sometimes insufficient (e.g. for lifting trailers) and modifications are available to increase lift height with both boom types.
- (3) Dipper arm. A range of lengths are available. The longer length options are best suited to log loading, to give adequate reach.
- (4) Hydraulic system. For grapple operation two extra circuits are required. The bucket circuit can be used for one and some excavator brands also have a spare implement circuit. Those without require an additional pump and valving for the second circuit. Cost is reduced by choice of a machine with spare circuit.

EXCAVATOR MODIFICATIONS

Having purchased an excavator, modifications that should be considered are :-

- (1) Grapple selection. Fully rotating types, and non-rotating grab types are available. The latter have one fixed jaw and the top clamp is operated by the bucket cylinder. Only one grab is used in New Zealand, but they are popular in Australia. Two main types of fully rotating grapple are used. These are the narrow, 3 tine type with side-mounted rams, and the wide jaw pulpwood type with horizontal ram, (usually found on self-loading truck cranes). Prices range from \$5,000 to \$20,000. The three grapple types are shown in Figure 2.

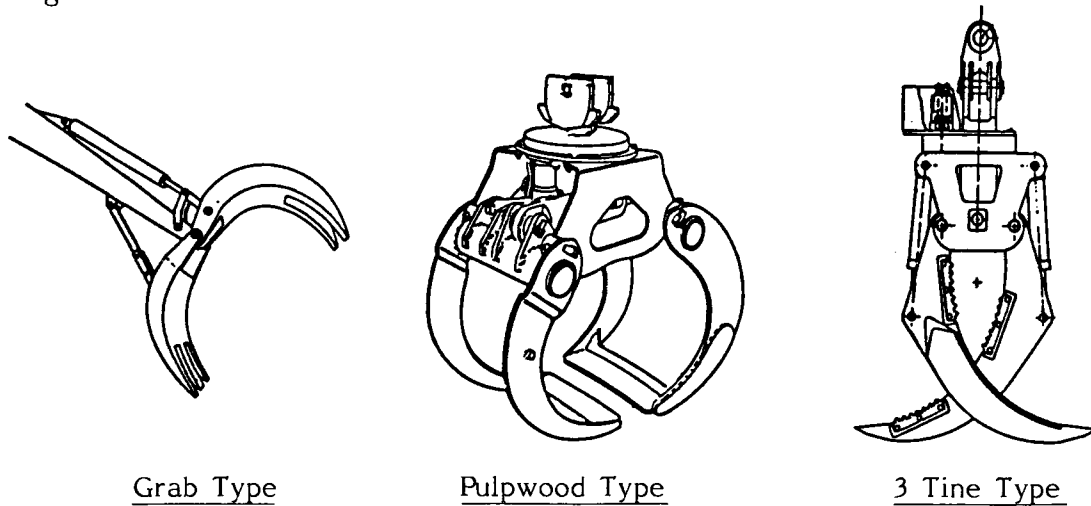


Figure 2 - Types of grapple

- (2) Hydraulic modifications. The bucket hydraulic circuit is used for the open/close grapple function. The spare implement circuit (if fitted) is used for grapple rotation and an extra control added in the cab to operate the rotator. Extra valving is required to give correct pressure and flow for the grapple selected. The cost of hydraulic work is \$3,000-\$5,000 if a spare circuit is used, and may be in excess of \$10,000 if an extra circuit is required.
- (3) Heel attachments. Live or fixed heel attachments are common on medium and large hydraulic loaders in the United States. In New Zealand, two machines have live heels. Heel attachments allow logs to be picked up off-centre which effectively extends reach and avoids the need to drag logs into the loaders and re-position the grapple to balance the load. Logs are positively controlled when heeled, and more easily loaded.
- (4) Main boom and dipper arm. Most excavator booms and dippers are not altered for logging in New Zealand. In the United States most machines are fitted with purpose-built log loading booms. These give greater lift height, reach, and operating range than excavator booms which are shaped and stress designed for digging. Cost of a purpose-built boom for a 20 tonne excavator is approximately \$60,000. Alternatively, low cost modifications to increase lift height and reach can be made to excavator booms and dipper arms.
- (5) Cab guarding and raising. Cab guarding is advisable and required by most Bush Inspectors. The cost is approximately \$2,000. Raised cabs to give better visibility when loading are considered desirable by most operators, many of whom position stockpiles so that they can load trucks from a bank to provide a better view. Raising a cab one metre is estimated to cost \$6,000. Folding cabs may be advisable to avoid height problems in transport.

LOADER PERFORMANCE

- (1) Lift and reach. Specifications for five size ranges of excavators, from 10 to 30 tonnes, are shown in Table 2. Details are for machines equipped with grapple, and lift capacity is based on 75% tipping load, at 6 m reach.

Table 2 - Lift and reach by machine size

SIZE RANGE	HORIZONTAL REACH (m)	LIFT HEIGHT (m)	FRONT LIFT (tonnes)	SIDE LIFT (tonnes)	POWER (kW)
10-12 tonne	7.5	5.5	1.8	1.5	60
14-16 tonne	7.9	5.7	3.3	2.3	68
18-20 tonne	8.7	6.5	4.6	3.1	79
22-24 tonne	9.3	6.8	6.5	4.4	98
28-30 tonne	10.4	7.3	7.3	5.4	136

Generally, machines in the 10-12 tonne range cannot unload trailers, or lift large logs. Sixteen tonne machines can unload two-axle trailers, while twenty tonne machines can unload three-axle trailers, and handle most log sizes. For heel boom loading long length, medium diameter logs, twenty-four tonne machines or larger are required.

Road transportation of the loader is affected by its size. The maximum weight for shifting without an overweight permit is about 20 tonnes. Machines above this size are generally also wider than the 3.1 m limit, and travel restrictions tighten. Transportation cost for a 20 tonne loader is around \$3.25 per km or \$78 per hour.

- (2) Grapples. The 3 tine grapple is most suitable for long single stems, and the pulpwood type best suited for small diameter multiple stems. Both varieties of grapple can handle most types of logs but multiple logs may twist in a 3 tine type, and pulpwood types have problems selecting individual logs from stockpiles. The 3 tine type are generally heavier and more robust. Most pulpwood types are designed for truck crane operation and give mechanical problems when fitted to powerful excavator type loaders. Most grapples suffer problems with hydraulic hose failure and operators need to carry spares, and be prepared to change hoses, if downtime is to be minimised.
- (3) Stacking and loading. Sorting and stacking multiple log sorts may require some loader movement. Excavators travel up to 4 km/hr and can operate all functions simultaneously. Loading trucks does not require travel, and typical load times range from 10 to 25 minutes depending on log size, these times being similar to those obtained with front-end loaders.

CONCLUSION

Excavator log loaders are a good alternative to the RTFEL type, particularly on small or wet skids. For low production crews, an excavator can be readily converted into a low cost loader. Higher production operations able to justify good equipment should consider excavators with purpose-built logging booms. These give improved operating range and may be fitted with heel attachments for improved handling of long length logs. Purpose-built booms increase productivity and reduce machine stress, but add to machine purchase price.

Use of an excavator loader may require some changes to the logging system. Landing layout should be designed to suit the loader, and minimise travel when sorting and stacking. Frequent loader shifts of more than a walking distance are expensive. Transportation of machines costs less if weight is less than 20 tonne and width under 3.1 m.

Choice of a suitable grapple is critical to successful operation. The 3 tine type are generally best. Loading speed is generally equal to or better than that with a RTFEL, and operating costs are lower.

Ref. Donovan, V.F. "Prediction of Machinery Requirements", Logging Machinery Seminar Proceedings, LIRA, 1982.

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