TRACKED SKIDDERS:

STEEP, MUD AND OVERSTOREY

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ABSTRACT

This paper summarises past New Zealand field trials of the FMC 220 CA skidder working in a number of different operating conditions. The KMC 2500 skidder which recently arrived in New Zealand is also mentioned. Recent trials of the Caterpillar tracked skidders are summarised and some subjective comments on their ability to work in adverse conditions are included. A brief extract on a field demonstration of a Timberjack 480BT quadtrack skidder is also outlined.

INTRODUCTION

For the purpose of this paper "tracked skidders" will be defined as those tracked machines that have been developed specifically for log extraction. These machines can be used successfully with integral arches or grapples.

Section I of this paper summarises past New Zealand studies of the FMC 220CA skidders (hereinafter called FMC) and takes a snapshot view of the KMC 2500 now working in Ngamu Forest, situated in the Wairapa. Section II summarises recent studies, with emphasis on production, of the Caterpillar tracked skidders and the third section briefly discusses the Timberjack 480BT, an articulated tracked skidder.

This is the second "Logging Machinery Seminar" LIRA has run, the first being in 1982. Predictions then suggested that the number of skidders and tractors (of a size suitable to extract clearfell sized trees) would increase rapidly in the 90's and there would be a drift away from crawler tractors to skidders, while flexible track skidders would operate on the steeper country.

While some of these predictions are proving to be correct new Niche machines have since been developed and are bridging the gap between ground based systems and cable operations.

SECTION I

FMC/KMC HIGH SPEED STEEL TRACK SKIDDERS

BACKGROUND

The FMC skidders were developed specifically for log extraction in the 1960's. The first FMC arrived in New Zealand in 1979.

This section of the paper briefly summarises past trials of the FMC and discusses productivity, advantages and disadvantages of the machine. It is reasonable to assume that production rates of KMC's will be similar to that of the FMC machines. Both machines have the same power rating, weight distribution, travel speed etc.

PREVIOUS TRIALS

In 1980 LIRA evaluated the FMC over a six month period working in different operating conditions. In typical tractor country (0-10°) downhill extraction produced up to 75m^3/productive machine hour (PMH). In marginal tractor/hauler country (10-20°) the machine, extracting downhill, produced 54m^3/PMH. In typical hauler country (30°+) production was 47m^3/PMH. That trial showed that the best application for the FMC was harvesting areas of marginal tractor/hauler country (4).

The effect uphill extraction had on machine productivity was tested in 1981 in Matahina forest. The trial showed that the FMC could uphill extract adequately on 13° slopes. With average uphill haul distances of 400m the machine produced approximately 30m^3/PMH (2).

A small trial was also undertaken to test the effect long haul distances had on production. For an average haul distance of 494m, 41m^3/PMH were produced. Drag volumes of 13m^3 appeared to be the maximum in flat, slash free ground conditions (2).

Subjective comments on the affect the machine had on the environment were given after a New Zealand Forest Service trial in Ngamu Forest in 1981. It was found the grousers did not break up the soft clay base soil and as such did not enhance downcutting of track ruts. The low ground pressure of the machine even when loaded did not create massive disturbance of the ground surface or create the mud conditions typical of other machines (10).

The high power rating, good traction and good stability meant that this machine could maintain year round log production under the most adverse ground conditions often experienced in Ngamu Forest (10). This point was reinforced when, at the 1986 LIRA Seminar an FMC owner contracting in Ngamu Forest concluded that this was the only machine he had seen that could work all year round in the Wairapa region (6).

Today, what was known as the FMC is now manufactured by "Kootenay Manufacturing Company" and is called KMC. Extensive modifications have been made to correct the problems that plagued the earlier machines. Two KMC's are now in operation in New Zealand. The first is working in radiata clearfell in Ngamu forest and the second is on trial in Kinleith forest. Both units incorporate a grapple (figures 1 and 2, appendix 1). The grapple arch has a fairlead so that the winch and mainrope can be used to break out trees inaccessible to the grapple. The grapple arch can be interchanged with a cable arch for added versatility (machine specifications and dimensions are given in appendix 2).

SECTION II

CATERPILLAR TRACKED SKIDDERS

Three Caterpillar D4H tracked skidders, two D5H tracked skidders and one D6H logging special are now working in both thinnings and clearfell operations in New Zealand.

CAT D4H CUSTOM SKIDDER

The first D4H tracked skidder to work in New Zealand has now completed over 2000 hours of radiata clearfell work. The machine is used successfully with an integral arch (machine specifications and dimensions are given in appendix 3).

Rainfall during the initial stage of a trial limited the machines access to the original steep country block. The machine was moved to a flat area. Haul distances during the trial ranged from 40m to 200m and averaged 140m. The average piece size was 2.7m^3. The machine has since been observed working on steep slopes (figure 4 appendix 3).

RESULTS

The average productive cycle (delay free) was 10 minutes. The average drag volume was 8.21m^3 equating to a production of 48.8m^3/PMH. The main factors affecting productivity were the volume skidded per cycle and haul distances. Loads greater than 12m^3 generally required winching during the travel loaded phase.

The study showed that the D4H is capable of effectively extracting wood with a mean piece size of 2.7m^3 and achieving good production targets under ideal conditions.

THE CAT D5H TRACKED SKIDDER

This is the first D5H tracked grapple skidder to be used in New Zealand and has completed approximately 1220 hours of radiata clearfell work (machine specifications and dimensions are given in appendix 4).

A trial was carried out in Tahorakuri forest compartment 8381/9. This was a small compartment originally planned as a hauler block. Slopes ranged from 0 to 32° over the entire compartment but for the trial area ranged from 0 to 28°. Skidding was in a downhill direction. Haul distances averaged 222m. Piece size averaged 3m^3.

RESULTS

The average productive cycle time (delay free) was 8.78 minutes. Production was 52.2m^3/PMH. Analysis showed that the best predictor of cycle time, used to estimate production, was the travel empty distance (figure 8 appendix 5).

CLIMBING ABILITY

Climbing ability is dependent on soil type and the condition of the machine. Soils in Tahorakuri are volcanic in origin, Kaharoa ash over Taupo pumice on ignimbrite bedrock and are friable. The D5H climbed slopes up to 25° on formed tracks. When travelling across the cutover slash severely affected the machines ability to climb adverse grades. The D5H was observed pushing in tracks on adverse grades up to 22°. Slopes up to 32° were negotiated downhill (figure 9 appendix 6).

FLEXIBILITY OF GRAPPLE UNIT

In an attempt to increase the drag size on long hauls the winch and four strops were used. A comparison of productivity of the two systems was made. The payload was increased from 8.65m^3 to 10.64m^3 (22%) when using the winch however cycle times were increased by 38%. Longer cycle times were attibutable to the longer position and hookup times when using the winch. The overall result was that there was no significant difference in the hourly production. Payloads using the grapple were often limited to two stems due to slippage of the third and subsequent stems once the machine started moving.

The machine performed very well in this large piece sized wood and 15° favourable slopes. Stems slipping from the grapple made it difficult to obtain optimum drag sizes. The winch gives the unit flexibility where skidding conditions do not favour grapple skidding.

CAT D6H LOGGING SPECIAL

This machine has been working in radiata clearfell since January 1990 and has completed 2000 hours of operation time. Although this machine can be used with a grapple (11) it incorporated a towed arch (figure 10 appendix 7).

The tractor has differential steering which provides power to both tracks during turning. This enhances the manoeuvrability of the machine on steep country and when under load. A unique feature of this machine is that all movements are controlled from one lever. The cab has been designed to enhance operator comfort. The seat is angled 15° to the right making it easier for the operator to look to the rear (figure 11 appendix 7). (Machine specifications and dimensions are given in appendix 8).

A trial of the machine was undertaken in two separate compartments of Pinedale forest, just south of Putaruru. Both blocks had a steep face leading to a Plateau area. The average haul distances were 146m and 74m for blocks 1 and 2 respectively. In block 1 the average piece size was 2.1m^3 and for block 2 the average piece size was 3.5m^3.

RESULTS

In block 1 the average productive cycle time was 16.1 minutes and the average drag volume was 12.2m^3 equating to a productivity of 45.4m^3/PMH. The average productive cycle time in block 2 was 13.23 minutes and the average drag volume was 15.5m^3 equating to a production level of 70.3m^3/PMH.

Standardising average haul distance to 60m the operation in block 2 had a 15% longer cycle time, 10% fewer stems per drag but a 50% greater drag volume. A 29% greater production level was recorded in block 2.

It was shown that high production and thus lower wood costs were achieved in the block with the larger piece sized wood.

SECTION III

TIMBERJACK 480BT QUAD TRACK SKIDDER

This machine is a tracked skidder in the true sense of the word (figure 12 appendix 9). The 480BT is identical to the 480B rubber tyred skidder down to the planetaries. The machine has a non-spin front differential and a differential lock in the rear. Heavy duty axles drive four track bogies (appendix 8 and 9 for machine details).

A Timberjack 480BT quadtrack skidder was demonstrated in Kamloops, British Colombia in September 1990. The machine easily accessed the 27° slope that characterised the demonstration site. It was reported that the machine had worked comfortably on slopes up to 36°. With a side slope capability of up to 27° the machine is ideal for steep country ground based extraction.

During the demonstration the machine skidded downhill with loads of approximately 5-6 tonnes, uphill with loads of 2-3 tonne and it backed a load uphill after having stopped on a slope of 27°. These loads are small and the machine is capable of carrying loads 2-3 times this size (figure 13 appendix 9).

The 480BT's top speed is just over 11km/hr. At this speed however, the track gear of the machine is very noisy. The track gear is identical to that of the CAT D5H and was reported to have an estimated life of between 4000-5000 hours if speeds of 6 km/hr are adhered to. Each track bogie weighs approximately 3-5 tonne.

SUITABILITY TO NEW ZEALAND

This machine, like the KMC fit into specific Niche applications. The quadtrack would be suited to large piece sized wood on steep country. The machines climbing ability is superior to that of the KMC however travel speeds are slower. The question must be asked, how well would a machine of this size be matched to New Zealands harvesting operations? A smaller quadtrack machine of a size similar to the 450B or even 380B may have more aptitude in New Zealand. Many developmental projects are underway and we may see these smaller quadtrack machines in the future.

SUMMARY

This paper has summarised the results and conclusions of past studies, critically evaluating the FMC 220CA skidder. A summary of recent productivity studies of the Caterpillar tracked skidders and has mentioned the Timberjack 480BT which may have potential for the New Zealand harvesting scene in the future.

The Caterpillar tracked skidders are proving to be effective skidding machines and we will continue to see more and more of these machines in operation. The KMC's are more specialised machines. They should not be veiwed as an alternative to CAT tracked skidders but belong to a niche of their own. The relatively high capital cost of KMC's should ensure their use in areas where adverse logging conditions make alternative harvesting methods expensive. As the KMC's prove themselves as effective skidding machines we will see more and more of them in our steep country operations. The Timberjack quadtracks are an exciting prospect for the future. In general, the design and development of skidding machines has taken giant forward bounds since the last "Logging Machinery Seminar" held by LIRA.

To round off this paper I think it is relatively safe to say that as developments proceed we will see more areas once logged with cable systems being safely and successfully logged with ground based machines.

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APPENDIX 1

Figure 1 : KMC 2500 Working in Ngamu Forest

Figure 2 : KMC 2500 Showing Grapple Configuration

APPENDIX 2

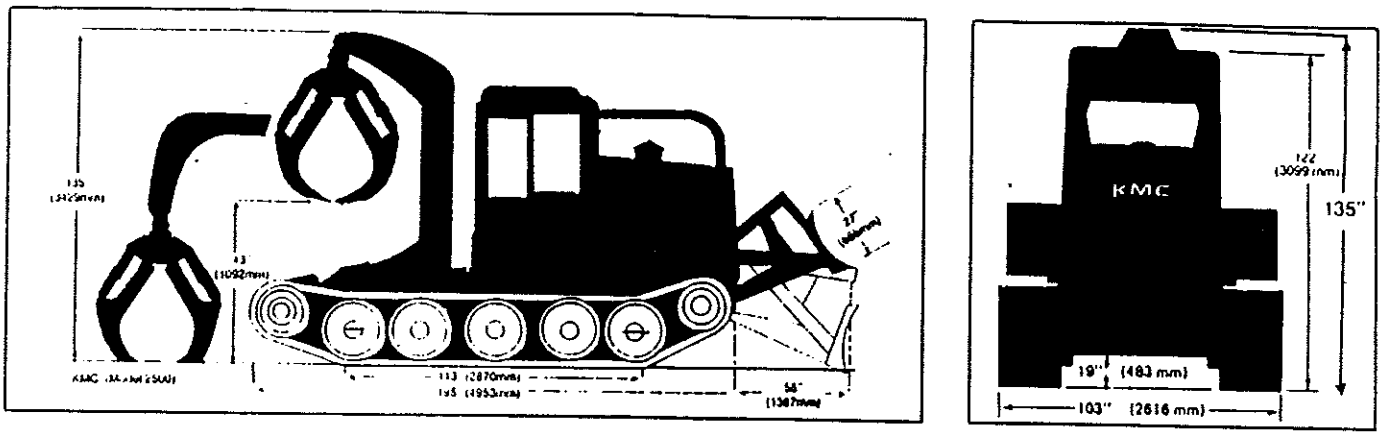


Figure 3: KMC 2500 Dimensions

Table 1 : Machine Specifications : KMC 2500

Operating Weight		15164kg
Engine Detroit Diesel 6V53W		200hp
Travel Speed	- 1st gear	3.5km/hr
	- 2nd gear	7.4km/hr
	- 3rd gear	12.9km/hr
	- 4th gear	23.3km/hr
Ground Clearance		483mm
Grapple	- maximum opening	2540mm
	- maximum closing	50mm
	- rotation	210°
Grapple Boom	- reach extended	2489m
	- below ground	1397m
Ground Pressure		6.4psi

APPENDIX 3

Figure 4 : D4H Tracked Skidder Working on 22º Slopes

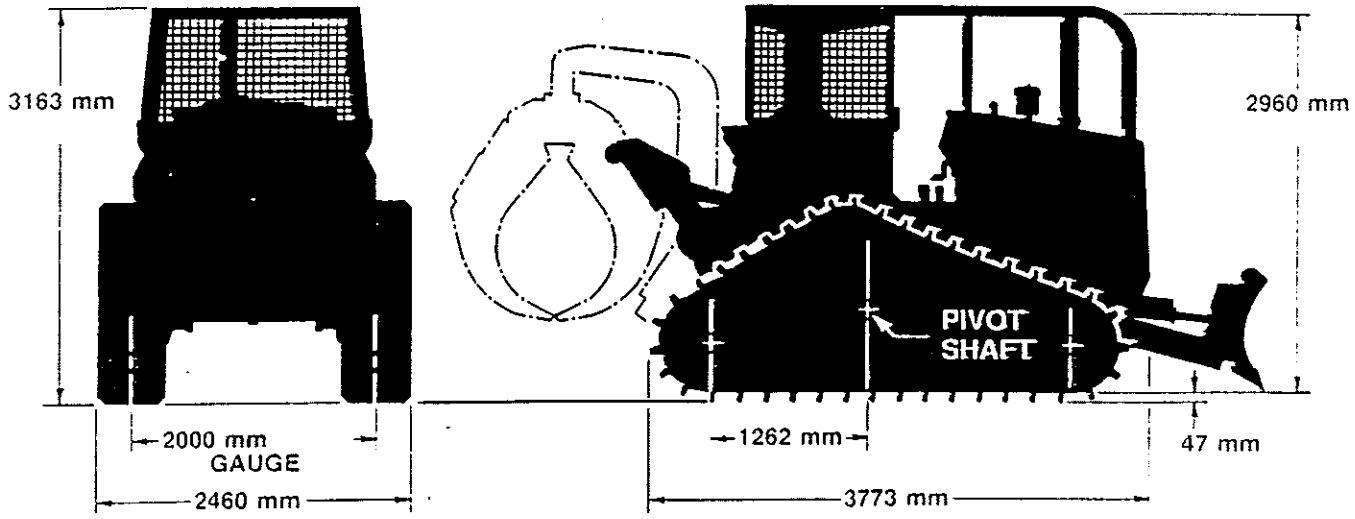


Figure 5 : D4H Tracked Skidder Dimensions

Table 2 : Machine Specifications - D4H Tracked Skidder

Operating Weight	12909kg
Engine Cat 3204 Turbo	74kW/99hp
Travel Speed - 1st gear	3.5km/hr
- 2nd gear	6.2km/hr
- 3rd gear	10.2km/hr
Ground Clearance	559mm
Winch Line Pull	15320
Ground Pressure	7.6psi

APPENDIX 4

Figure 6 : D5H Tracked Skidder with Grapple Arch Extended

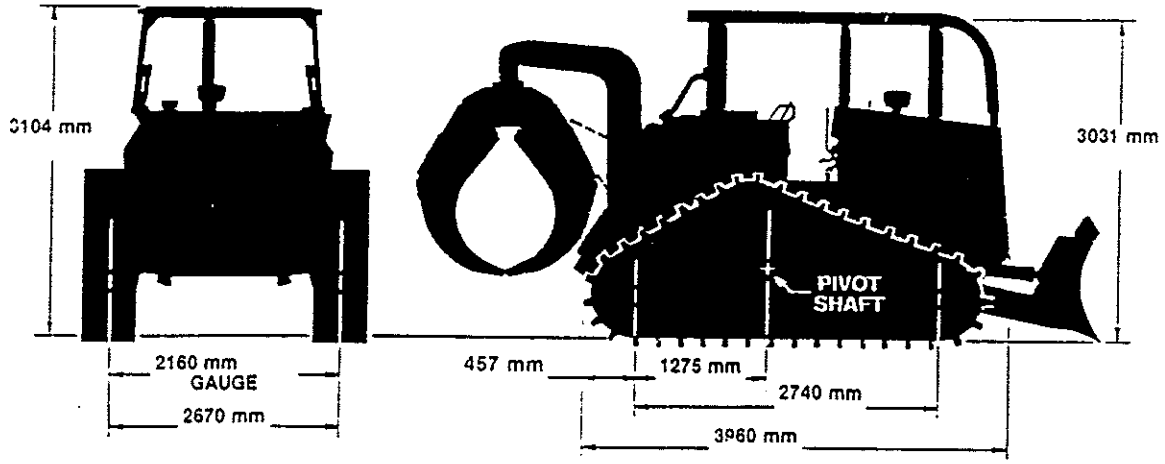
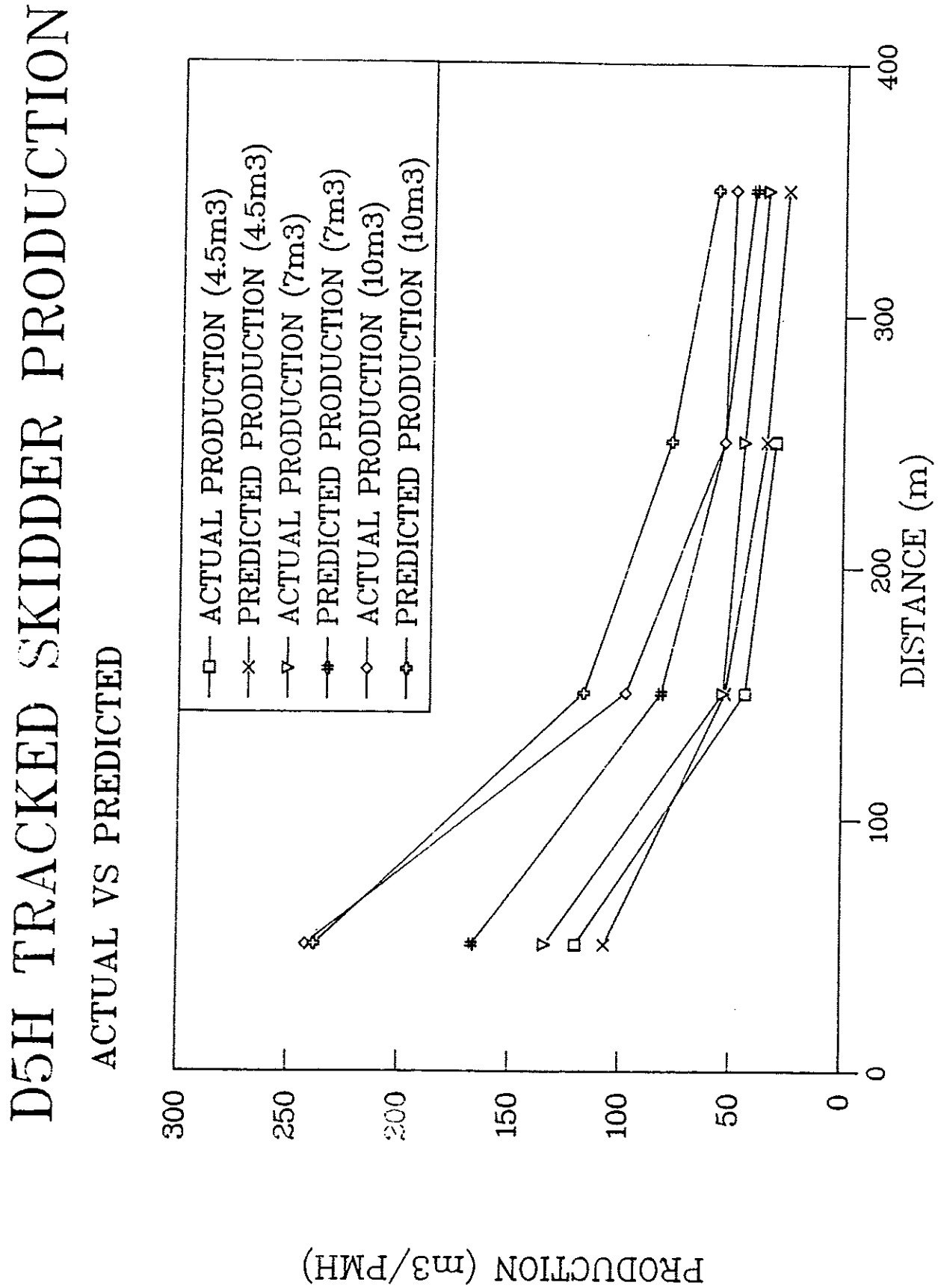


Figure 7 : D5H Tracked Sidder Dimensions

Table 3 : Machine Specifications - D5H Tracked Skidder

Operating Weight	16177kg
Engine Cat 3304 Turbo	96kW/129hp
Travel Speed - 1st gear	3.6km/hr
- 2nd gear	6.4km/hr
- 3rd gear	10.9km/hr
Ground Clearance	563mm
Grapple Maximum Opening	2540mm
Maximum Closing	50mm
Rotation	290°
Grapple Boom Reach Extended	2000mm
Ground Pressure	8.2psi

APPENDIX 5


D5H TRACKED SKIDDER PRODUCTION
ACTUAL VS PREDICTED
ACTUAL PRODUCTION (4.5m3)
PREDICTED PRODUCTION (4.5m3)
ACTUAL PRODUCTION (7m3)
PREDICTED PRODUCTION (7m3)
ACTUAL PRODUCTION (10m3)
PREDICTED PRODUCTION (10m3)
PRODUCTION (m3/PMH)
DISTANCE (m)
0
50
100
150
200
250
300
0
100
200
300
400

APPENDIX 6

Figure 9 : D5H Tracked Skidder Operating on 32º

APPENDIX 7

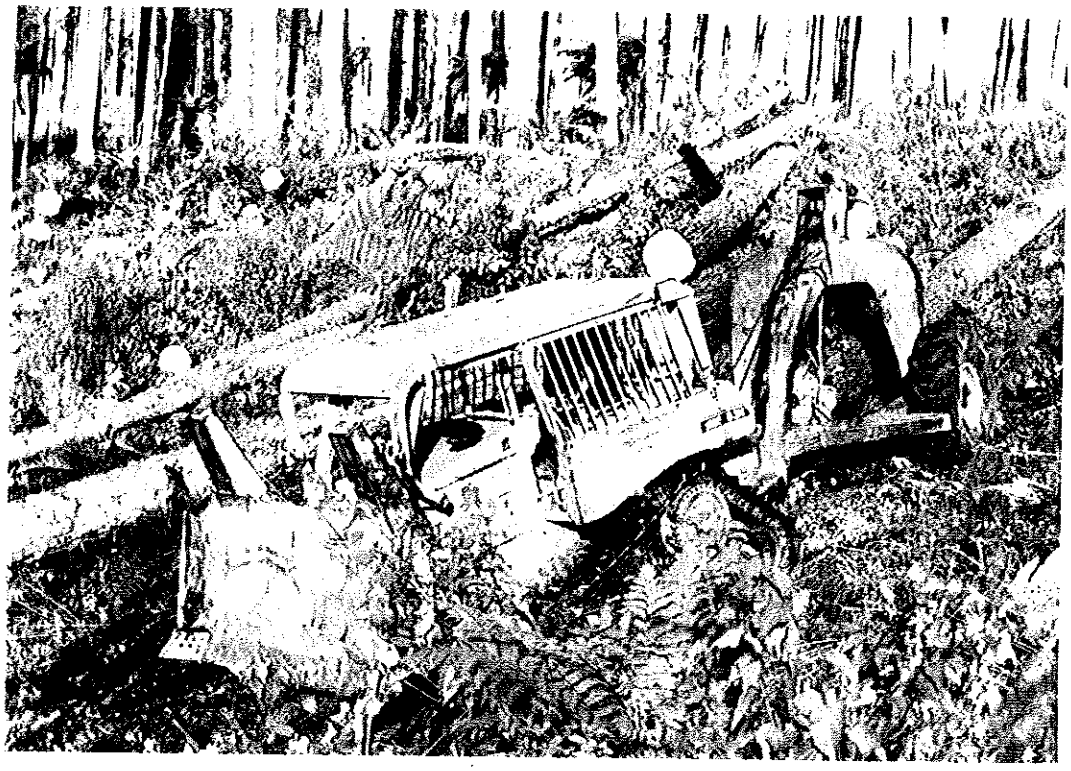


Figure 10 : D6H Logging Special and Towed Arch

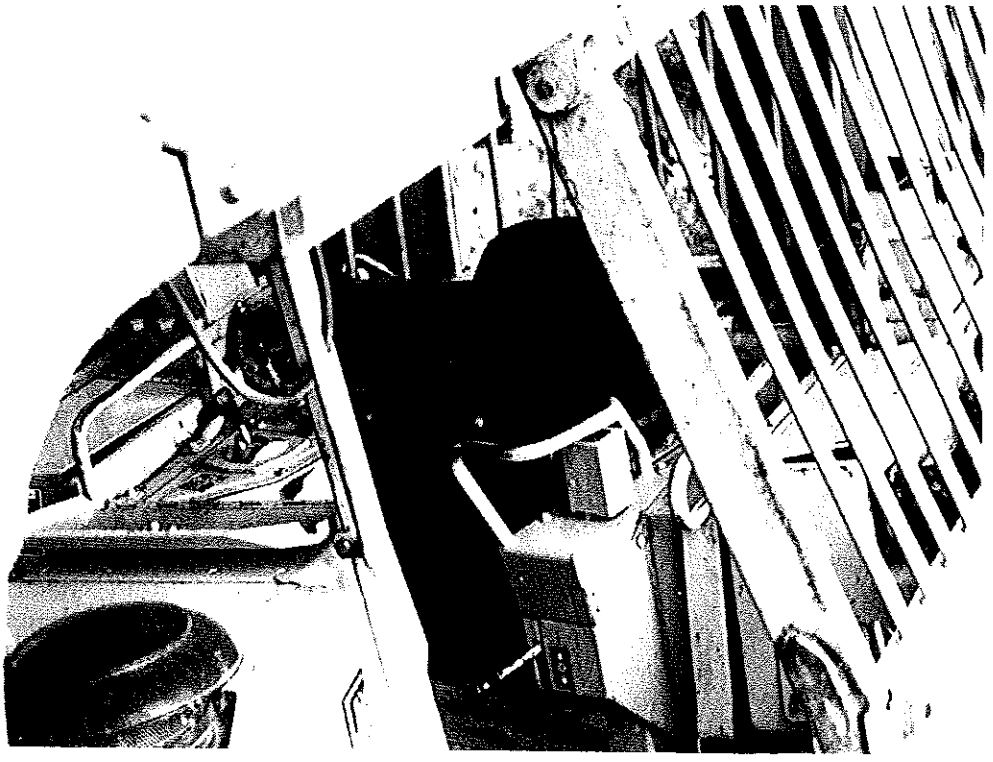


Figure 11 : View of Operators Seat and Controls in D6H Logging Special

APPENDIX 8

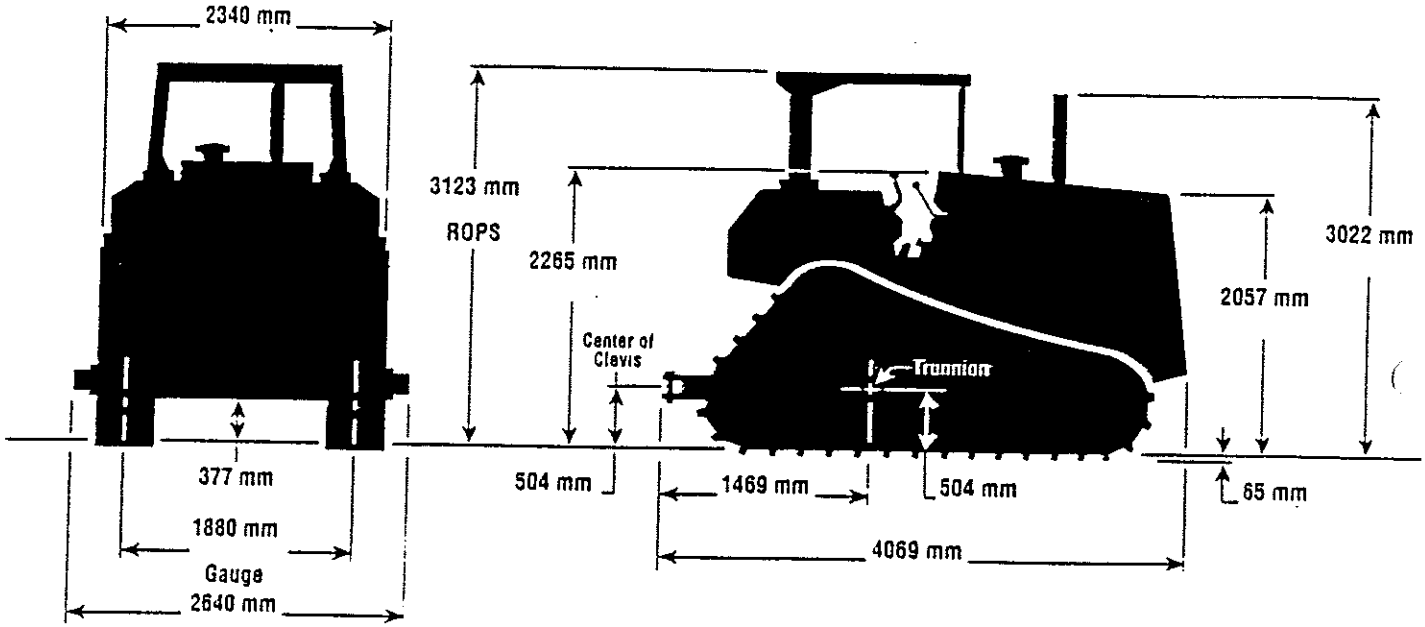


Figure 12 : D6H Logging Special Dimensions

Table 4 : Machine Specifications - D6H Logging Special

Operating Weight	20612kg
Engine Cat 3306 Turbo	133kW/179hp
Travel Speed - 1st gear	3.8km/hr
- 2nd gear	6.5km/hr
- 3rd gear	11.3km/hr
Ground Clearance	377mm
Ground Pressure	8.68psi

Table 5 : Machine Specifications - Timberjack 480BT

Operating Weight	22226 kg
Engine Cummins 6BtA5.9	132 kw/177 hp
Travel Speed Range	2.4 - 11.2 km/hr
Ground Clearance	843mm
Ground Pressure	9.5psi
Overall Width	3350m

APPENDIX 9

Figure 13 : Timberjack 480BT Quadtrack Skidder