GROUND BASED SYSTEMS - AN OVERVIEW

Bruce Larsen
Sales and Harvesting Manager
Carter Holt Harvey Forests Limited
Auckland Region

Introduction

The New Zealand Forest Industry is about to move into an era of unprecedented expansion over the next ten years. This expansion will involve the harvesting of extensive areas of "difficult terrain". For the purposes of this paper, "difficult terrain" can be defined as:

> Any area in which debate is generated as to the most appropriate harvest system.

This debate may be caused by any number of reasons including:

(i) Steepness of the land
(ii) Soil type in the harvest area
(iii) Visual effects of the proposed harvest
(iv) Effect of the harvest on water quality
(v) Safety of the workforce
(vi) Off-site or downstream effects
(vii) Productivity of subsequent crops

Ground-based extraction systems can be defined as:

> Any system utilising wheeled or tracked machines where the logs are pulled behind, or carried on the machine.

Advantages of ground-based machines over cable systems include: improved mobility, lower capital and operating costs (usually), improved flexibility and the ability to handle a wide range of terrain and soil types. It has also been reported that ground-based systems have higher manpower and machine productivity.

Ground-based systems tend to be restricted by steep slopes, broken or rocky terrain and soft wet soils of low bearing strength. They also tend to require a higher density of roads and tracks than Cable systems.

The major types of Ground-based Systems

1. Crawler Trawlers

Crawler tractors have traditionally been a favourite machine for New Zealand loggers as they are capable of handling a wide range of operating conditions. They can operate on slopes up to 15-20^{o} without tracking and on steeper slopes by forming access tracks. They are capable of pulling relatively large loads and can extract uphill. Ground pressures tend to be moderate, usually in the 40-60 kPa range, depending on track size.

The introduction of "high drive tractors" or "custom skidders" is a relatively recent innovation in ground-based skidding equipment. The high drive is designed to isolate final drives, steering clutches and brakes from ground-induced impact and shock loads. These machines are noted for their improved side slope stability by virtue of a wider track base and a forward centre of gravity. They are also characterised by higher ground clearance and reduced ground pressure.

(ii) **Rubber-Tyred Skidders**

Skidders are the most widely used machine for extracting logs in New Zealand. They are purpose-designed for high-speed extraction, with travel speeds of 5-15 km per hour loaded and 25-30 km per hour unloaded. They can operate without tracks on slopes up to 15°, but generally need access tracks to travel on steeper terrain. They are best suited for pulling moderate loads (3-6 tonnes) over longer distances (150-500 metres) on flat or downhill slopes up to 20°. Under these conditions they provide a very effective and low cost method of log extraction.

Because the skidders economically viable haul distance is greater than that of tractors, the required density of roads and landings is reduced. This reduces the proportion of area in a coupe which will undergo massive soil disturbance.

The use of extraction tracks may allow skidders to extract logs from steep country at a lower cost than with cable systems. The use of contour tracking at Golden Downs Forest on the Moutere gravels would be an example.

The relatively recent introduction of wide tyres for skidders and quad-tracked skidders are two innovations which are designed to allow skidders to operate on difficult terrain. Wide tyres reduce the ground pressure and improve side slope stability allowing the skidder to effectively operate in wet soils or soils of low bearing strength. Machines such as the Quad tracked skidder produced by Timberjack are based on a skidder design, with the wheels replaced by four track pods. These machines are designed to extend skidder logging on to what would otherwise be cable terrain, by virtue of wetness, steepness and/or uphill skidding. Observations reported have suggested that site disturbance is low compared to conventional machines.

(iii) **Flexible Tracked Skidders**

Flexible tracked skidders such as the KMC (FMC) evolved from armoured personnel carriers. These machines are

designed with a high power-to-weight ratio and offer high speeds with heavy loads and superior climbing ability. They are capable of operating without tracks on slopes up to 25° and can travel loaded uphill on slopes of 15°+. Ground pressure is around 30-40 kPa, substantially less than traditional ground-based machines of similar size. Travel speeds are reported to be 24 km per hour unloaded and up to 20 km per hour loaded. These machines can be used for either long or short hauls with heavy loads. They have commonly been used in marginal situations where slope or soil conditions may be limiting for other machines.

Although Flexible tracked skidders have been available in New Zealand for a number of years, they have not made a significant impact. This can be attributed to reported problems such as:

- high capital cost
- high operating cost
- questionable reliability
- use in overly difficult conditions

(iv) **Forwarders**

Forwarders are capable of carrying heavy loads (up to 12-15 tonne) over long distances, cross-country on easy terrain. They require only a very low density roading system. However, they have had little use in New Zealand. They are restricted to relatively flat land and generally to handling logs in short lengths. Ground pressures are high (70-140 kPa), which means they have a high potential for ground compaction on susceptible soils.

Forwarders have never really been successfully utilised in New Zealand on a large scale due to:

- inflexibility of the system
- the requirement to produce long lengths for certain customers
- large piece size of "first crop"
- dissected terrain of much of New Zealand
- total cost of the system

(v) **Shovel Logging**

Shovel logging utilises an excavator-based hydraulic loader to repeatedly swing logs from the stump to the road edge. Generally, no landings need to be formed, with load out taking place directly from the roadside. It has been found to be competitive with other systems on suitable terrain where trees are of a uniform size and suited to cross-country handling.

The excavator is capable of operating on slopes up to 20° with very little soil disturbance. However, economic swing distances are

typically short at around 100 metres. It is reported that excavators used for shovel logging experience high undercarriage maintenance costs with the life of tracks substantially reduced.

As more and more excavator-based hydraulic loaders are introduced into systems within New Zealand, I expect that "shovel logging" will become an accepted "tool" to be used in conjunction with other extraction systems.

The Auckland Region

Our basic strategy when dealing with ground-based logging in difficult terrain is to avoid it where-ever possible. Our forest resource utilisation plan has, as a major objective, the provision of adequate Sand Forest logging over the winter period. This reduces our exposure to logging on Clay forests in wet conditions. The major advantages in following this strategy are:

(i) The use of ground-based logging equipment on saturated soils is avoided thus minimising erosion, puddling and compaction of the soil.

(ii) Productivity of the logging crews is maintained through adverse weather conditions

(iii) The use of available equipment is maximised.

(iv) Productivity of logging in the sand is improved.

This last point may need some explanation. Dry, loose sand has a very low bearing strength which results in reduced wheel traction. On fine, dry sand skidder productivity can easily be halved through loss of traction and an inability to pull economic pay loads. By concentrating logging in these forests through the wetter months of the year, the average productivity of these crews can actually be increased.

The second method used to avoid ground-based logging in difficult terrain is to utilise a Cable Logging System. The advantages of these systems included:

(i) A lower density of roads, landings and tracks.

(ii) Loads may be partially or fully suspended

(iii) Soil disturbance is minimal and restricted to haul corridors

(iv) Soil compaction only occurs on the landing

(v) Slope does not affect production to the same extent as with ground based machinery.

The harvest planning process aims to ensure that land which is too steep, too broken or too wet to be successfully logged with ground-based systems is identified and set aside as hauler areas. While this may be an ideal situation in theory, it does have inherent difficulties and problems:

(i) Planning is constrained to the systems available

(ii) Cost considerations must also be included in analysis

(iii) Market requirements must be considered when planning production

In marginal areas where ground-based logging will be carried out several guidelines are followed:

(i) Schedule the setting for summer to minimise the likelihood of wet ground conditions.

(ii) Plan the location of tracks and landings so as to minimise the potential impact on the environment.

(iii) Careful attention must be paid to the construction and post logging treatment of haul tracks, landings and harvest roads to minimise erosion and excessive run-off.

Our primary Clay Forest Skidder Crews are now utilising excavator loaders to reduce the soil disturbance on the landing. This is resulting in a new set of planning problems for the harvest planner - especially with regard to the number of log sorts able to be handled.

Planning Ground-Based Logging to Avoid Problems

To successfully log difficult country with ground-based systems requires thorough planning of all harvest related activities.

More and more people are becoming aware of their environment and most are self appointed experts on how it should be managed. Therefore if the industry wishes to be able to operate with minimal constraints placed upon it from external bodies, then it must be seen to be acting in a responsible manner.

Other benefits which flow from thorough harvest planning include:

(i) Reduced costs of logging. By carrying out an economic analysis of the various options identified at the planning stage, it is possible to select the best combination of roading and extraction costs which will minimise total harvest costs.

(ii) A better level of understanding of the problems being faced by the Contractor at any given time.

(iii) The ability to anticipate any problems (environmental or otherwise) and take the necessary action to minimise the impact.

As I stated three years ago at the LIRA "Cable Logging Seminar" the challenge, as I see it, is to **profitably** market, harvest and re-establish the tree crop in a manner which is environmentally acceptable to all parties.

To meet this challenge the harvest planner must select the correct logging system. He must give adequate consideration to the density, location and construction methods used in building a road and landing

layout. Operational guidelines must be developed to ensure timber harvesting is carried out so as to minimise long term impact on the environment and the productivity of the site. The safety, productivity and economic viability of each proposed system must then be evaluated.

The results of this process should be a least cost and lowest impact harvest plan which is acceptable to all parties likely to be involved or affected by the logging. If developed with care this system may well be ground-based.