Advantage

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Contents

Observations of a Skylead sled yarder used for long-distance cableway logging operations

Abstract

Skylead Logging Equipment Corp. has produced a new sled yarder for long-distance cableway logging systems up to 1500 m long. The yarder can be separated into five components and airlifted to the top of a cutblock with a Bell 212 helicopter. The Forest Engineering Research Institute of Canada (FERIC) observed an operation with 500 m yarding and five spar trees. This report includes productivity results and considerations for systems application and block layout.

Keywords

Skylead, Sled yarder, Cable yarding, Long-distance cableway, Carriages, Interior British Columbia.

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Introduction

In November 2000 FERIC visited Tembec Industries Inc.'s Parson Division near Parson, B.C. to observe M & H Logging Limited's new Skylead sled yarder operating on a long-distance cableway system. Long-distance cableway systems have been used on a very limited basis to harvest timber in B.C. and the Pacific Northwest since the 1950s, using equipment manufactured in central Europe (Bennett 1996). Skylead Logging Corp.'s new yarder is the first modern commercially available yarder manufactured in North America for this logging system. The system differs from conventional yarding because the yarder is positioned at an elevation above the cutblock and the logs are lowered by gravity to the landing below. The yarder can be separated into several components, airlifted by helicopter to the top of a cutblock, and reassembled. For a complete description of the yarding system see Bennett (1996).

Objectives

The objectives of this report are to:

- Provide technical information about the yarder and the yarding system.
- Describe the operation, including productivity estimates.
- Suggest applications and layout considerations for the system.

Site and stand description

The 7.4-ha cutblock was located in the Engelmann Spruce Subalpine Fir biogeoclimatic zone (ESSF wm 01), in the north fork of the Spillimacheen River area in southeastern B.C. The block was about 350 m long by 200–250 m wide (Figure 1). Although ground slopes were only 20–50%, a ground-based logging system could not be used due to wet, unstable soils in the block. Net volume was 286 m³/ha with 6% decay, waste, and breakage, for a total net cruise

Figure 1. Map of study block.

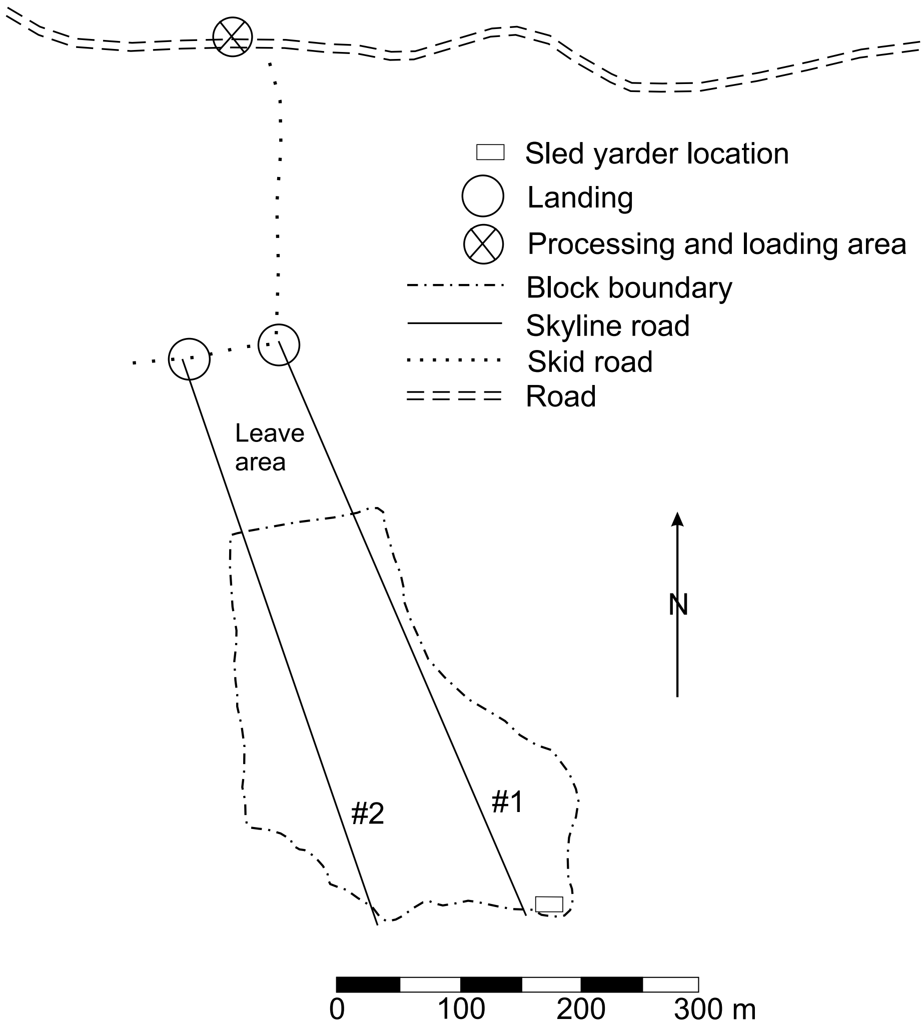

Table 1. Stand description	
Species	Engelmann spruce (60%), subalpine fir (40%)
Net volume (m^3/ha)	286 m^3/ha
Merchantable tree height (m)	19
Total tree height (m)	24
Green tree dbh (cm)	27
Net tree size (m^3)	0.47
Gross tree size (m^3)	0.50
Density (trees/ha)	606

volume of 2116 m^3. Snow cover was 5 cm when FERIC visited the block. A 150-m-long area of timber was left standing between the bottom of the block and the landing due to adjacency constraints. Table 1 provides more information about the stand.

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Equipment description

Skylead sled yarder

The Skylead yarder (Figure 2) consists of a large mainline drum with a water-cooled brake, a strawline drum, a 112-kW diesel engine, and a four-speed automatic transmission, all mounted on a steel sled (Table 2). The separate operator's cab can be located up to 6 m away from the sled. The yarder has no tower and wooden spar trees must be rigged to elevate the skyline. The yarder can be separated into five pieces or "picks" for transport by helicopter (Table 3).

Figure 2. Skylead 6000 Series sled yarder and operator's cab. Strawline drum is not installed.

The heaviest pick is the empty mainline drum and brake which weighs 1310 kg. Components can be lifted by a light lift Bell

Table 2. Yarder specifications

Model	Skylead 6000 Series
Engine type	Cummins diesel 4BTA3.9C, 4 cylinder, turbocharged and after-cooled
Engine power (kW)	112
Fuel consumption (L/h)	3 (approximate)
Transmission	Allison AT-545 Detroit, 4 speed automatic
Drive train	Engine to transmission to air clutch to chain drive to mainline drum
Mainline brakes	1 Eaton 124 water-cooled, 1 band brake
Mainline line pull (kg)	6998 (maximum at mid-drum)
Total weight[a] (kg)	5730
Mainline	
Line diam. (mm)	16
Type	swaged
Drum capacity (m)	1 829
Strawline	
Line diam. (mm)	10
Type	regular lay
Drum capactiy (m)	1 829
Skyline diam. (separate from yarder)	
Line diam. (mm)	32
Type	regular lay
Drum capacity	n.a.[b]

[a] With strawline and without mainline.
[b] Not applicable - skyline not stored on the yarder.

Table 3. Yarder components for helicopter transport

Pick	Components
1	Mainframe, air tank, fuel tank, and water tank
2	Engine, transmission, air compressor, and air clutch
3	Mainline drum (empty)[a] and brake
4	Strawline drum and strawline
5	Operator's cab

[a] Mainline is pulled up the hill to the yarder with the strawline. Mainline pulls the skyline up.

212 helicopter which has a rated maximum payload capacity of 2268 kg. On average, approximately 2 hours of helicopter time are required to mobilize or demobilize the system, including 0.5 h ferry time to and from the helicopter's base.

The contractor has two mainlines for the machine: 1524 m long (about 2087 kg), and 610 m long (about 835 kg) for shorter settings. The 610-m mainline is light enough to be airlifted by a Bell 212, making it unnecessary to use the strawline to pull the mainline up to the yarder. This reduces set-up time on shorter settings and eliminates the need to airlift the strawline drum and install it on the yarder.

The sled yarder observed by FERIC was the first manufactured by Skylead and a final selling price had yet to be established. This unit had been operating for 1.5 months when FERIC visited the block and was being used on its second block. Before purchasing this machine, M & H Logging operated an older European-built sled yarder for eight years. The contractor felt that the new yarder had more power, faster line speed, and more responsive braking compared to the previous older machine. It also had the additional features of more line capacity, an operator's cab, and a strawline drum. The contractor stated that the strawline drum available with the Skylead yarder reduced set-up time by 4 to 5 hours when the longer mainline was required.[1]

Figure 3. Skylead C7 carriage with a turn of logs. Two intermediate supports are visible in the background. Horizontal yarding distance was 500 m.

Carriage

The yarder was operated with a Skylead C7 motorized slackpulling carriage (Figure 3 and Table 4), designed for use on small- to medium-sized yarders. The carriage has an Omnex radio control system with built-in safety interlocks, automatic safety shutdown systems for loss of oil pressure and high engine temperature, and four skyline sheaves: two 25-cm-diameter sheaves and two 15-cm-diameter sheaves, for smoother and faster intermediate support jack crossings. The mainline drops out of the centre of the carriage, making it suitable for bi-directional yarding. Skylead has sold seven C7 carriages and M & H Logging has been operating its carriage for two years.

[1] Clayton Mattson, Owner, M & H Logging Limited, personal communication, November 24, 2000.

Table 4. Carriage specifications

Model	Skylead C7 (motorized slackpulling)
Price ($)	67 000
Engine	Lister-Petter 2 cylinder diesel, air-cooled, 10.5 kW
Drive	Hydrostatic, 2 speed
Load capacity (kg)	6804
Weight (kg)	971
Skyline line diam. range (mm)	19–32
Mainline line diam. range (mm)	13–19
Slack-pulling line pull (kg)	
Low speed	1 007
High speed	503
Slack-pulling line speed (m/min)	
Low speed	60
High speed	124

System description

Although the Skylead sled yarder is new, a similar long-distance cableway system was invented in Switzerland in 1939 by Jakob Wyssen (Pestal 1953). In this operation, the standing skyline system was set up with the yarder offset to the side of skyline road #2 by about 150 m (Figure 1). Five spar trees were rigged to support the skyline including a headspar at the top of the yarding road, three intermediate supports, and a tailspar at the landing, below the block (Figure 4). The skyline was anchored to a stump at the top of the block and to a large crawler tractor at the landing. The tractor's winch was used to pretension the skyline, as the skyline was not connected to the yarder. During yarding operations, the mainline pulled the empty carriage uphill during outhaul and gravity moved the loaded carriage downhill during inhaul. The yarder's water-cooled brake controlled the loaded carriage's speed during its descent to the landing.

The entire block was logged using two skyline roads. Logs were yarded downhill to small landings located about 150 m below the block, through corridors cut in the leave area. Maximum horizontal yarding distance was 500 m and the "anchor to anchor" skyline length was about 650 m. Lateral yarding distance ranged from 0 to 100 m. After unhooking at the landing, the logs were skidded approximately 450 m with rubber-tired line skidders to a clearing at the road for processing and loading. Logs could not be yarded directly to the road because the ground slope was too flat between the landing and the road for the gravity inhaul. The systems and equipment used for the operation are shown in Table 5.

The system has the capability to yard a maximum distance of approximately 1500 m when using a 16-mm mainline. A typical anchor to anchor distance for this contractor has been 900 m. This operation used a crew of 7 to 10 people: one to three fallers, one yarder operator, two chokersetters, one chaser, one to two skidder operators, and one bucker/log processor. In addition to the crew, the owner was on site helping about half the time. The contractor stated that it took about 1.5 fallers to keep up with the yarder. After falling a corridor for the skyline road, the fallers worked concurrently with the yarding operation. Crew members communicated by

Table 5. System and equipment summary

Falling	Handfalling and topping
Yarder	Skylead sled yarder
Carriage	Skylead C7 motorized slackpulling carriage
Skyline anchor	Caterpillar D8 tractor
Skidders	Caterpillar 518 line skidders (2)
Processing	Manual bucking and delimbing at the landing
Loading	Self-loading log trucks

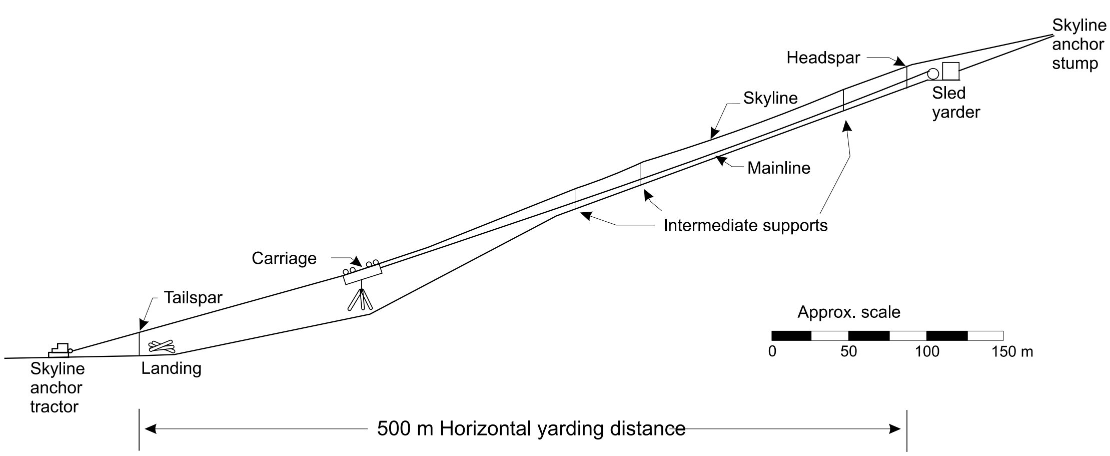

Figure 4. Profile of skyline road 2.

radio using voice signals only. The contractor and crew believed that voice signals were necessary for precise control. The crew worked 8 h/day spending about 0.5 h/day hiking up and down the hill and 7.5 h/day yarding.

Productivity

The limited experience with the new Skylead machine makes it difficult to estimate average productivity but the contractor's objective is 100 m³/8-h day. The contractor's previous machine averaged about 80 m³/day. For this block, the contractor estimated yarding productivity to be 140 m³/day or about 15 days for the 2116 m³. Preparation and flying in took 0.5 days; setup and one yarding-road change each took 2.5 days; demobilization took 1 day; and flying out took 0.5 days for a total of 22 days. Overall, productivity averaged 96 m³/day. On the contractor's first block with the new yarder, 9 days were spent to set up, yard 2200 m³, change roads, and demobilize for an average overall productivity of 244 m³/day. Yarding distance was shorter with an anchor to anchor skyline length of only 500 m.

FERIC conducted a short time study of 9 turns in 92 minutes. The average slope yarding distance was 413 m and the average lateral yarding distance was 63 m. The average turn size was 4.5 logs or an estimated 2.12 m³. The carriage's average travel speed was 313 m/min during outhaul and 308 m/min during inhaul. The average cycle time elements are shown in Table 6. Using these numbers, productivity was estimated to be 12.5 m³/h, when yarding. The yarder spent 26% of the time in delays, mainly due to hang-ups. Productivity was estimated to be 17 m³/h when delay time was removed. Overall productivity is dependent on set-up and road change times and the amount of wood that can be logged per setup.

Table 6. Average cycle time elements

Cycle element	Average time (min)
Outhaul	1.3
Lat-out, hook, lat-in	4.3
Inhaul	1.3
Unhook	0.6
Delay-free time/turn	7.5
Delays	2.7
Total time/turn with delays	10.2
Average slope yarding distance (m)	413
Average lateral yarding distance (m)	63

Implementation

An important factor for a successful operation is the amount of wood that can be logged per setup. A minimum of 2000 m³/road is preferred because of the long set-up times and helicopter costs required for the system. A viable operation for this system requires about 20 000 m³/y. The low productivity of the yarding system favours a manual bucker/processor at the landing and self-loading logging trucks over a mechanical processor and a full-time loader.

This system may be applicable where low volumes would make a conventional skyline or heli-log operation uneconomical. It can be used to yard downhill great distances to a valley bottom road system in locations where road costs are prohibitive or to avoid construction on unstable slopes. It has many of the advantages of conventional skyline systems such as the ability to fully suspend logs over sensitive areas and to yard laterally in partial cuts. It is quieter than heli-logging and may be applicable where noise is a concern such as close to residents or sensitive wildlife habitat. It is also not as weather-dependent as heli-logging where wind, low visibility and icing can cause delays. This system may provide more employment opportunities for the local workforce compared to heli-logging.

The contractor has applied this logging system to a variety of silvicultural systems ranging from clearcuts to seed tree systems. He has also used it to log ski runs for heli-ski operators and has logged timber sales designed for helicopter logging.

When life-cycle analysis[2] is used to address a forest operation's impact on the environment, a logging system's fuel consumption is important. Compared to the yarding phase of the typical systems used on the B.C. coast (about 0.5 L d.e./m³ [3] for loader-forwarding in a clearcut to 7.0 d.e./m³ for heli-logging in a clearcut) (Sambo 1997), this system's fuel consumption per m³ of wood harvested falls at the low end of the range (1.4 L d.e./m³),[4] including the use of a helicopter for setup and teardown. The system's reduced road requirements would also have a positive effect on a life-cycle analysis.

Disadvantages of this system are its low productivity and the need for a high level of technical skill for rigging. Also, the yarder is not usually accessible by road when operating so repairs are difficult. Long walks required for the crew to get to the work area may also be considered a disadvantage.

References

Bennett, D.M. 1996. Harvesting sensitive sites with a long-distance cableway system: productivity and costs. FERIC, Vancouver, B.C. Technical Note TN-238. 13 pp.

Pestal, E. 1953. The transportation of wood by long skylines. Translated from German by Dieter Mueller-Dombois, edited and condensed by F.M. Knapp. The University of British Columbia, Faculty of Forestry, Vancouver, B.C. 9 pp.

Sambo, S.M. 1997. Fuel consumption estimates for typical coastal British Columbia forest operations. FERIC, Vancouver, B.C. Technical Note TN-259. 4 pp.

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[2] A tool for making a comprehensive assessment of a product's (or service's) impact on the environment, throughout the life span of the product (Sambo 1997).

[3] Litres of diesel equivalent per cubic metre of wood harvested.

[4] Calculated by the author.