

EXCAVATORS IN FOREST ROADING OPERATIONS

A Report by Peter Kemp, New Zealand Forest Service, Nelson



Fig. 1 - Hitachi UH121 Excavator cutting down to grade from a pilot track.

INTRODUCTION

Excavators have been used for forest roading work in the Nelson conservancy over the past five years. They were first introduced for operations in extremely steep terrain where granite rock formations required continuous blasting to maintain acceptable progress for tractor operations. Various makes, sizes and types of excavators have been used since then.

METHODS

Two main methods of working have evolved. Both involve using an excavator working in conjunction with a tractor.

The first method involves a small 12-15 tonne excavator pilot tracking for heavy tractors. The excavator cuts a minimum width bench over the line of the batter stakes. The tractors, following on behind, cut the pilot track down to the final grade line.

The second method involves using a heavier excavator of 25-30 tonnes to carry out all the prime earthworks. After cutting a minimum bench, the excavator then uses its full digging capability to cut down to the grade line. A small tractor with an angle blade follows up to shape and finish the subgrade.

In Nelson, both methods have produced cost savings of around 20% on the prime earthworks phase. Using a small excavator to pilot track for medium to heavy tractors has produced savings of \$1,000 - \$2,000 per kilometre, in conditions ranging from very wet flats to moderate dry slopes. On steeper terrain, where a heavy excavator has been used to complete the prime earthworks, a cost saving of \$1,700 per kilometre was achieved. As the terrain becomes progressively more difficult for roading operations, the savings become correspondingly greater.

CHOICE OF MACHINE

For steep terrain, the prime requirements are the ability of the machine to climb steep side-slopes and a strong robust turntable with sufficient power to allow some side casting. Of the different models tested, the Hitachi excavators seemed to be the most suitable, regardless of size.

A Hitachi UH121 was tested in local operations with two different stick lengths and it was apparent that the short stick was better suited to requirements. The short stick provided a considerable increase in tooth force, which is an important factor in our normal rocky conditions, while the reduced reach was not a significant disadvantage. Overall, we consider the short stick to be more suitable for forest roading operations.

The common bucket for our use is the standard manufacturer's rock bucket; bucket capacity is 0.6 m³ for the UH061, 1.2 m³ for the UH121. These are fitted with additional ripper teeth on the back for easier digging in rocky conditions. The shanks are fitted with normal ripper shoes and have a similar working life. Operator technique is important to minimise twisting of the bucket at the wrist pin and reduce wear on the lip plates. A full or partially full bucket will improve bucket stability for ripping.

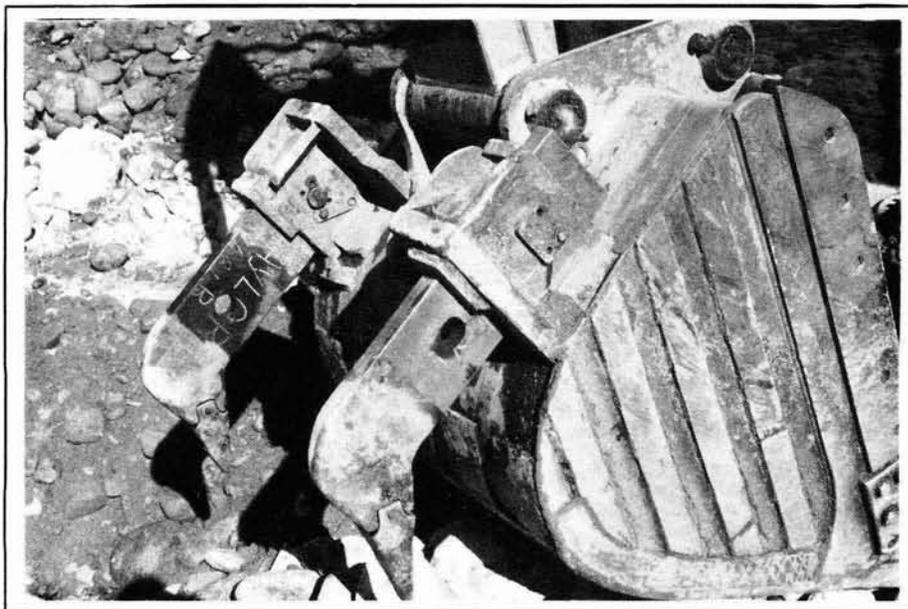


Fig. 2 - Rippers mounted on rock bucket.

CHOICE OF OPERATOR

The operator must have had sufficient experience in forest roading work to be able to follow a flagged grade line accurately. He must also be reasonably enthusiastic about this method of road construction. Nothing can jeopardise the effectiveness of this system more than an operator grudgingly operating the excavator and secretly wishing to be moving earth by a more conventional method.



Fig. 3 - UH121 Excavator pilot tracking

ADVANTAGES

The advantages of an excavator over a tractor are :

- (a) Cheaper prime earthworks.
- (b) Earthworks are minimised and therefore more environmentally acceptable.
- (c) Neater earthworks as the machine can reach up to high batter stakes on steep country.
- (d) Cleaning up of gullies and installation of major culverts during the prime earthworks operation.
- (e) A neater job of inside bends where most of the earthworks erosion in roading operations is generated.
- (f) Its ability to work in much wetter conditions than a conventional tractor.
- (g) Its ability to work efficiently travelling uphill. This is particularly useful in steep rocky country where there is no access available to the top of the work.
- (h) Its greater effectiveness at breaking out rocks and stumps.

- (i) Its greater versatility with the potential to move earth, load ballast, load logs, dig drains and install culverts.
- (j) Its lower rate of fuel consumption, around 30% less than for a tractor of comparable horsepower.
- (k) Its stationary mode of operation, which minimises the very expensive "track group" overhauls normally associated with all track laying equipment.

DISADVANTAGES

The disadvantages of the excavator are :

- (a) It is not particularly suitable as a stand-alone machine as it lacks the ability to grade a surface or side-cast effectively. It is more effective when worked with at least one side-casting machine, preferably a tractor with an angle blade.
- (b) It does not achieve the same degree of compaction as the tractor. This can be compensated for, to some degree, by extra attention to this aspect when finishing the earthworks and during metalling operations.
- (c) It is less efficient in short distance bulk pushing, such as skid site construction. It is possible that a combination of a tractor and excavator would reduce the cost of landing formation on steep country (e.g. an excavator breaking out and feeding the material to a tractor for disposal).

COMMENTS

The excavator has proved to be superior to a tractor for roading or tracking in standing timber, as it has more control of the falling tree. This can give improved volume recovery through reduced breakage, and provides a safer working environment by avoiding the need to manually fell into standing trees.

There is no difference in the angle of the batter slopes from either an excavator or tractor operation as they are determined by the natural angle of repose of the material. The excavator does produce neater and more precise batters.

There have been no noticeable differences in metalling costs between the two types of road construction.

It should be noted that explosives will continue to be used in roading operations in rocky terrain, although our experience shows that the prying action of excavators can reduce blasting costs.

SUMMARY

It would seem that worldwide, owing to differing climates and terrain, methods of utilising the excavator vary considerably. In all cases, significant cost savings are being recorded.

There is no doubt that excavators have distinct advantages when used in conjunction with tractors in a prime earthworks team. Management should accept excavators as a unit with many special features that should be utilised wherever possible.

This Technical Release is the work of the author and is not the result of LIRA project work. LIRA publishes it in the interests of wider dissemination of knowledge in the industry. LIRA takes no responsibility for the accuracy of figures nor does it necessarily support or disagree with the opinions and conclusions shown.

For Further Information Contact:	N.Z. LOGGING INDUSTRY RESEARCH ASSOC. INC. P.O.Box 147, ROTORUA, NEW ZEALAND.	Phone 87-168
---	--	---------------------