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CONVERTING HYDRAULIC EXCAVATORS TO LOG LOADING

(GRAPPLE, HEEL RACK, CAB AND HYDRAULIC MODIFICATIONS).

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Figure 1 - Mitsubishi MS180-8 log loader

INTRODUCTION

The use of modified hydraulic excavators as log loaders is not new in New Zealand operations. There are some twenty excavator-based log loaders in use, most in the 18 to 20 tonne range (Ref. 1).

Many of these machines have had minimal modifications which typically have been replacing the bucket with a rotating grapple, hydraulic modifications to suit the grapple and adding a cab guard.

The grapple is the key to the success, or failure of an excavator-based log loader. Many of the grapples in use in New Zealand have had design and reliability problems.

ACKNOWLEDGEMENTS

LIRA wishes to acknowledge the assistance of Skyline Logging Limited and Domtrac Equipment Limited.

This Report outlines the modifications made to an 18 tonne Mitsubishi MS180-8 excavator for Skyline Logging Limited. This machine is the first excavator in New Zealand to be extensively modified for use as a log loader, and is being used in Patunamu Forest to sort and load 50,000 m^3 per year.

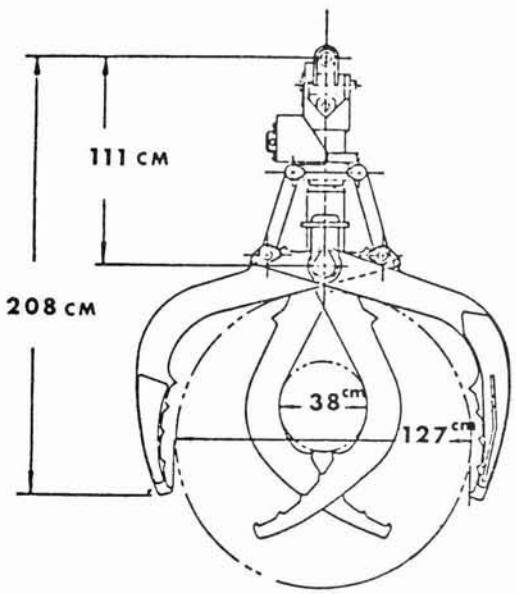
Ref. 1 Langsford, J.F. "Hydraulic Excavators as Log Loaders (A Review of the New Zealand Situation)", LIRA Project Report No. 25, 1985.

GRAPPLE AND HEEL RACK

The Pierce RHLG grapple and heel rack is a purpose-built, matched unit, designed to be used with a logging boom, or as an attachment to an excavator boom. For this conversion, the grapple and heel rack have been mounted to the standard excavator boom of a Mitsubishi MS180-8.

Figure 2 - Pierce RHLG 50 grapple and heel rack

Grapple



The grapple motor has 360° continuous rotation capability, and a 4 to 1 reducer which enables the grapple to rotate large logs using the grapple power. A single, internally-mounted cylinder controls the opening and closing of the grapple. The cylinder is protected from accidental damage as are the hydraulic fittings to both the cylinder and rotator.

The grapple has a minimum opening of 38 cm and will open to, and handle, logs up to 127 cm in diameter.

Figure 3 - Pierce RHLG 50 grapple

Heel Rack

The "live" heel rack is mounted to the boom stick through the bucket linkage, and is operated by the bucket cylinder. The grapple is hung from the top of the rack and the two heels allow variations in log length to be safely handled.

HYDRAULIC MODIFICATIONS REQUIRED

The hydraulic modifications required will depend on whether a grapple only, or a live heel and grapple are to be fitted, and how many spare valves the base machine is fitted with. Where a live heel is used, it can be operated by the cylinder normally used for opening and closing the bucket. An additional hydraulic circuit will be required to run both the rotator and the opening/closing of the grapple. The rotator requires an oil flow of 4 to 5 gallons per minute, while full flow is required to open and close the grapple.

For the Mitsubishi, the bucket cylinder was used for the heel rack, and a power steering pump was fitted to the engine to provide the extra hydraulic circuit. Oil from this pump is fed through a flow control valve which operates the grapple rotator. A half gallon per minute is diverted to a slave cylinder which operates the spare valve in the valve bank. This valve is used to operate the opening and closing functions of the grapple.

To enable both the rotation and the opening/closing of the grapple to be operated without adding to the cab controls, a two-way, thumb operated switch was fitted to the top of each joystick. These switches are connected to electric solenoids which operate the valves.

CAB MODIFICATIONS

Figure 4 - Raised cab

For log loading, it is desirable to elevate the cab to give the operator better visibility. The cab and floor plate were detached from the machine, leaving the control linkages in place. A steel box, 90 cm high, was fabricated to fit the original cab location, and bolted to the frame. The cab and floor plate are bolted to the top of this box. Hollow steel tubes are used as extensions to join the control linkages.

COUNTERWEIGHTS

The lifting requirements for a log loader are greater than those required in a conventional excavator application, so additional counterweights are desirable. One tonne was added to the existing counterweight to improve both the lifting capability and machine stability. An additional 0.5 tonne could be added if required, and still remain within the manufacturer's warranty conditions.

WORKING RANGE

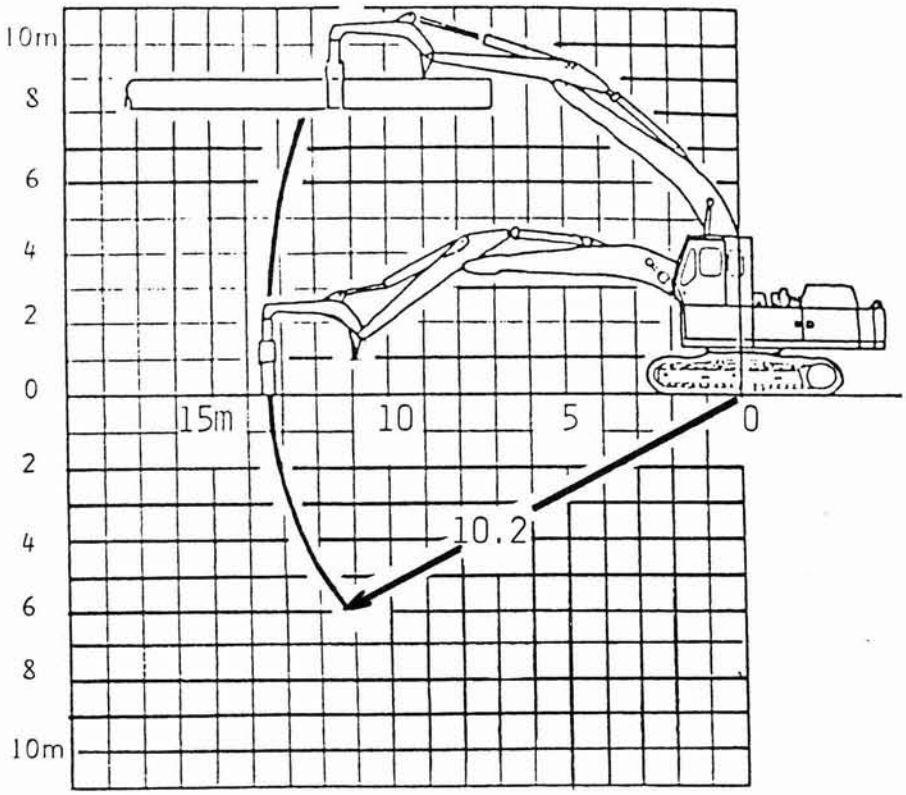


Figure 5 - Working range of a Mitsubishi MS180-8 log loader

The conventional "banana" shaped excavator boom does not have the same lifting height and capacity as a purpose-built "straight" logging boom. With an 18 to 20 tonne excavator, this is not critical as the lifting height is more than adequate to clear a highway truck's stanchions with sufficient capacity to handle a 3 tonne 2-axle shorts trailer.

The excavator boom does have an advantage over the straight boom in reaching below ground level.

Working range is :

- maximum reach at ground level - 13.3 m
- maximum reach below ground level - 10.2 m
- maximum loading height - 8.1 m

(height is measured under a level, heeled 50 cm diameter log at 11.2 m radius).

CONCLUSION

Excavators modified for use as log loaders will be required in the future as logging operations move into steeper ground with smaller landings. Past experience has shown that the major problems with these loaders have been with the attachments.

Purpose-built logging booms, grapples and heel racks are now available in New Zealand and these should be considered, along with; a raised cab, additional counterweights and changes to the hydraulic circuits, when modifying an excavator for use as a log loader.

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