



Log chutes



MINISTRY FOR FOREIGN
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1. Introduction

Historical accounts in the Middle East of log chutes or slides made from assembled logs and used for transporting cedar logs date back two thousand years. Their application peaked in the nineteenth and early twentieth centuries, seeing large-scale use in the mountainous regions of Europe and the United States. The construction and maintenance of such tools required a great deal of labor and materials, which led to their being replaced by other methods of forwarding, such as skyline systems.

Wooden chutes for big, heavy timber built with round logs can provide permanent transportation solutions. However, their use in tropical natural forests cannot be generally recommended due to the fact that their construction needs specially trained labor and that extractable volumes are often very low, in most cases not exceeding 20-30 meter (m)³ per harvest cycle. Instead, their economic application may be best in the logging of pure stands of coniferous and hardwood timber plantations.



Figure 1. Permanent chutes built from logs (USA early 1900s)



2. Prefabricated log chutes

Timber chutes are slides constructed from synthetic materials shaped into channels that carry timber by using the cheapest form of energy: gravity. Their length is adjusted to the slope on which they are installed with adjustments to the cross slope layout to avoid reaching excessive speeds. Timber chutes thus extend the distance over which logs can travel. Reduced friction enables quicker delivery compared to an earth slide. With the arrival and manufacture of synthetic materials, new possibilities opened up for the construction of slides. The Austrian firm Leykam developed the first plastic slide known as the Leykam Log Line, which was introduced to the market in 1975.



Figure 2. Leykam logline installation with mobile winch (Acar 2005)

3. Technical and operational details

The Log Line is composed of a semicircular plastic channel made of polyethylene, a material that retains its shape, is robust and can operate over a wide temperature range both above and below zero, all of which guarantees a long service life. When the product was first introduced to the market, it consisted of pipes for the main run and open sections at the delivery point.

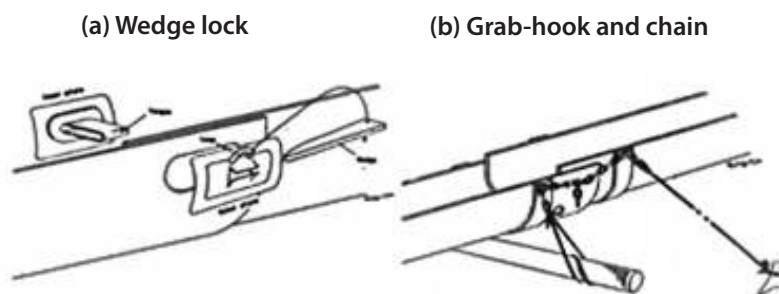


Figure 3. Log chute connection and fixation

Today, only open channels are used, which have an internal diameter of 350 millimeters (mm) and walls 9 mm thick. Each channel has a length of 5 m and weighs 25 kilogram (kg). The individual shells are fixed together in a line of required length using stainless steel quick couplings and rope attachments (Figure 2). For ergonomic reasons, and because they travel better, wood lengths of 2-4 m are most efficient to transport. Depending on the radius of the curves on the slide and how straight the logs are, log lengths



up to 6 m and a diameter of 30 centimeters (cm) at the wider end can be accommodated. Spacing on slopes between extraction lines should be 15-30 m depending on weight/volumes to be moved manually from the felling site to the log lines. There have been various attempts in other countries such as South Africa (1990s) and Turkey (2005) to fabricate similar log lines.

Figure 4. Comparative log line testing of locally manufactured log lines in Turkey (Acar, 2005)

Table 1: Technical specifications and prices for log lines developed in Turkey.

Type of chute	Firm	Raw Material	shape	Length (m)	Diameter (cm)	Thickness (mm)	Weight (kg)	Price (€/m)
Acar OLUKPeF50/600	Firat Plastik	Polyethylene	Semicircle	6	50	6	25	10.00
AcarOLUKPeD60/600	Dizayn Grup	Polyethylene	Semicircle	6	60	5	20	13.88
AcarOLUKFb50/500	Poler Plastik	Fiberlass	Semicircle	5	50	5	30	46.12



Figure 5. AcerOLUKPeF50/600(a), AcerOLUKPeF50/600(b), AcerOLUKFb50/500(c)

Various recommendations and attempts to build log lines from metal sheets, either with V-shaped or rounded cross-sections (FAO 1989, Acar, HH 1995)

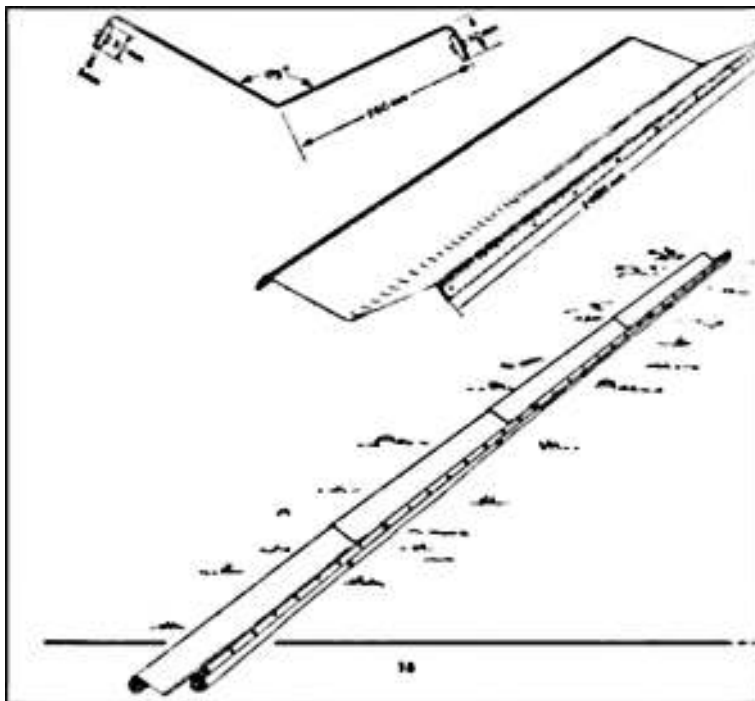


Figure 6. Metal log chutes (FAO 1989)

Because logs can build up speed, stretches running 200 m are the most practical. The individual channels are tied with nylon rope to neighboring trees, stumps, etc. If none are available, stakes can be used that can be quickly cut and sharpened from treetops using a chainsaw and then driven in next to the channels. To prevent the channels from sagging, branches and brush can be placed under them. To avoid the possibility of breakage, the chute should not be laid over loose rocks or bumpy ground. For similar reasons, corners with a narrow radius should be avoided since there is danger that the wood could slide out of the channel. If this is unavoidable, the corners should be built with higher sides.

Depending on the weather and the condition of the wood, a minimum gradient of 15-25 percent is required for a trouble-free operation. The maximum possible gradient is 50 percent, which requires that braking measures be taken, or if possible, the chute should be laid across the slope. Dirt, rocks, bark and vegetation falling into the slide during an operation can significantly increase friction.

Speeds of over 15 m per second are to be avoided for the following reasons:

- The kinetic energy of the log increases quadratically with speed. This necessitates strong extensions above the corners and a stable construction to cope with the increasing centrifugal force and the force of the log's impact, which results in higher construction costs.
- At points where the terrain suddenly changes or where the direction of travel changes, there is a danger that pieces of wood can slide out of the chute. This will damage the log or the remaining stand. Repairs will add to the overall cost of the operation.
- It will become more difficult to gather the wood at the outlet and losses in timber will mount.
- Safety is compromised and the potential for accidents increases.
- Braking measures become unmanageable at high speeds.

Breaks as shown in Figure 3 can be inserted into the line along steep slopes to reduce log speed and address safety.

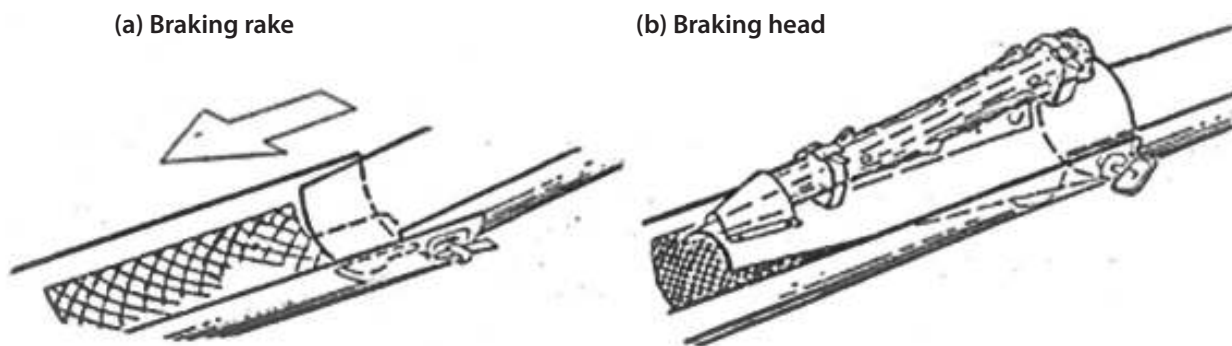


Figure 7. Braking system of the Leykam Log Line (Engelbrecht 1994)

4. Productivity and efficiency in chute extraction of timber

4.1 Southern Germany

Studies on the log line were carried out by KWF (Forestry Work and Technology) Germany in 1999. Excluding time values in setting up the log line, the following performance of a three-man team resulted when operating the logline over distances varying from 100 m to 150 m.

DBH (diameter at breast height)	12	15	20	25
Average volume (m ³ under bark)	0.06	0.12	0.25	0.45
Performance/person (m ³ /hr)	1.8	2.2	3.2	3.7

Note: machine costs of about US\$ 4 should be included.

4.2 Austria

Similar results in the performance of a three-man team on slopes of 34 and 38 percent with extraction distances of 45 and 120 m. Average log length was 3.8 m with middle portion diameters of 13-15 cm. The performance of the system was 1.4-2.0 m³/hour (hr)/man (Proell 2000). Setting up the log line required between two and five person-hours for the above distances, respectively.

4.3 United Kingdom

Studies were carried out by the United Kingdom (UK) Forestry Commission (1994) on small broadleaved stands on steep slopes revealed lower performance compared to the preceding studies listed above, likely due to the low extraction volume derived per unit of area. The manual set-up time for the chutes with assistance of a 40-m winch was about 35 m/hr. Winch machine costs of US\$ 0.3/hr should be included in this case.

4.4 Turkey

Performance studies on systems in Turkey were carried out by KTU Faculty of Forestry in 2002 to 2005 on slopes ranging from 21 to 58 percent. Transported logs reached speeds of 12-42 kilometer (km)/hr. Extraction rates were fairly similar and reached 26m³/hr for the 600 mm chute types and 19m³/hr for the 500 mm chute over average distances of 100 m. Set-up time for work teams ranged from 15 to 30 m to 16 hours for a 260 m chute length (see Figure 8 below). The work teams consisted of three to four persons.

Table 2: Extraction outputs and costs of log line trials UK (1994)

Study No/Chute Type	Chute Length (m)	Product Density (m ³ /10m)	Volume Extracted (m ³)	Chute Slope (%)	Output (m ³ /shr)	Cost (£/m ³)
4906 Vertical	64	0.67	4.30	44% overall	1.01	18.32
4907 Vertical	59	0.50	2.97	44% overall	0.76	24.34
4908 Diagonal	110	0.75	1.8	27% overall 22% minimum 56% maximum	0.92	20.11

SM or shr - Standard output units included allowances of 10% for Other Work and 23% for Rest.
The hourly capital and labour costs assumed are Labour at 16.00 (2 operators) and Chute at 2.50



Figure 8. Set-up of 260 m extraction line on slope averaging 30 percent

5. Summary and recommendations

Chutes have the following advantages compared to other steep-slope systems:

- Relatively low capital cost in comparison;
- Require minimal maintenance;
- Low environmental impact;
- Minimal damage to remaining stands, vegetation and soil surface; and
- Can be produced locally, either from metal sheets or recycled large-diameter PVC piping materials.

Considerations and disadvantages:

- Careful planning is required to identify the ideal log line location in terms of slope, steepness, etc.;
- Skilled labor is needed for efficient use of the chute system and the prevention of accidents;
- The felling pattern must complement chute lines;
- Chute operators must be able to handle logs manually from the felling site to the log line.
- Log diameter should be at least 5 cm smaller than that of the chute;
- Maximum length of logs should be below 6 m; and
- De-branching quality should be of a high standard.

Prefabricated log chutes are the next logical step once manual downhill drifting has proven to be successful and a certain skill level of forest workers has been reached. Since the alternative method of downhill skyline extraction is, in developing countries, too difficult and costly to introduce, log chute extraction may be the preferred, or even, only practical method for forwarding logs.



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