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LOGGING
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PROJECT REPORT

CLAMBUNK SKIDDERS

DO THEY HAVE A PLACE IN THE NEW ZEALAND LOGGING INDUSTRY?

P.R. 26

1985

N.Z. LOGGING INDUSTRY RESEARCH ASSOCIATION (INC.)

P.O. Box 147 Rotorua New Zealand

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- CLAMBUNK SKIDDERS -

Do they have a place in the New Zealand Logging Industry?

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A C K N O W L E D G E M E N T S

LIRA wishes to acknowledge the assistance of Lees Industries Ltd and Motor Holdings for supplying information on the machines and also acknowledge Harvesting Planning Group, FRI and N.Z. Forest Products Limited for their assistance in estimating productivity for conventional extraction machines in second crop radiata pine.

S U M M A R Y

The use of clambunk skidders has increased in popularity in certain parts of the world, most notably in North America and Scandanavia. Their main advantage lies in the ability to accumulate a large load of 15-25 tonnes, which allows for economic long distance skidding. By skidding long distances, roading and landing requirements are reduced, resulting in a potential for reduced harvesting costs. In addition clambunks can work on steep slopes and can reduce site disturbance (low ground pressure and fewer passes through the site).

In New Zealand there has been increased interest in the potential for using clambunk skidders as an extraction machine. This report looks at that potential, by simulating the expected clambunk productivity and relative harvesting costs in a second crop radiata stand and compares that to conventional extraction methods (skidder and crawler tractor).

The simulation was done, using base data from overseas work studies, in a second crop stand defined by 1.9 m^3 merchantable tree size with 300 stems per hectare. Load sizes of 15, 21 and 25 m^3 were simulated, over average haul distances from 150 to 500 metres. Predicted productivity ranged between 180 and 420 m^3 per day. The daily costs of a clambunk ($475,000 and 8 year life) was estimated at $945 per day with an operator.

In terms of extraction costs alone the conventional skidder was still the most cost effective method. However when long distance clambunk skidding is used (150 versus 250 metres) there was potential roading and landing cost savings. In areas of low roading and landing costs the skidder is still the most cost effective method. When roading and landing costs are high ($25,000 - 30,000/km and $3,000/landing) long distance clambunk skidding becomes the most cost effective method.

Under the assumptions in the simulation the clambunk skidder is only economic for long distance skidding in areas where roading and landing costs are high. Clambunks may also have potential for working steep or broken slopes considered marginal hauler terrain or on sensitive unstable soils where reduced site disturbance is critical and where roading and landing area must be minimised.

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I INTRODUCTION

A clambunk, is a skidder with an inverted grapple mounted over the rear axle or axles. The grapple can open to receive whole trees or tree length logs and close to grab the logs for extraction. A knuckleboom loader is used to load logs into the grapple. The machine has the ability to travel through the bush accumulating its optimum payload. Once on the landing the inverted grapple is opened, the machine driven forward and the load deposited. The clambunk can be mounted to base carrier skidders or forwarders with the following configurations : 2 x 2, 2 x 4, 4 x 4 and tracked.

The use of clambunk skidders has gained acceptance in certain parts of the world. Some of the stated advantages are :

* Ability to accumulate many pieces into an optimum payload.

* Capacity to carry large loads of 15 - 25 m^3.

* Large payloads allow economic long distance skidding.

* Long skidding distance can reduce roading and landing requirements hence potential cost savings.

* Capability of working on slopes up to 50-60%, and improved stability on side slopes due to ability to shift load to the high side.

* When fitted with boggie axles can traverse rough terrain, i.e. boulders, and stumps.

* Low ground pressure especially when fitted with band tracks and reduced site disturbance with fewer pases through the site.

* Smooth ride for operator and improved operator work environment.

* Reduced support labour, e.g. no breakerouts required and no unhooking on the landing.

* Clean wood since close to 2/3rds of load supported off the ground.

* Potential for long working hours, e.g. work in wet weather, work double shift, lights allow night time work.

However, there are some disadvantages :

* High cost $300,000 - $500,000 (although even conventional extraction machines are approaching this).

* Large machine size probably limits their use to clearfell operations.

* Must be able to travel within knuckleboom's reach of every stem.

* Large tree size in clearfell operations negates advantage of load accumulation.

* Manoeuvrability reduced, especially when turning on slopes.

* Cannot drop and winch to overcome obstacles or boggy ground conditions.

* Increased training levels required for both operators and mechanics.

* Problems on the landing in processing and handling loads of 15 - 25 m^3.

* Unless machine popultaion grew rapidly, there would be initial problems with parts availability and servicing.

This report reviews and summarises the overseas literature available at LIRA. Based on an indepth study of clambunks in Finland and supporting information from North America, the average cycle times for a clambunk (Lokomo 933C) working in New Zealand second crop clearfell conditions is simulated. Using the predicted cycle times, productivity is predicted for various load sizes and skid distances.

The LIRA costing handbook was used to estimate daily cost for a LOKOMO 933C Clambunk skidder, a 130 KW skidder and a 100 KW crawler tractor with logging arch. Based on existing standards for productivity of the skidder and tractor, the extraction costs/m^3 is compared to the predicted cost of using a clambunk. The question of roading and landing costs is briefly analysed with respect to potential cost savings through long distance skidding.

All productivity and costings are not necessarily actual but are indicative. As such, they provide a basis for manipulation by the reader, to adjust to their own conditions and past experiences.

II LITERATURE REVIEW ON CLAMBUNK SKIDDERS

1. Pawlett, S. "Clambunk Skidder Boost Productivity" Canadian Forest Industries, May 1984.

   A Lokomo 933C was working in 15-20 cm dbh Black Spruce on flat terrain. Skidding distances were 700 m. The machine worked behind a feller-buncher. The machine was getting 3 cycles per hour with loads around 15 m^3. Average production was 43 m^3 per productive machine hour. Fuel consumption was around 25 litres/PMH.

2. Johnson, T. "Long Distance Clambunk Skidding" Journal of Logging Management, Jan 1978.

   A Kockums CS-21 155hp 6 wheeled clambunk skidder with a 12 tonne capacity was tested. The stand was a Lodgepole pine with a tree size of .57 m^3 and a stocking of 200 to 250 sph on rolling terrain up to 35%. Average skid distance was 360 metres. Mechanical availability was low and parts availability was a problem. Over the 83 day period productivity was 44 trees or 25 m^3/PMH. Traction and manoeuvrability were better than a skidder but the machine was too low in horsepower and travel speeds.

3. Powell, L. "Timberjack 520 and Bombardier BT-12 Clambunk Skidders" Interim Report 1 FERIC Sept 1980.

   Two clambunk skidders were tested in a stand with tree size of .35 m^3. Both worked behind a feller-buncher. Total cycle time for the TJ520 was 12.88 min with a load of 25 trees or 8.8 m^3 for a productivity of 41 m^3/PMH with an average skid distance of 81 m. The Bombardier had a cycle time of 19.38 min with a load of 28 trees or 9.9 m^3 for a productivity of 31 m^3/PMH with an average skid distance of 114 metres.

4. McMorland, B. "Evaluation of Volvo BM 971 Clambunk Skidder" FERIC Technical Release TR-16 June 1977.

   A three month trial of the Volvo clambunk skidder with 2 m^2 bunk. Unit worked in clearfell of Lodgepole and spruce with a tree size of .77 m^3 at 530 sph. Cycle times were 23.5 min/cycle with 20 trees or 15.3 m^3 over a 350 m skid distance. Productivity was 39 m^3/PMH. Over long term mechanical availability only 69%. Maximum observed load was 25.5 m^3. Load assembly time was .92 min/tree in chainsaw felled wood.

5. Salminen, J. "Comparison of Haulage Methods" Metsateho Review 5/1983.

   Four options were studied: winch skidder, grapple skidder, forwarder and clambunk skidders. Productivity was simulated for each option over various tree sizes and is shown below. Skidding distance used was 300 - 400 metres.

Productivity - m^3/PMH

Machine	Tree Size (m^3)				
	.1	.2	.3	.5	.6
1. Forwarder (Bunched)	12	12.5	13	14	14.5
2. Winch Skidder (scattered)	6	9	13	19.5	23
3. Grapple skidder (bunched)	8	11.5	13.5	18	20
4. Clambunk ($2m^2$) (Scattered)	12	18.5	24	30	31.5
5. Clambunk ($3.5m^2$) (bunched)	23.5	27.5	30.5	35	37

Conclusions were that winch skidders were cheaper than forwarders in tree sizes over .3 m^3. With bunched stems a grapple skidder is betten than a forwarder. A clambunk is better than a forwarder in all tree sizes with the larger the stem size the better. Conclude for Finland the most economical method of hauling is with a clambunk skidder.

6. Pease, D. "Big Skidding Machine Reserved for Long Runs" Forest Industries, May 1983, Vol. 110, No. 5.

Timberjack 520 working in strip clearfelling in Canada behind a fellerbuncher. The TJ520 was pulling 225 trees/hour and making 3-4 trips an hour over 500 meter average skid distances. Load sizes was around 14 m^3. Tree size was between .25 - .30 m^3. Productivity was between 42-56 m^3/PMH.

7. Friesen, J. "Self Loading Skidder Aids Productivity Increase" Logging & Sawmilling Journal March 1984.

Herman Brothers operation on clearfell of a mix of small regeneration less than 25 cm and scattered stems over 60 cm. Load size varied from 15-20 tonne. The TJ520 averaged 3-4 trips per hour over skid distance of 400-600 m and averaged 550 tonne/day. When pulling uphill load size drops. They have downhill skidded on slopes of 45-50%.

8. Savage, M. "Clambunk" Timber Harvesting, Sept 1984, Vol 32, No. 9.

A Timberjack 520 was cycling in 18 minutes, carrying a load of about 13 tonne over long skid distances. Report also states low ground pressure, reduced site disturbance, and cleaner wood.

9. Anon, "Timberjack 520 Clambunk Demo in Tasmania" Logger Sept/Oct 1982.

The TJ520 was working behind a JD743 harvester in clearfell of .30 m^3 radiata pine. The machine was delivering an average load of 65 trees or 20 tonne in a cycle time of 30 minutes over a skid distance of 680 metres. With prebunched wood it is reported to reduce cycle time to 17 minutes.

10. Thesslund, O. "Clambunk Skidding of Stems Felled and Delimbed by a Tree Length Harvester" Finnish National Board of Forestry, 1979.

A Lokomo 933TC Clambunk skidder fitted with a 2 m^2 clambunk was used to extract tree length wood produced by a Lokomo 961 tree length harvester. Tree size was .30 m^3 with stockings from 900 - 1200 sph. During the study skid distances were 179 metres loaded with an average of 33 trees or 9.8 m^3/load. Time study results are shown below in min per m^3.

	Element	min/m^3	Dist.	Speed
1.	Load*			
	Loading	.93		
	Sorting	.12		
	Move	.20	62 m	(31m/min)
	Total	1.25		
2.	Travel			
	Empty	.33	179 m	(55m/min)
	Loaded	.29	111 m	(40m/min)
	Total	.62		
3.	Unload	.04		
4.	TOTAL	1.91 min/m^3 or 31.4 m^3/PMH		

* Load size of 33 stems = 9.8 m^3
Volume per grapple full = .41 m^3
Volume per loading site = 1.1 m^3

Loaded travel speeds were studied and the results are shown below :

Travel Path	Grade %	Travel Speed metres/minute Load 20 m^3	Load 26.5 m^3
Straight	0	57	52
Turning	0	53	32
Straight	-10	82	81
Straight	+13	25	19

11. Productivities reported in the literature are summarised in Table 1.

Table 1 - Summary of Productivity from Literature Review

Ref.	Machine	Tree Size (m^3)	Load Size (m^3)	Skid Dist. (m)	m^3/PMH (m^3)	m^3/Day (m^3)
1.	Lokomo 933	15-20 cm	15	700	43	280
2.	Kockums CS-21	.57	12	360	25	165
3.	Timberjack 520	.35	9	81	41	265
	Bombadier BT-12	.35	10	114	31	200
4.	Volvo BM971	.77	15	350	39	255
5.	Simulation	.60	10-14	300-400	31	200
		.60	20-27	300-400	37	240
6.	TJ 520	.27	14	500	49	320
7.	TJ 520	?	17	500	?	550
8.	TJ 520	?	13	?	43	280
9.	TJ 520	.30	20	680	40	260
10.	Lokomo 933	.30	10	179	31	204

III SIMULATED PRODUCTIVITY OF A CLAMBUNK SKIDDER

Based on the literature search, work study data has been isolated and was used to estimate the Clambunk productivity. For the purposes of the simulation a second crop stand was defined as 300 sph with a tree size of 2.0 m^3. After felling the recoverable merchantable piece size used was 1.9 m^3. The machine (Lokomo 933C) chosen had a 3.5 m^2 bunk size with an estimated load capacity of 25 m^3 or 13 trees. Load sizes of 15 and 21 m^3 were also calculated for comparison.

A. Travel Speeds : Travel speeds will vary greatly with terrain changes and skid distance. A constant speed was used dependent on load size. However, with long distance skidding speeds could be expected to increase slightly, as the operator becomes familiar with a path and that path becomes broken-in or prepared, allowing for faster speeds. Consequently travel times, especially with long skid distance, are overstated and therefore productivity on long skidding distance is under-estimated.

1. Empty speeds

   a. Maximum Rated Speed 27 km/h - 450 m/min
   b. Ref 10 55 m/min in bush
   c. Assume speed 55 m/min

2. Loaded Speed

   a. Ref 10

      (i) Load 10 m^3 speed 40 m/min
      (ii) Load 20 m^3 speed ranged 25-82 m/min
      (iii) Load 26.5 m^3 speed ranged 19-81 m/min

   b. Assume speed :

      (i) 15 m^3 35 m/min
      (ii) 21 m^3 30 m/min
      (iii) 25 m^3 30 m/min

B Loading Times

1. Ref 10 Cycle Times :

   a. Load .93 min/m^3 x (.3 m^3/tree) = .28 min/tree
   b. Move .20 min/m^3 x (1.1 m^3/load point) = .22 min/loadpoint

2. Ref 4 Load assembly time per tree = .92 min in chainsaw felled wood of 0.77 m^3/tree.

3. Assume :

a. Load time = 1.0 min/tree
b. Move time = 2 trees/load point = .11 min/piece
c. Total time/piece = 1.11 min

C. Unload Times

1. Ref 10 .04 min/m^3

2. Assume :

a. Load of 15 m^3 or 8 pieces = .60 min
b. Load of 21 m^3 or 11 pieces = .80 min
c. Load of 25 m^3 or 13 pieces = 1.00 min

D. Daily Clambunk Productivity (See Appendix I)

The estimated daily clambunk productivity over different skid distances and load sizes is shown in Table 2.

Table 2 Daily Clambunk Productivity (m^3/6.5 hr productive day)

		Skid Distance (Metres)					
		150	200	250	300	400	500
Load Size	15 m^3	350	310	275	250	210	180
	21 m^3	390	350	315	290	245	215
	25 m^3	420	380	345	315	270	240

E. Convention Extraction Productivity

1. Assumptions

a. Skidder 130 Kw : 1.9 m^3/piece, 3 pieces/drag
b. Crawler Tractor 100 Kw 1.9 m^3/piece, 5 pieces/drag

2. Daily Productivity (See Appendix 2, 3)

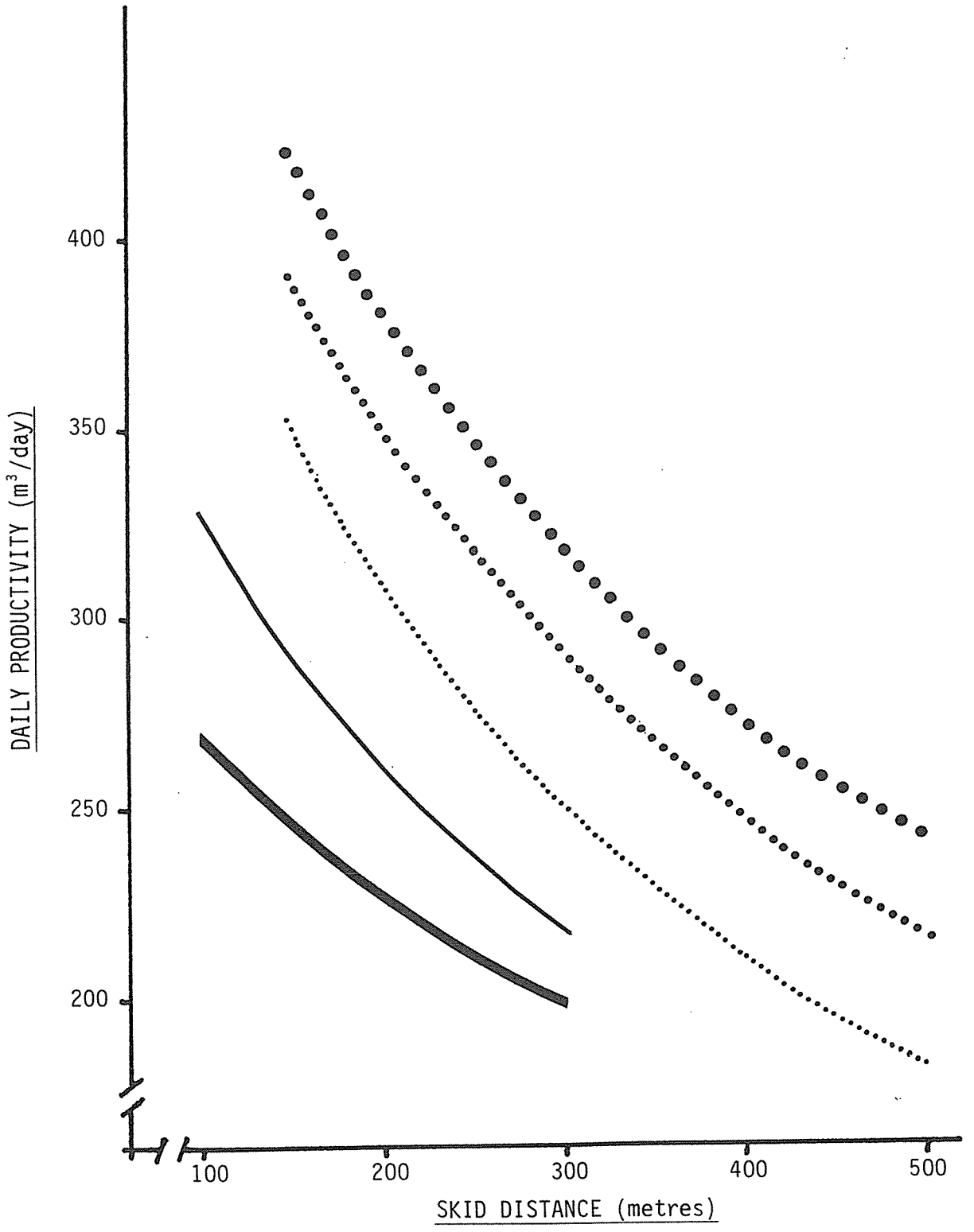
The daily productivity for the skidder and crawler tractor over various haul distances is shown in Table 3.

Table 3 Skidder and Crawler Tractor Daily Productivity (m^3/day)

Machine	Skid Distance (meters) 100	150	200	250	300
Skidder	330	290	260	235	215
Crawler Tractor	265	245	225	210	200

F. Productivity comparisons over various skid distances are shown in Figure 1.

FIGURE 1 - DAILY EXTRACTION PRODUCTIVITY OF A CRAWLER TRACTOR, SKIDDER, AND CLAMBUNK SKIDDER WITH VARIOUS LOAD SIZES VERSUS SKID DISTANCE



IV ESTIMATED MACHINE COSTS

Costs were calculated using the LIRA Costing Handbook approach. Costing information was based on estimates available as of Feb 1985. They are not actual cost but are indicative costs only. The calculations are in Appendix 4, 5 and 6.

A. Purchase price and working life

1.	Clambunk	:	475,000, 8 years
2.	Skidder	:	205,000, 5 years
3.	Crawler Tractor	:	270,000, 7 years

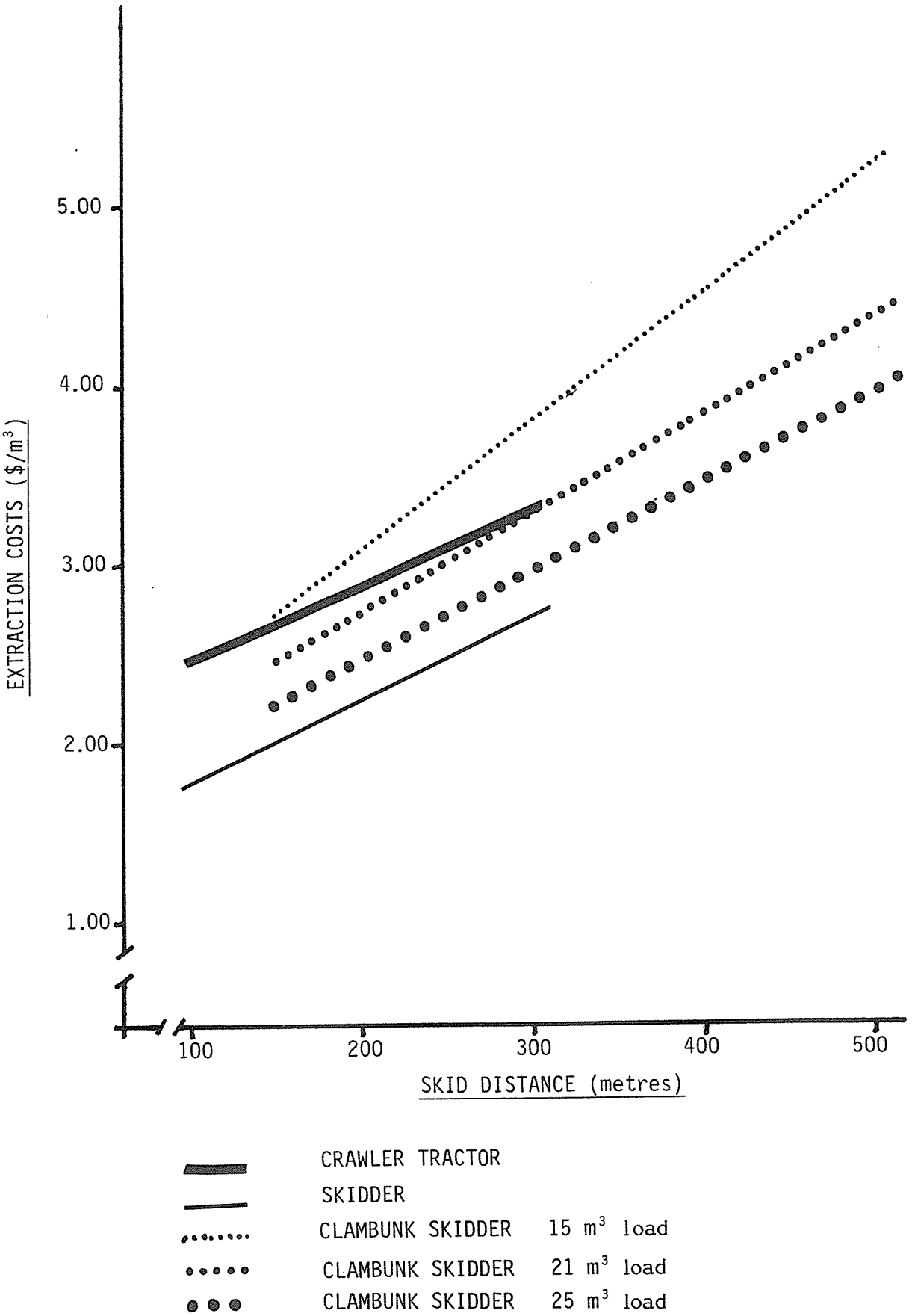
B. Estimate daily machine cost and operator costs

1.	Clambunk	:	855 + 90 = $945/day
2.	Skidder	:	490 + 90 = $580/day
3.	Crawler Tractor	:	560 + 90 = $650/day

V COST PER CUBIC METRE COMPARISONS

A. Cost per cubic meter comparisons over various haul distances are shown in Figure 2.

FIGURE 2 - EXTRACTION COSTS PER CUBIC METRE USING A CRAWLER TRACTOR, SKIDDER, AND CLAMBUNK SKIDDER WITH VARIOUS LOAD SIZES VERSUS SKID DISTANCE



VI ROADING AND LANDING COSTS

With the large payload capacity of a clambunk skidder long distance skidding becomes economically possible. Long distance skidding can reduce roading and landing densities, and therefore reduce costs. Conventional planning aims to keep average skid distance in the range of 150 metres. For the exercise skidding distances for the clambunk will average 250 metres.

A. Roading Density

Currently roading densities average around 45 metres of road per hectare. Of this 15-20 metres is comprised of spur roads to provide access to interior landings. (J. Kennedy personal comments). With increased skid distances of 100 metres it is estimated that 10 metres per hectare of spur road can be eliminated. So for the comparison, with conventional extraction there will be 45 metres per hectare and with a clambunk there will be 35 metres of road per hectare.

Using a stand volume of 570 m^3/ha and a range of road construction costs per kilometre, the roading costs per cubic metre for conventional and clambunk skidding are shown in Table 4.

Table 4 Roading Cost Per Cubic Metre for Conventional and Clambunk Skidding

Roading Cost per m^3

	Extraction Method		
Roading Construction Costs $/km	Conventional 45m/ha	Clambunk 35m/ha	Savings
$ 5,000	.39	.31	.08
$10,000	.79	.61	.18
$15,000	1.18	.92	.26
$20,000	1.58	1.23	.35
$30,000	2.37	1.84	.53

As expected - as roading costs increases the potential savings by using clambunk skidding increases. In addition would be the savings of road R. & M. (grading, metal etc) of the spur roads.

B. Landing Density

Currently the average setting size serviced by a landing is around 5 hectares. With an increased skidding distance of 100 metres it is estimated that the average area serviced by a landing would increase to 8 hectares.

So stand volumes handled by a landing would be 2850 m^3 (5 ha x 570 m^3/ha) for conventional extraction and 4560 m^3 (8 ha x 570 m^3/ha) for clambunk skidding. Using a range of landing construction costs the costs per cubic metre for conventional and clambunk skidding are shown in Table 5.

Table 5 Landing Cost per Cubic Metre for Conventional and Clambunk Skidding

Landing Costs per m^3

Landing Construction Cost	Extraction Method: Conventional (5 ha)	Extraction Method: Clambunk (8 ha)	Savings
1,000	.35	.22	.13
2,000	.70	.44	.26
3,000	1.05	.66	.39

Again as landing cost increases the potential savings through long distance skidding increases. In addition, would be the savings of landing R. & M. made up primarily of metal costs.

VII COST COMPARISONS : CONVENTIONAL VERSUS CLAMBUNKS

The costs per cubic metre for extraction and roading were calculated for each system. Skid distance was 150 metres for the conventional and 250 metres for the clambunk. To simplify the analysis support labour and machines i.e. fallers, skiddies, loaders were ignored. Clambunk skidders will eliminate the need for a breakerout which may be used in the conventional systems. Roading and landing costs represent construction costs only, so no Repairs and Maintenance costs are included.

Two examples were worked out, one with low cost road and landings and the other with high cost road and landings, and are shown in Table 6.

Table 6 Extraction, Roading and Landing Costs per Cubic Metre for Conventional and Clambunk Skidding

Costs $/m^3

	Conventional (150m skid)		Clambunk (250m skid)		
Cost Item	Skidder	Crawler Tractor	25 m^3	21 m^3	15 m^3
Roads @ $10,000/km	.79	.79	.61	.61	.61
Landing @ $1,000	.35	.35	.22	.22	.22
Extraction	2.00	2.65	2.75	3.00	3.40
TOTAL *	3.15	3.80	3.60	3.85	4.25
Roads @ $30,000/km	2.37	2.37	1.84	1.84	1.84
Landing @ $3,000	1.05	1.05	.66	.66	.66
Extraction	2.00	2.65	2.75	3.00	3.40
TOTAL *	5.40	6.05	5.25	5.50	5.90

* Totals rounded off to nearest 5 cents.

The calculations indicate that with low construction cost roading and landings the savings by using long distance skidding are not enough to offset the added extraction costs. However, in areas where road and landing construction is expensive, using long distance skidding is cheaper.

VIII DISCUSSION

The literature review reported clambunks skidding distances from 81 to 700 metres with productivity ranging from 165 to 550 m^3 per day. The largest tree size material reported was .77 m^3. Clearfell of second crop in New Zealand will involve tree sizes averaging between 1.0 to 3.0 m^3. Consequently no direct comparison could be made between overseas productivity and expected New Zealand productivity.

Using work study data from the literature (loading and unloading times and travel speeds), the expected productivity of a Lokomo 933 clambunk skidder was simulated for clearfelling of a second crop stand with a merchantable piece size of 1.9 m^3 and 300 sph. Load sizes simulated were 15, 21 and 25 m^3 and skid distance varied from 150 to 500 metres. Predicted productivity ranged from 180 to 420 m^3 per day.

The predicted daily productivity for the clambunk skidder was then compared to existing standards for a 100 Kw crawler tractor (9.5 m^3 load) and a 130 Kw skidder (5.7 m^3 load). The comparison showed the clambunk skidder to be more productive than either the crawler tractor or skidder, regardless of skid distance. Clambunk productivity was highest when loads of 25 m^3 were extracted. The conventional skidder out-performed the crawler tractor. The comparisons of the slopes of the curves showed the clambunk productivity declining at similar rates to the skidder with increased skid distance. However due to the large clambunk payload its productivity should be less effected by skid distance than conventional skidders. This discrepancy can be attributed extrapolation of skidder productivity standards beyond their normal skidding distances and to an under estimate of clambunk travel speeds, especially over long distances.

Using the LIRA Costing Handbook the daily costs for each machine, with an operator, were estimated. Daily operating costs for a $475,000 Clambunk with an 8 year life were $945/day, and for a $270,000 Crawler Tractor and logging arch with a 7 year life were $650/day, and for a $205,000 skidder with a 5 year life were $580/day.

Using the estimated daily operating costs and expected daily productivity the extraction costs per cubic metre were calculated for each of the machines. The results showed that the clambunk with a load of 15 m^3 was the most costly of all extraction methods. The cheapest method was the rubber tyred skidder. The Clambunk with a load over 21 m^3 was cheaper than the crawler tractor. As with the productivity curves the costs of clambunk and skidder extraction were increasing at similar rates as skid distance increased. It could be expected that clambunk cost curves would flatten out over long haul distances and that the skidder cost curve would start to rapidly increase.

Current logging planners keep average skidding distances less than 200 metres and aim for around 150 m. This results in a roading density of around 45 metres/hectare and a landing density of around one landing per 5 hectares of forest. With a clambunk, skidding an average of 250 metres, then densities would reduce to an estimated 35 metres of road per hectare and one landing for every 8 hectares. Depending on roading and landing cost this would represent a savings between .21 to .92/m^3 or even higher. Additional savings would be realised by a reduction in the amount of roads and landings requiring Repairs and Maintenance.

Combining extraction, roading and landing costs for conventional extraction over 150 metres and clambunk extraction over 250 metres showed that the skidder was still the cheapest method when roading and landing costs were low ($10,000/km and $1,000/landing). However, where roading and landing costs are high ($30,000/km and $3,000/landing), the clambunk skidder with a 25 m^3 load becomes the cheapest extraction method.

IX CONCLUSIONS

Based on the assumptions and calculations made in this report the following points arise.

- Clambunk skidders have high productivity potential but are also expensive to operate.
- With the clambunk machine used in the simulation, optimum productivity and lowest costs were achieved at maximum load capacity - (25 m^3).
- Skidders are still the most economical extraction method in terms of extraction costs alone.
- Where terrain permits skidders should be used instead of crawler tractors.
- In areas where roading and landing costs are high, long distance clambunk skidding is cheaper than conventional skidding.
- The feasibility of long distance skidding with conventional skidders should be investigated for areas with high road costs.

The major advantages of clambunk skidders reported from overseas are :

- Ability to work slopes up to 60% and work on rough broken ground.
- Low ground pressure and reduced site disturbance.
- Its ability to accumulate its own load to achieve optimum payload under various conditions, thus allowing for economic long distance skidding.

The major disadvantage of clambunk skidders could be the problem of handling logs once delivered to the landing. The clambunk would deposit a heap of 25 m^3 or 13 trees on the landing. This may create problems for both the loading machine and the skiddies, when processing, sorting, and stacking.

This report looked at one clambunk model costing $470,000. Other models and makes are on the market which may be less expensive to own and operate. Under the assumptions a clambunk skidder will only be economic in areas where roading and landing construction and R. & M. costs are high. Clambunks may also have a place working on steeper slopes considered marginal hauler terrain or on sensitive unstable soils where reduced site disturbance is critical and where roading and landing area must be minimised.

APPENDIX I

SIMULATED CLAMBUNK PRODUCTIVITY

Assume 6.5 productive hours/day
1.9 m^3/piece

1. Load size 15 m^3 (8 pieces) Cycle Times (minutes)

Element	Skid Distance (metres) 150	200	250	300	400	500
TE *	2.75	3.65	4.55	5.45	7.25	9.05
LOAD	8.88	8.88	8.88	8.88	8.88	8.88
TL *	4.30	5.70	7.15	8.60	11.70	14.30
UNLOAD	.60	.60	.60	.60	.60	.60
TOTAL TIME	16.63	18.83	21.08	23.53	28.13	32.83
m^3/day	350	310	275	250	210	180

2. Load size 21 m^3 (11 pieces) Cycle Times (minutes)

Element	Skid Distance (metres) 150	200	250	300	400	500
TE *	2.75	3.65	4.55	5.45	7.25	9.05
Load	12.21	12.21	12.21	12.21	12.21	12.21
TL *	5.00	6.65	8.35	10.00	13.35	16.65
UNLOAD	.80	.80	.80	.80	.80	.80
TOTAL TIME	20.76	23.31	25.91	28.46	33.61	38.71
m^3/day	390	350	315	290	245	215

3. Load size 25 m^3 (13 pieces) Cycle Times (minutes)

Element	150	200	250	300	400	500
TE *	2.75	3.65	4.55	5.45	7.25	9.05
LOAD	14.43	14.43	14.43	14.43	14.43	14.43
TL *	5.00	6.65	8.35	10.00	13.35	16.65
UNLOAD	1.00	1.00	1.00	1.00	1.00	1.00
TOTAL TIME	23.18	25.73	28.33	30.88	36.03	41.13
m^3/day	420	380	345	315	270	240

* Assume travel empty equals travel loaded distance

SKIDDER PRODUCTIVITY 130 Kw CLASS

A. 2.0 m^3/tree
B. 1.9 m^3 recoverable log size
C. 3 tractor lengths or 5.7 m^3/cycle

Skid Distance[1] (metres)	Cycle Time[2] (minutes)	Daily Production[3] (m^3/day)
100	8.30	330
150	9.40	290
200	10.50	260
250	11.60	235
300	12.70	215

1 Average skid distance

2 Cycle time including contingency allowances (31.8%) and an interference allowance of 1.0 min

3 Based on 480 minute day

CRAWLER TRACTOR PRODUCTIVITY 100 Kw CLASS

A. 2.0 m^3/tree
B. 1.9 m^3 recoverable log size
C. 5 tractor lengths or 9.5 m^3/cycle

Skid Distance[1] (metres)	Cycle Time[2] (minutes)	Daily Productivity[3] (m^3/day)
100	17.20	265
150	18.65	245
200	20.10	225
250	21.60	210
300	23.15	200

1 Average skid distance

2 Cycle time includes appropriate allowance for rest, breakdown, R. & M.

3 Based on a 480 minute day of which 85% is mechanically available

Fig. 2: MACHINE RATE CALCULATION FORM

BASIS Machine LOKOMO 933 CLAMBUNK — Flywheel power 141 kw — Date FEB. 1985

(a) New replacement cost, ready to operate : $ 475,000
(b) Resale value $ 95,000
(c) Tyre cost, 1 set $ 13,200
(d) Rigging cost $ -
(e) Subtotal (b) + (c) + (d) $ 108,200
Depreciable value, (a) - (e) 366,800

Fuel Consumption 25 litres/productive hour
Oil Consumption 1.5 litres/productive hour
Machine service life 8 years
Utilisation 1500 productive hours per year
Tyre life 4500 hours
Basis for R & M 100%

OWNING COSTS	$/prod.hr
1. Depreciation:	
Depreciable value / Depreciation Period = $ 366,800 / 12,000hrs. =	30.57
2. Return on Investment:	
Average Annual Investment = $475,000 (purchase price) x .65 resale factor = $308,750	
Return on Investment = $308,750(AAI) x .21 (%rate) / 1500 (prod. hrs/yr)	43.22
3. Insurance:	
Quote on AAI, or AAI x % premium rate / productive hrs/year = $308,750x.015 / 1500 hrs. =	3.09
TOTAL OWNING COST = $	76.88

OPERATING COSTS	$/prod.hr
1. Fuel 25 l/hr x $ .675 /l =	16.87
Oil 1.50 l/hr x $ 3.00 /l =	4.50
Tyres $13,200 (current cost, 1 set) / 4500 hours life	2.93
2. Rigging & Rope	
(1) $ ÷ hrs. =	
(2) $ ÷ hrs. =	
(3) $ ÷ hrs. =	
(4) $ ÷ hrs. =	
3. Repairs and Maintenance: Based on Depreciation:	
$ 30.57 Depreciation/hr x 100% R&M factor / 100 =	30.57
Or: other basis:	
TOTAL OPERATING COST = $	54.87

TOTAL COST Owning Cost = $ 76.88
Operating Cost = $ 54.87

TOTAL COST = $ 131.75 /prod.hr. x 6.5 prod.hr/day = $856.41 /day + $90/day operator

APPENDIX IV

Fig. 2: MACHINE RATE CALCULATION FORM

BASIS Machine CAT 528 SKIDDER — Flywheel power 130 kw — Date FEB.1985

(a) New replacement cost, ready to operate		$ 205,000
(b) Resale value	$ 41,000	
(c) Tyre cost, 1 set	$ 16,000	
(d) Rigging cost	$	
(e) Subtotal (b) + (c) + (d)		$ 57,000
Depreciable value, (a) - (e)		148,000

Fuel Consumption 15 litres/productive hour
Oil Consumption .55 litres/productive hour
Machine service life 5 years
Utilisation 1500 productive hours per year
Tyre life 3500 hours
Basis for R & M 80%

OWNING COSTS	$/prod.hr
1. Depreciation:	
Depreciable value / Depreciation Period = $148,000 / 7500 hrs. =	19.73
2. Return on Investment:	
Average Annual Investment = $205,000 (purchase price) x .68 resale factor = $139,400	
Return on Investment = $139,400(AAI) x .21 (%rate) / (prod. hrs/yr)	19.52
3. Insurance:	
Quote on AAI, or AAI x % premium rate / productive hrs/year = $ 139,400x.015 / 1500 hrs. =	1.39
TOTAL OWNING COST = $	39.64

OPERATING COSTS	$/prod.hr
1. Fuel 15 l/hr x $ .675 /l =	10.12
Oil .55 l/hr x $ 2.17 /l =	1.19
Tyres $ 16,000 (current cost, 1 set) / 3500 hours life	4.57
2. Rigging & Rope	
(1) $300 ÷ 300 hrs. =	1.00
(2) $320 (4) ÷ 100 hrs. =	3.20
(3) $ ÷ hrs. =	
(4) $ ÷ hrs. =	
3. Repairs and Maintenance: Based on Depreciation:	
$19.73 Depreciation/hr x .80 R&M factor / 100 =	=15.78
Or: other basis:	
TOTAL OPERATING COST =	$35.86

TOTAL COST Owning Cost = $ 39.64
Operating Cost = $ 35.86

TOTAL COST = $ 75.50 /prod.hr. x 6.5 prod.hr/day = $490.75 /day + $90/day operator

APPENDIX V

Fig. 2: MACHINE RATE CALCULATION FORM

BASIS Machine CAT D6 + Arch — Flywheel power 104 kw — Date FEB. 1985

(a)	New replacement cost, ready to operate	: $ 270,000	
(b)	Resale value $ 54,000		
(c)	Tyre cost, 1 set $ -		
(d)	Rigging cost $ -		
(e)	Subtotal (b) + (c) + (d)	$ 54,000	
	Depreciable value, (a) - (e)	216,000	

Fuel Consumption 16 litres/productive hour
Oil Consumption .45 litres/productive hour
Machine service life 7 years
Utilisation 1500 productive hours per year
Tyre life - hours
Basis for R & M 100%

OWNING COSTS	$/prod.hr
1. Depreciation:	
Depreciable value / Depreciation Period = $ 216,000 / 10500 hrs. =	20.57
2. Return on Investment:	
Average Annual Investment = $270,000 (purchase price) x .68 resale factor = $183,600	
Return on Investment = $183,600(AAI) x .21 (%rate) / (prod. hrs/yr) .00	25.70
3. Insurance:	
Quote on AAI, or AAI x % premium rate / productive hrs/year = $183,600 x .015 / 1500 hrs. =	1.83
TOTAL OWNING COST = $	48.10

OPERATING COSTS	$/prod.hr
1. Fuel 16 l/hr x $.675 /l =	10.80
Oil .45 l/hr x $2.17 /l =	.98
Tyres $ (current cost, 1 set) / hours life	
2. Rigging & Rope	
(1) $ 300 ÷ 300 hrs. =	1.00
(2) $ 480 (6) ÷ 100 hrs. =	4.80
(3) $ ÷ hrs. =	
(4) $ ÷ hrs. =	
3. Repairs and Maintenance: Based on Depreciation:	
$20.57 Depreciation/hr x 100% R&M factor / 100 =	=20.57
Or: other basis:	
TOTAL OPERATING COST =	$38.15

TOTAL COST
Owning Cost = $ 48.10
Operating Cost = $ 38.15

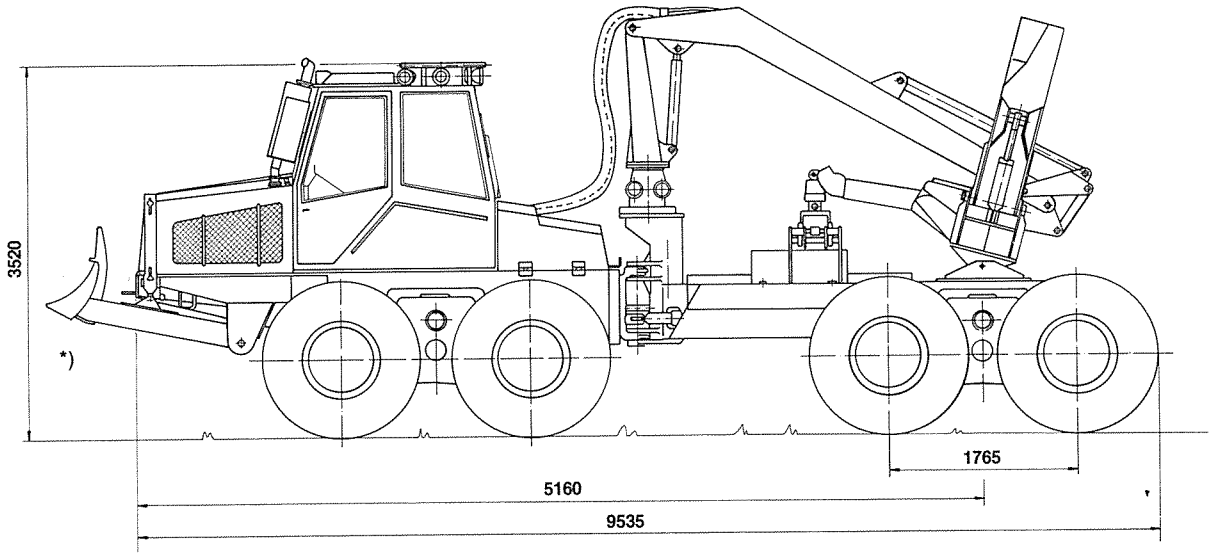
TOTAL COST = $ 86.25 /prod.hr. x 6.5 prod.hr/day = $560.63 /day + $90/day operator

APPENDIX VI

RAUMA-REPOLA

LOKOMO 933 C

LOKOMO 933 C Clam skidder



*) Dozer blade is optional equipment

LOKOMO 933 C is an 8-wheel drive clam skidder with articulated frame steering.

TECHNICAL DATA

Load rating	18 t
Max. pull	245 kN
Max. speed	30 km/h
Length	9535 mm
Width	2700 mm
Height excl. loader	3520 mm
Ground clearance	700 mm
Clam bunk cross-sectional area	3.5 m²
Weight with standard equipment	17.0 t

Engine

Turbo-charged 4-stroke, water-cooled diesel-engine.
Max. output
141 kW (192 HP)/37 r/s DIN
165 kW (223 BHP)/37 r/s SAE
Max. torque 682 Nm/23 r/s
Alternatively:
8-cylinder, 4-stroke air-cooled dieselengine.
Max. output 151 kW (205 HP)/37 r/s DIN
177 kW (240 BHP)/37 r/s SAE
Max. torque 705 Nm/26 r/s

Transmission

Clark torque converter with Power Shift transmission.
Mechanical range gear.
2 × 3 speeds forward and reverse.

Axles

Identical tandem axles front and rear with No Spin differential locks. Power transmission through gears.

Tyres

8 off: 17.5—25
or 20.5—25

Brakes

Pneumatically actuated wet multiple disc brakes in the front axles. These brakes serve as driving and service brakes as well as spring loaded parking and emergency brakes and act on all wheels.

Steering

Hydraulic articulated frame steering with two steering cylinders.

Hydraulic system

2 separate hydraulic circuits.
2 hydraulic pumps 2 × 110 l/min/37 r/s. Operating pressure 17.5 MPa. The loader is operated with a two-stick system.

Operator's cabin

Sound and thermal insulated one-man safety cabin built to fulfil the ergonomic standards. Dual controls for driving forward and reversing.
Fresh air cabin heater unit.

Loader

Total lifting moment 80 to 140 kNm.
Alternatives: Ösa 395
Cranab 100

Electrical system

Voltage 24 V
Batteries (2) 12 V/155 Ah
Alternator, output 28 V 55 A

Clam bunk

Hydraulically operated
Cross-sectional area
— Lokomo 350 3,5 m²

Standard equipment

Fresh air heater
Work lights (8)
Provision for radio and communication radio
Compressed-air take-off
Tools
Master switch

Optional equipment

Tracks
Snow chains
Air conditioning
Engine preheater
Sun visors
Winch
Dozer blade
Tow hook rear

Specifications are subject to alteration without prior notice.
475-84-05

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520A

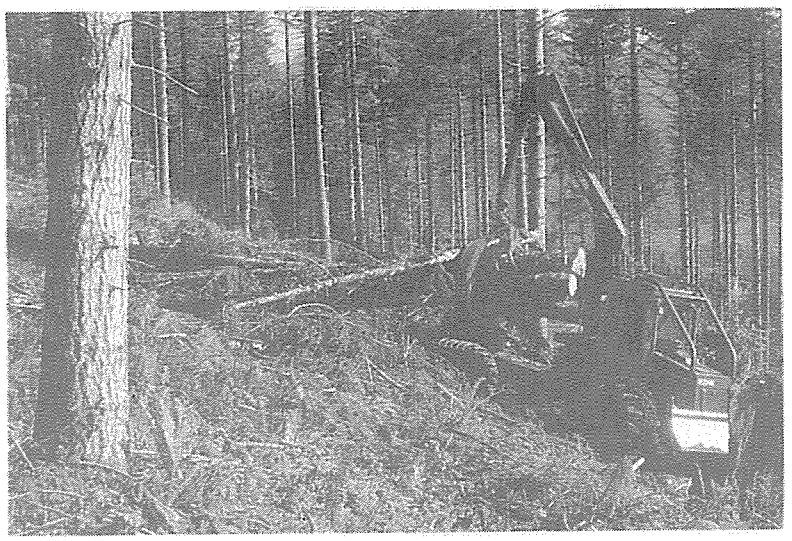
Clambunk Skidder

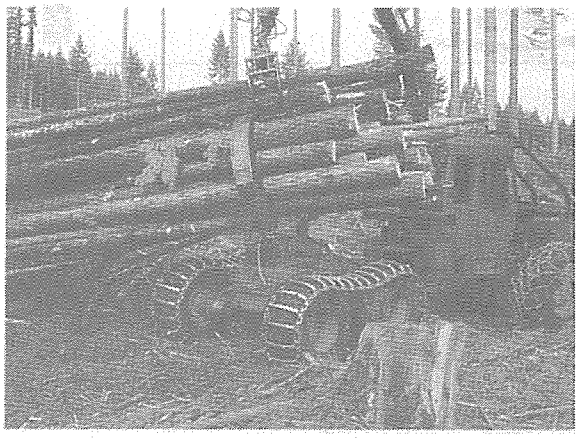
Timberjack

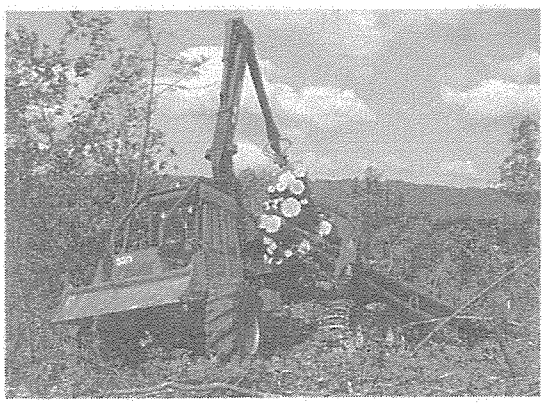
chine illustrated may be equipped with options.

Big load, long haul, high volume logging plus major savings in road costs

PERFORMANCE





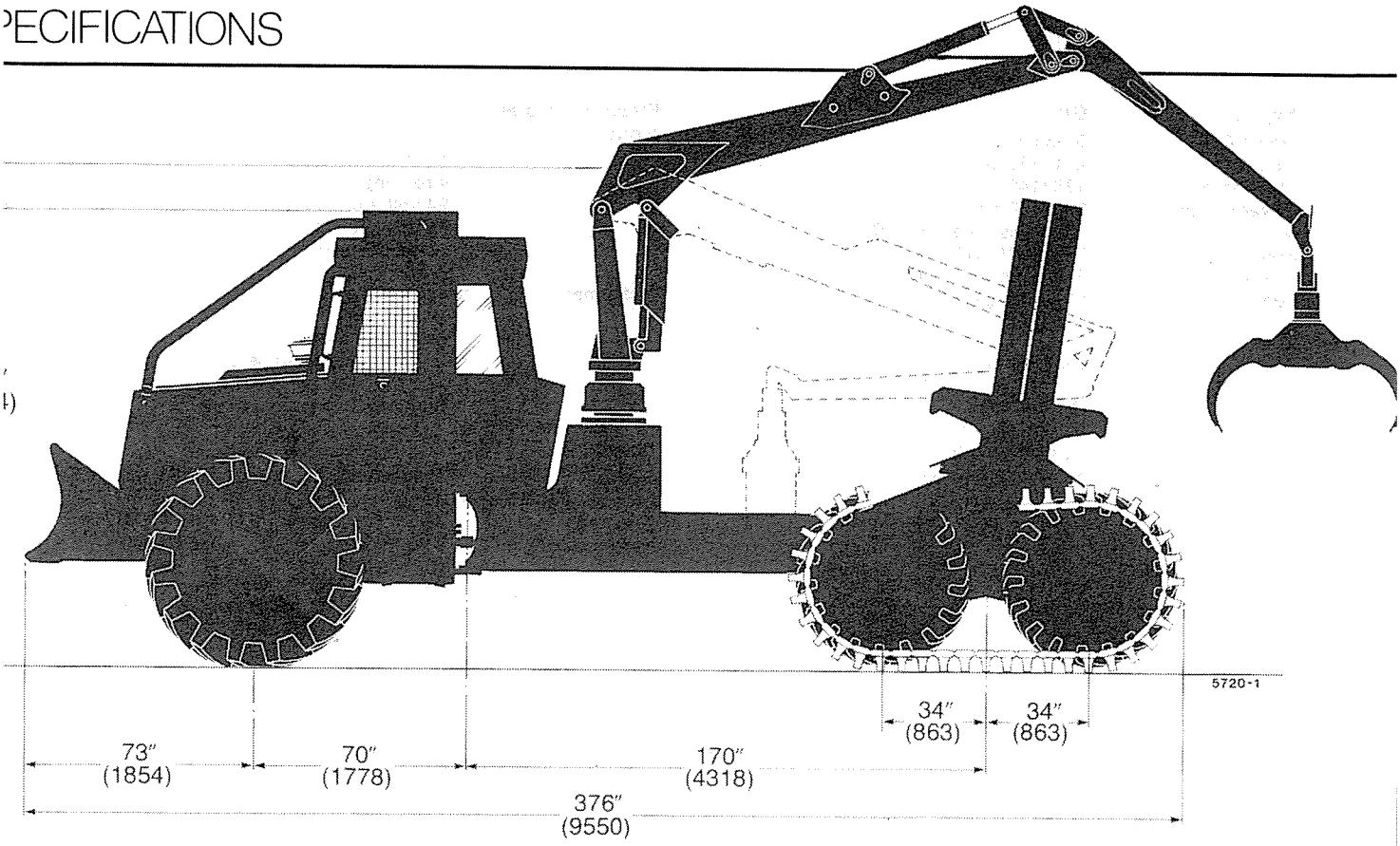


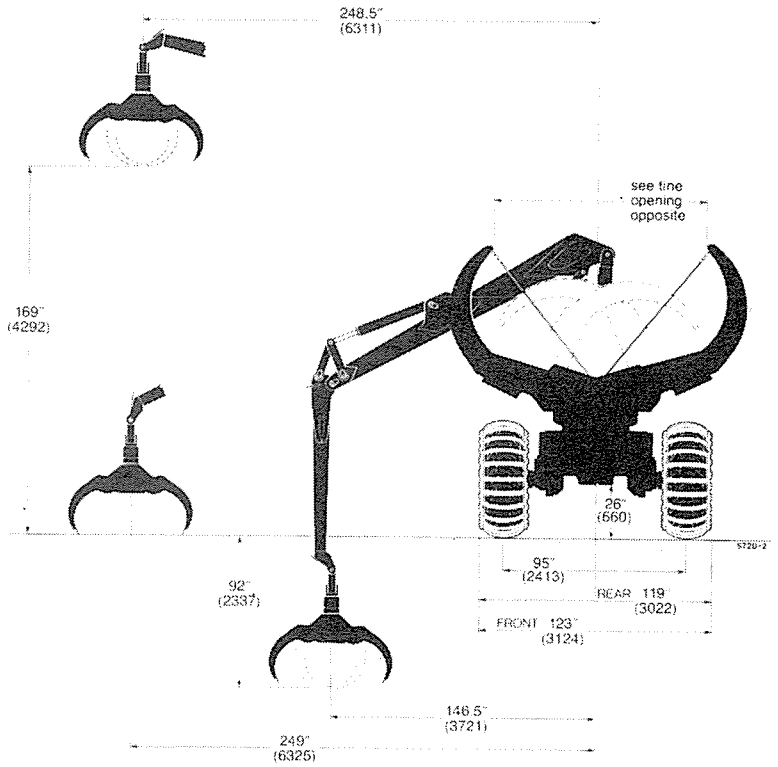
Timberjack® 520A Clambunk skidders bring a totally r dimension to your logging operations. These 6-wheel drive skidders are rated at an impressive 15 tons (13, tonnes) though, depending on the wood, many operat are handling more. The result? A high volume, long-distance skidding system which greatly reduces need for roads and improves the productivity of feller bunchers, delimbers, chippers and related equipment

- Payloads three to five times greater than conventio skidders.
- Economical skidding distance more than doubled.
- A smooth, fast ride through 6-wheel drive and the combination of rear bogie and walking beam front axle.
- Low ground pressure for mobility on soft ground.
- Less ground disturbance because fewer trips are needed to log out a section.
- Stability on sidehills increased by controlled shiftin the load to the high side.
- Clean wood — load is skidded high off the ground.
- Fast cycle time — drop the load on the go, then tur the seat instead of the machine. The dual driving controls let you return facing the rear.
- Bright work lights for night shift production.
- Easily serviced by a skidder mechanic.
- Optional felling grapple for feller/skidder operation.

Also available in a 15 ton (13,6 tonnes) Forwarder version (left), with an 18 ft. (5,5 m) bunk for transporti log length or two tiers of 8 ft. (2,5 m) wood.

PECIFICATIONS





ısions based on 30.5 x 32 front, 20.5 x 25 rear (with tracks).

520A
Clambunk Skidder

Engine	**GM**
Model/Cyls.	6V-53/6-cyl.
*Max. hp	201 (150 kW)
**Flywheel hp	186 (140 kW)
Governed rpm	2500 full load
Max. torque	455 ft. lbs. (619 N•m) @ 1500
Bore x Stroke	3 7/8" x 4 1/2" (98,4 mm x 114,3 mm)
Displacement	318 cu. ins. (5,2 litres)
Fuel tank capacity	80.4 U.S. gals. (303 litres)

*Max. hp of basic engine under standard SAE J816 conditions.
**Net usable hp at engine flywheel under standard SAE J816 ambient conditions with fan, alternator, water pump, lub. oil pump and air cleaner.

Weight	(SAE operating)
Front axle	20,355 lbs. (9 233 kg)
Rear axle	24,915 lbs. (11 301 kg)
Total	45,270 lbs. (20 534 kg)

Tires	Size	Overall width
Standard		
Front	30.5 x 32	123" (3124 mm)
Rear (tracks)	20.5 x 25	119" (3023 mm)
Optional		
Front	24.5 x 32	113" (2870 mm)
Rear (no tracks)	28L x 26	123" (3124 mm)
Rear (no tracks)	23.1 x 26	114" (2896 mm)

Power Train	
Torque converter	Single stage
Transmission	Powershift, full reversing
No. of speeds	4 forward, 4 reverse
Speed range (standard tires)	0 - 18.6 mph (0 - 30 km/h)
Axles	Front - Outboard planetary type and no-spin differential Rear - Bogie axle assembly
Axle oscillation	±15° (front)
Bogie oscillation	±10° (rear)

Brakes	
Service	Hydraulically actuated oil cooled multiple disc in transmission and dry type multi-disc rear drive line brake.
Auxiliary	Hydraulically applied, 2 caliper drive line disc brake in rear frame.
Park	Mechanically applied transmission brake.

Hydraulic System	
Pump capacity at governed rpm	2 x 28 U.S. gpm (2 x 106 litres/min)
System pressure	2250 psi (15 503 kPa)
Reservoir capacity	36 U.S. gals. (136 litres)
Hydraulic cylinders	Blade (2) 3 1/2" dia. (89 mm) Steering (2) 3 1/2" dia. (89 mm) Stabilizer (2) 3 1/2" dia. (89 mm) Cable tightening (2) 3 1/2" dia. (89 mm) Clambunk arm (2) 5 1/2" (139,7 mm)

Electrical System	
Alternator	24 volt, 42 amp.
Batteries (2)	12 volt, wet charge, 172 amp. hr. each
	Sealed epoxy-filled transistorized voltage regulator
	Electrical cut-off switch
	Parking brake warning light

Electrical System (cont.)	
	Circuit breaker with automatic reset
	Neutral safety start
	4 roading lights and 6 working lights
	24 volt auxiliary steering pump
	12 volt circuit for radios with 20 amp. capacity standard

Instruments	
	Tachometer/hourmeter
	Ammeter
	Engine oil pressure gauge
	Engine coolant temperature gauge
	Transmission temperature gauge
	Transmission pressure gauge

Clambunk		
Model	Timberjack 32	Timberjack 21.5
Load area of opening	32 sq. ft. (3,0 m²)	21.5 sq. ft. (2,0 m²)
Tine opening	114.5" (2908 mm)	100" (2540 mm)
Load capacity	30,000 lbs. (13 608 kg)	30,000 lbs. (13 608 kg)
Rotation	300°	300°
Tilt (front, back)	+12°, −28°	+12°, −28°

Loader	
Model	Cranab 9025
Boom rotation	380°
Grapple rotation	Continuous
Grapple capacity (gross)	5950 lbs. @ 13' (2 699 kg @ 4 m) 4800 lbs. @ 17' (2 177 kg @ 5 m) 3625 lbs. @ 23' (1 644 kg @ 7 m)
Grapple jaws opening — 1/4 cord	63" (1600 mm)
Grapple area of opening	2.7 sq. ft. (0,25 m²)

Standard Equipment

Six wheel drive • Lexan enclosed cab • Canopy meets SAE J231 and SAE J1040 • Heavy duty dozer blade • Heavy duty axles • Two dry type air cleaners with safety element, vacuators and external air intake • Deluxe suspension seat, Seat belt • Air conditioner/heater • Pusher fan • Emergency steering • Muffler/spark arrestor • Fire extinguisher • Windshield washers and wipers (front and rear) • Brush guards • Door screens • Walking beam stabilizers • Heavy duty bogie tracks (20.5 x 25) • Working and driving lights • Owner's manual, Parts book.

Optional Equipment

Engine block heater • Front bumper • Dozer blade extensions • Soft ground bogie tracks (20.5 x 25) • Horn • Back-up alarm • Pre-cleaner • Field installed chainsaw felling grapple — 24" (610 mm) capacity.

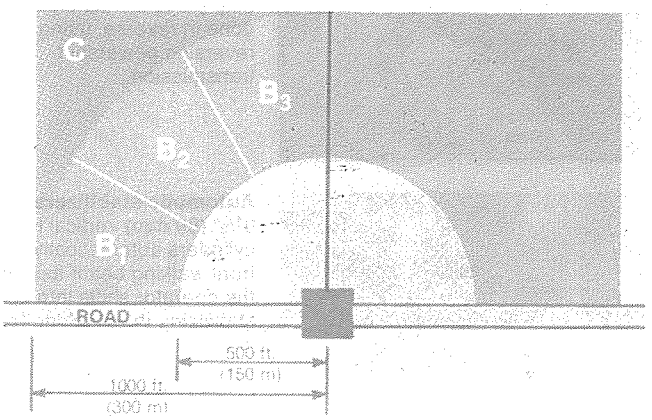
520A

SYSTEM PLANNING — Clambunk Skidder

The switch from conventional skidding to long-distance Clambunk skidding can give a powerful boost to your entire logging system and to your volume and profit figures. To start with, a Timberjack Clambunk ordinarily replaces at least three, sometimes as many as *six* conventional skidders. And that's just the beginning.

The sheer volume of wood per load, cycled fast over long distances, exerts a positive influence on the whole operation. Feller buncher productivity is increased because less time is required for piling. At roadside, delimbers and chippers are fully utilized and haul truck turnaround time is improved.

Equally important is the major saving in the cost of building and maintaining roads. If, for example, road construction averages $20,000 per mile, the savings in road-building costs *alone* may pay for the initial cost of the Clambunk within three years.



The 4 to 1 Strategy. If you are now skidding say, 1000 feet (300 m) maximum and 500 feet (150 m) average, then only area A or 20% of the trees in a 1000 ft. (300 m) logging block lie within your average skidding range.

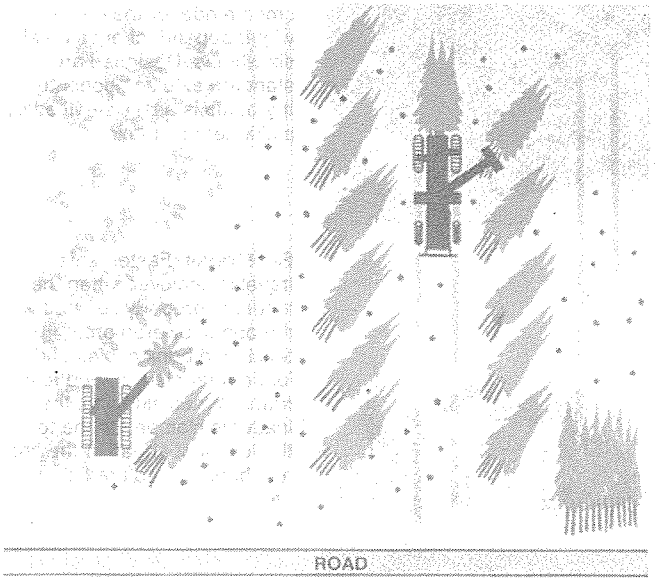
The other 80% contained in areas B_1, B_2, B_3, and in corner area C are outside normal efficient skidding distance.

Using a Timberjack 520A Clambunk, you can quickly get out to the back of the block and pull 4 big loads from the long distance to every one from the short distance. This 4 to 1 strategy equalizes daily production for constant utilization of roadside equipment and haul trucks.

Starting at the back works well on difficult terrain, too. If there is an uphill or wet section at the farthest distance, your operator can take a half load there and pick up the other half on good ground on the way in. Less ground disturbance. Less risk of bogging down.

Doubling your average skidding distance produces not twice, but four to five times the volume of wood on the landing, so you can build your logging roads — and clear your landing areas — much farther apart.

And you can go a step beyond that. Some loggers use their small skidders such as Timberjack 200A Series to pre-bunch trees for the Clambunk — especially effective in some select cut operations, in logging out small pockets of wood or for clearing road right-of-ways.



Felling Pattern. Loading the Clambunk is most efficient when the feller buncher lays the bunches on an angle 15° to 30° from the line of travel of the machine. The Clambunk operator can reach out 20 ft. (6,1 m) either side to pick up the bunches as he travels.

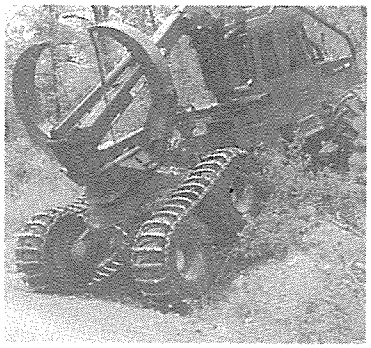
In this ideal situation, a Timberjack™ TIMBCO™ feller buncher achieves a uniformity of pre-bunched piles laid out to exactly suit Clambunk loading. Since the Clambunk has its own loader, the piles can be smaller than for a grapple skidder, saving time for the feller buncher.

Will a Clambunk work for you? Take the time to lay out a road pattern with logging blocks four times as large and only half the number of landings. Then look at your felling and processing capabilities in relation to the Clambunk's high volume skidding. If everything shapes up on paper as the most cost-effective system you've ever considered, let's talk about making it a reality.

520A

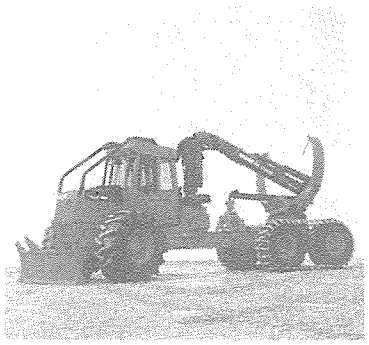
FEATURES

Clambunk Skidder

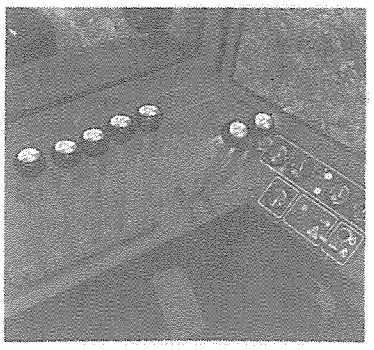


Smooth, stable ride. The oscillating bogie in combination with a long wheelbase and walking beam front axle provides an exceptionally smooth ride for the operator, with independent drive on all six wheels. Designed around standard axle componentry, the bogie is easily serviced by a skidder mechanic.

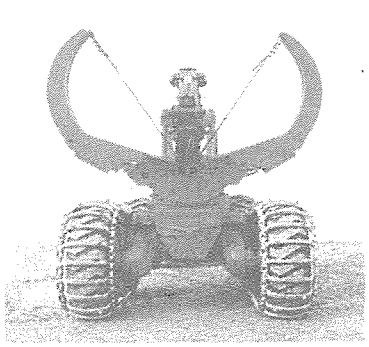
Comfortable workplace. All welded Lexan-enclosed steel cab meets SAE J231 and SAE J1040. Hinged steel mesh guards on door windows. Lockable doors. Standard equipment includes heater, air conditioner and operator-controlled fresh air pressurizer for all-weather comfort.



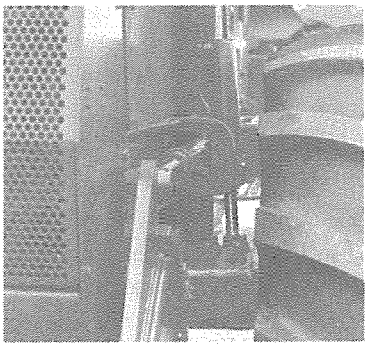
Fast travel. Faster, safer travel is achieved when the loader is properly secured with the boom lowered onto tensioned bunk cables and the loader grapple clamped to the frame. When skidding, the loader is clamped to the top of the load just ahead of the tines and bunk cables are tightened fully.



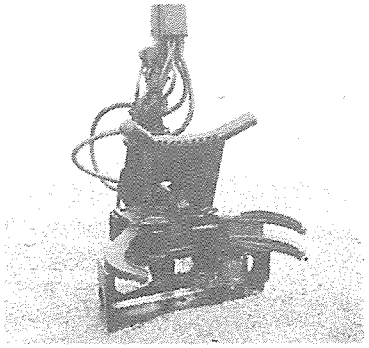
Dual controls. Swivel mounted suspension seat and dual steering, throttle and service brake controls allow the operator to turn his seat instead of the machine for the return trip. Thus, traveling empty back to the stump is done in reverse, using the fully reversing powershift transmission.



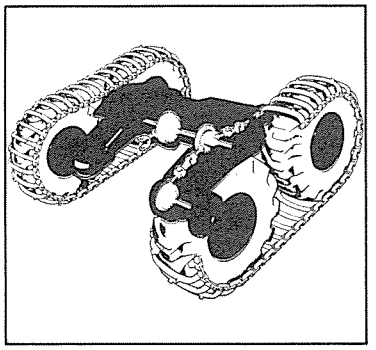
Large capacity. Load area of the model 32 Clambunk is 32 sq. ft. (3,0 m) for large loads of small trees — in some cases up to 150 or more. Model 21 holds 21.5 sq. ft. (2,0 m) for heavy loads of large diameter long trees. Independent tines allow the load to be deliberately shifted sideways for greater stability on sidehill skidding.



Automatic stabilizers. Two $3\frac{1}{2}$" (89 mm) vertical hydraulic cylinders automatically lock the front walking beam axle when the operator shifts into neutral, stabilizing the machine for loading. These stabilizer cylinders also act as shock absorbers to help smooth the ride.



Feller grapple option. In less than 30 minutes, you can replace the standard loader grapple with an optional 24" capacity feller grapple which converts the Clambunk into a feller skidder. Felling is by chain saw with an automatically retracted bar. Rotation of the grapple head combined with lift of the main boom guides the tree in the desired direction.



Simplified bogie. A very practical direct drive system for the center differential through crown gears and pinions out to skidder-type planetary hubs, with 10" (254 mm) oscillation at the wheels. No complex systems. No hard-to-get parts.

Timberjack

Woodstock, Ontario, Canada N4S 7X1 (519) 537-6271

ÖSA 260
FELLER SKIDDER

ÖSA 260 Feller skidder has the wellknown ÖSA 260 forwarder as carrier. Due to hydrostatic transmission the machine has extraordinary off-road capabilities and thanks to first class operator working conditions a high degree of utilisation and work satisfaction is maintained.

Felling equipment

is, as a standard fitting, the 11 m long ÖSA 395 knuckle boom loader, which can also be supplied as a knuckle arm loader with 6,5 m reach. Both variations are very strongly built for considerable lifting and slewing capacity and are equipped with a tilting device. Owing to this trees can be easily positioned, safely felled and speedily recovered to the clam bunk even on difficult sloping ground.

ÖSA 642 Felling Saw is a flexible, considerably developed piece of equipment which is suspended in a rotator with a slewing capacity of 330 degrees, automatic levelling and encased hydraulic hoses. The well-protected guide bar operates close to the ground providing low stump height. An accurate dimension sensor is incorporated in the felling saw which has strong suspension attachments and low weight. A 2-lever electronic-hydraulic servo comfortably controls the felling equipment.

Clam bunk

is the ÖSA 820, a wellknown and thoroughly tested clam bunk, with considerable opening width and large gripping area. Correctly designed clamping arms and steel wires which can be tightened around the timber provide a secure towing grip and easy loading, considerable loading capacity and quick unloading of timber.
Clam bunk ÖSA 820 is flexibly attached to a slewing rim, it is moveable in a circular direction as well as according to the loaded timber's degree of inclination. This construction reduces the considerable stress which occurs with skidding. Due to the clam bunks flexibility this makes it possible to load the timber in many directions and not necessarily parallel to the driving direction. When the arms clamp together and the steel wires tighten up, the timber is maintained in a secure grip, regardless of whether one or more trunks are to be transported.

ÖSA 260 FELLER SKIDDER

TECHNICAL SPECIFICATION

Weight complete ..... approx 17 000 kg

Load capacity ..... approx 12 000 kg

Engine Scania D8, SMMT at 40 r/s, 123 kW (167 hp)

Transmission – Hydrostatic-mechanical transmission

Speed range

Off-road	0-8 km/h
Road driving	0-25 km/h

Differential lock

Automatic front, air pressure operated rear

Tyres

Front, Steelguard	23,1 x 34"/14 ply
Alternatively Kevlar	30,5 x 32"/16 ply
Rear, Steelguard	17,5 x 25"/16 ply
Alternatively Steelguard	22 x 25"/16 ply

Steering – Power assisted steering for road transport and high speed pulse steering via push button on steering lever for off-road driving.

Turning radius	8450 mm
Max steering angle	40°

Brakes

Air pressure operated disc brakes and parking brake on all wheels.

Hydraulic system

Constant pressure type ..... 17,5 MPa (175 bar)

Electrical system

Battery capacity, 2 batteries	150 Ah 24 volt
Generator	120 A, 24 volt, tot. 2880 W
Head lights	2 lamps à 70 W
Working lights	18 lamps à 70 W – 1260 W

Fuel tank, volume ..... 150 l

Cab – Rubber anti-vibration mountings, thermal and sound insulation, flat floor, hanging foot pedals. Noise level below N 85. Safety belt. Air conditioning, windscreen cleaner and wipers, cab is tiltable.

Loader ÖSA 395

Knuckle boom design

Reach	11 m
Lifting power at the tip of loader	600 kg
Recommended pump capacity	2,5 l/s

Knuckle arm design

Reach	6,5 m
Lifting power at the tip of loader	1300 kg
Recommended pump capacity	1,6 – 2 l/s
Max adjustment pressure for both loaders	17,5 MPa

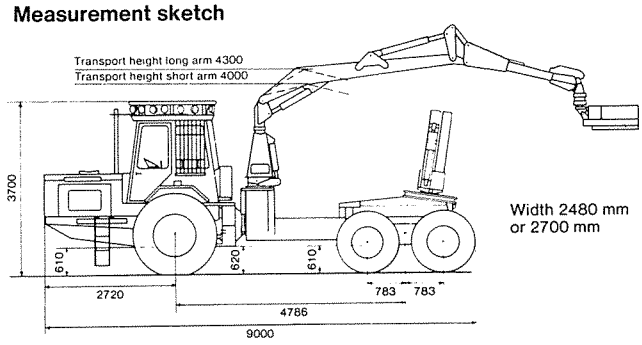
Felling Saw ÖSA 642

Max stump diameter	56 cm
Rotator slewing angle	330°
Guide bar type roll top, saw chain 10,3 mm	(0,404")
Max adjustment pressure	17,5 MPa
Weight, incl rotator	525 kg

Clam Bunk ÖSA 820

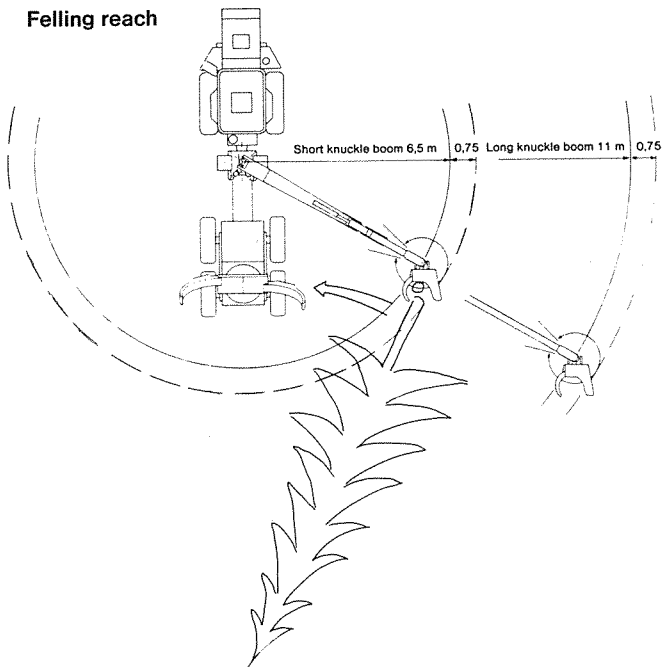
Loading area 2 m², opening width 2,7 m, slewing angle 180°.

Measurement sketch



ÖSA 260 Feller Skidder equipped with a 6,5 metre long knuckle arm loader, ÖSA 395.

Felling reach



We reserve the right to alter specifications and designs.

ÖSA AB

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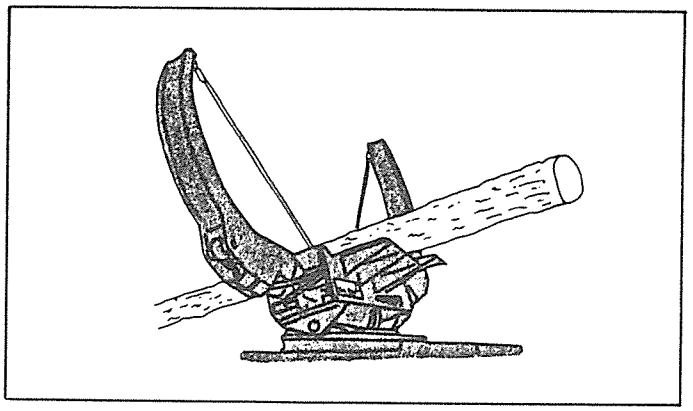
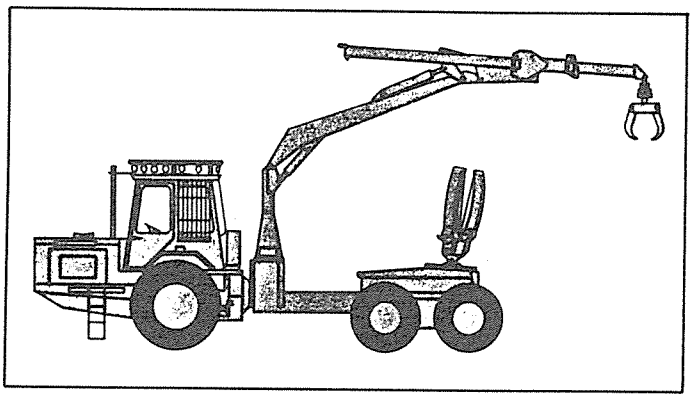
A Rauma Repola Company



ÖSA 820 CLAM BUNK

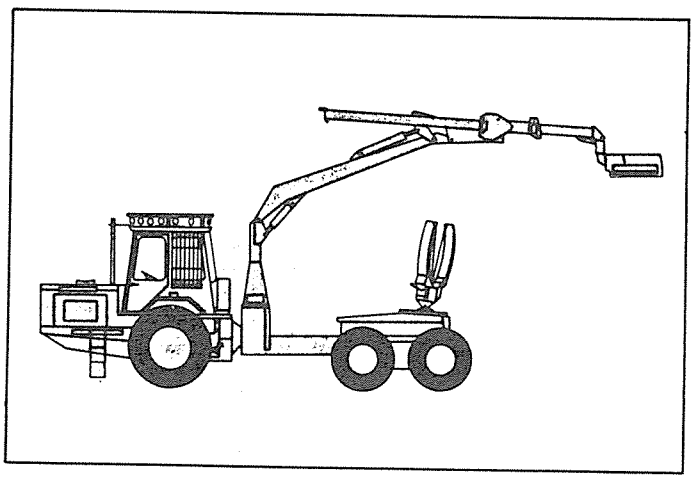
ÖSA 820 is designed for mounting on suitable forwarder chassis and consists of a base frame with a ball bearing slewing rim, support beam and clam arms with steel cables and cylinders.
The clam bunk has a large opening width and gripping area which makes loading easier and enables a good load capacity. When the arms clamp together and the cables tighten the trees are held securely.

Weight	1350 kg (2976 lb)
Opening width	2,7 m (8.86 ft)
Gripping area	2,0 m^2 (21.5 ft^2)



ÖSA 260 CLAM BUNK SKIDDER

ÖSA 260 clam bunk skidder has 6-wheel drive and hydrostatic-mechanical transmission. It is equipped with the reliable, secure-gripping clam bunk having a load capacity of 2 m^2 (21.5 ft^2 and an opening width of 2,7 m (8.8 ft), as well as loader ÖSA 398 with fixed outer boom, 6,5 (21.3 ft) reach and full tree grapple. Otherwise the same chassis as ÖSA 260 forwarder but 300 mm (11.82 in) shorter.



ÖSA 260 FELLER-SKIDDER

ÖSA 260 is an articulated frame steered 6-wheel driven felling and transport machine which, due to the hydrostatic-mechanical transmission, has an excellent off-road performance. Felling equipment consists of an ÖSA 395 knuckle boom loader with 11 m (36 ft) reach and an ÖSA 642 felling head with 56 cm (22 in) as maximum stump diameter. Exemplary operator comfort with air conditioning, comfortable driver seat, low noise level and minimum vibration. First class accessibility for servicing with amongst other things a tilting cab. The machine has power assisted steering and dual control. ÖSA 260 forwarder serves as carrier.

Weight	15500 kg (34177 lb)
Width	248 cm (8.1 ft)
Length	900 cm (29.5 ft)
Ground clearance	62 cm (2 ft)
Engine power in SMMT	123 kW (167 hp)
Transmission	Hydrostatic-mechanical
Wheel front	23,1 x 34/14 ply
Wheel rear	17,5 x 25/16 ply or alt 22 x 25/16 ply
Loader	ÖSA 395 knuckle boom loader
Felling head	ÖSA 642

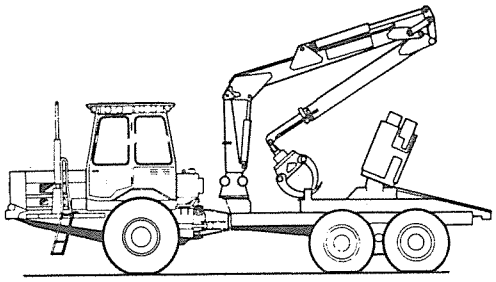
KOCKUMS INDUSTRI

LOGGING DIVISION
P.O. Box 506, S-826 01 SÖDERHAMN, SWEDEN
Phone (46)270-170 00. Telex 47 338 kocklog s.

LIST OF ACTUAL DISTRIBUTORS FOR KOCKUMS LOGGING DIVISION.

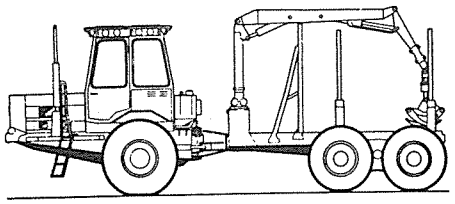
..... 84 CLAM BUNK SKIDDER

The 84 Clam Bunk Skidder is built on Kockums 84-35 Forwarder (for data on the 84-35, see overleaf).



84-35 FORWARDER

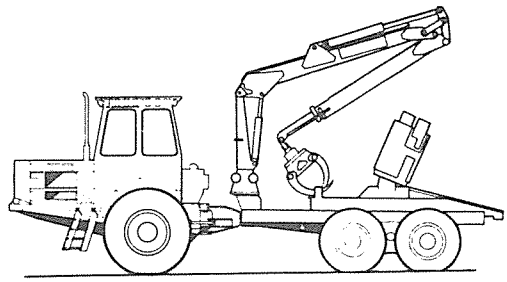
The 84-35 is a combination forwarder for thinnings and final fellings. The tilting cab gives the driver an excellent working environment. Partload pressure system and two-levers are standard, as is the wheel steering with changeover for both road and terrain driving forwards. The electrical system is new and th twin-circuit brakes give increased safety. The 84 is an efficient, stable and sophisticated forwarder with excellent overall economy.



Loading capacity	9500 kg
Service weight	11500 kg
Gross weight	21000 kg
Ground pressure with load, front	0.59 kp/cm²
rear	1.28 kp/cm²
rear with tracks	0.46 kp/cm²
Length	9090 mm
Width	2490 mm
Ground clearance	540/720/570 mm
Engine	Ford 2725E, 6-cyl. diesel
Rating	90 kW (122 h.p.)
Torque	37 kpm
Under guard, front	Hydraulically adjustable
Gearbox	Clark with power shift
Tractive force	12500 kp
Brakes	2-circuit, compressed-air disc brake on pinion shaft, multiple disc brake in oil bath
Steering	Wheel steering forwards on and off road. Lever in working direction
Hydraulic system	Partload, 250 litres/min
Electrical system	24 Volts
Cab	Safety-tested, tilting
Loader	Cranab 6010 as standard
Outreach	6.5 m
Loader control	2-lever, armrest-mounted
Tyres, front	23.1x26/14
rear	17.5x25/16

..... 85 CLAM BUNK SKIDDER

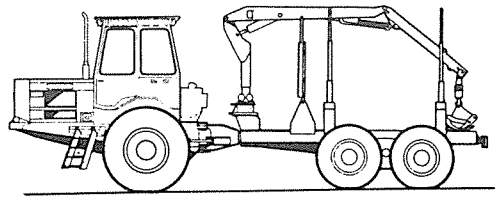
The 85 Clam Bunk Skidder is built on Kockums 85-35 Forwarder (for data on the 85-35, see overleaf).



85-35 FORWARDER

The 85-35 is Kockums largest forwarder. The new tilting cab gives the driver an outstanding working environment. Partload pressure system and two-lever are standard, as are a series of other features.

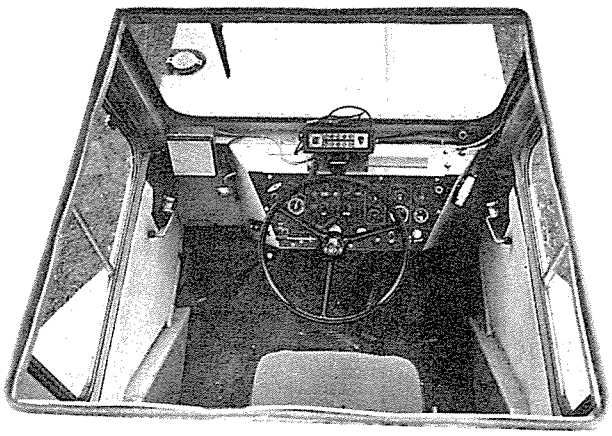
The 85 is built for a 15-tonne load and double-shift working, year after year. The basic design is well-tested and reliable, with a high degree of technical sophistication. The 85 gives outstanding overall economy.



Loading capacity	15000 kg
Service weight	15000 kg
Gross weight	30000 kg
Ground pressure with load, front	0.74 kp/cm²
rear	0.90 kp/cm²
rear with tracks	0.69 kp/cm²
Length	9630 mm
Width	2650 mm
Ground clearance	600/775/540 mm
Engine	Scania DN8, 6-cyl. diesel
Rating	123 kW (167 h.p.)
Torque	54 kpm
Under guard, front	Hydraulically adjustable
Gearbox	Clark with power shift
Tractive force	16000 kp
Brakes	2-circuit, compressed-air disc brake on pinion shaft multiple disc brakes in oil bath
Steering	Wheel steering forwards on and off road. Lever in working direction.
Hydraulic system	Partload, 250 litres/min.
Electrical system	24 Volts
Cab	Safety-tested, tilting
Loader	Cranab 6010 as standard
Outreach	6.5 m
Loader controls	2-lever, armrest-mounted
Tyres, front	23.1x34/16
rear	17.5x25/16

VOLVO BM

CLAM BUNK SKIDDER 971



NEW!

The VOLVO BM 971 tree length hauler is a sturdy, comfortable and fast logging machine. The 118 kW engine and a well matched hydraulic transmission giving combine to develop a tractive effort of more than 15 tons. The six-wheel drive and articulated steering ensure good manoeuvrability.

Well planned, comfortable cab

A comfortable and spacious cab, and easily accessible controls with fingertip actuation, are some of the factors contributing to a truly pleasant working environment for the driver.

VOLVO BM 971

Fast loading and transport

The hydraulic system of the VOLVO BM 971 has two servo-assisted control levers — one for each hand. Two separate oil pumps deliver oil to the crane, enabling it to carry out at least two operations simultaneously. This, together with the foot-operated gear selector, makes the machine fast in loading and in operation. The fact that the wheel rims can be reversed to increase the width to 9 ft 2 in (2.8 m), improves the stability of the machine for off-road operation.

As a grapple forwarder, the VOLVO BM 971 is equipped with a bear hug mounted on the trailer chassis. The arms, open to 8 ft 10 in (2.7 m) with a grip of 21.5 sq ft (2 m^2), allow for rapid loading and high capacity. The bear hug is operated by powerful hydraulic cylinders with fast return action. The tree lengths are gripped securely by the arms and flexibility of the load is provided by steel cables inside the arms which are tightened hydraulically. Unloading is carried out instantaneously by releasing the arms and steel cables and driving the machine forward. This one-operator machine is equally as efficient in full tree or tree-length operations.

The tandem-drive bogie ensures perfectly equal distribution of tractive power and it has a good halfmetre range of movement.

SPECIFICATION

Tyres

Front	23.1×34 Steel Guard
Rear	17.5×25/16 SGL or 20.5×25/16 SGL

Weight

	empty
Total weight	17.3 tons
Front axle load	8.9 tons
Bogie load	8.4 tons

Length

Total length	31 ft 10 in (9700 mm)

Width

Total width	8 ft 2 in/9 ft 2 in
Wheel base	(2500 mm/2800 mm) 16 ft 9 in (5100 mm)

Height

Total height incl. crane	11 ft 10 in (3625 mm)

Steering

Two separate circuits
— highway steering with steering wheel and orbitrol
— off-road steering with lever across valve section

Steering angle	45°
Steering moment (at 90 % efficiency)	35—50 kN.m

Electrical system

Voltage	24 V
Alternator	1 200 W
Batteries	2×12 V/125 Ah

Engine

Volvo D70 B
Rating 118 kW SAE/2400 rev/min
Maximum torque 50 kgf m at 1500 rev/min
The engine can withstand 45° inclination in all directions.

Transmission

Transmission	VOLVO BM type
Torque converter	Twin Disc type
Number of gears, forward	4
Number of gears, reverse	4
Power shift between two ratios maximum tractive effort	15.4 tons

Speed range

1st gear	0— 2.8 miles/h (0— 4.5 km/h)
2nd ,,	0— 4.7 miles/h (0— 7.5 km/h)
3rd ,,	0—11.9 miles/h (0—19 km/h)
4th ,,	0—18.8 miles/h (0—30 kmh)

Hydraulic system

Hydraulic pumps	Twin pumps
Capacity at 2400 rev/min	2×25 gall/min (2×115 l/min)
Hydraulic pressure	160 bar
Servo pump	6.1 gall/min (28 l/min) 2400 rev/min limited to 3.3 gallons/min (15 l/min)
Servo pressure	15 bar

Crane operation
— with two separate hydraulic circuits and controlled by means of oil servo
— two-lever control
Grapple operation via electrical servo.

Brakes

Front axle	Pneumatic disc brakes
Bogie	Pneumatic — hydraulic disc brakes
Parking brake	spring-loaded brake on front wheels

Service capacities

Fuel tank capacity	40.7 gallons (185 l)
Hydraulic oil tank capacity	26.4 gallons (120 l)

The manufacturer reserve the right to change specifications without prior notice.

VOLVO BM
VOLVO BM AB ESKILSTUNA SWEDEN

Ref.No. 21 1 669 1133
ENGELSKA