

RIGGING FOR BREAKING-OUT

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INTRODUCTION

It is commonly recognised that the strop attachment phase is one of the longest elements in a log extraction cycle. Both the type and system of rigging used must therefore be efficient and cost effective.

Often in New Zealand, tradition or ignorance determines which type of rigging is chosen, and the way it is used. This paper discusses two factors which directly influence stropping efficiency, and in the longer term, overall productivity. These factors are: rigging options (type of strop) and rigging systems (method of use).

RIGGING OPTIONS

Basically, a logger has three choices when rigging his machine with strops. He can use either polypropylene, wire rope, or chains. The most important consideration is that whatever configuration he chooses, he gets the correct capacity strop for the intended job. In some areas, the right size is not always available, but there is little doubt that if a demand exists, retailers will endeavour to satisfy that demand. Perhaps the easiest way to compare these three options is to summarise the advantages and disadvantages of each.

(i) Polypropylene Strops

These have been tried by F.R.I., K.L.C., and LIRA in different trial situations. They are used extensively in the United Kingdom, particularly in small sized roundwood operations (\*Ref.1). The general impression in New Zealand is that in ground based and cable operations, they are limited to small piece sizes (\*Ref.2). This is further substantiated by reportage on trials in small (.044 m<sup>3</sup>) thinnings, where polypropylene was used in a pre-stropping system with a double-drum winch mounted on an agricultural tractor (\*Ref.3). Polypropylene also has distinct advantages in helicopter logging, where weight is a critical factor and where shock loading is minimal.

The following chart outlines the advantages and disadvantages of polypropylene strops:

<u>Advantages</u>	<u>Disadvantages</u>
1. Low cost	1. Unable to withstand shock loading
2. Light weight	2. Low resistance to abrasion
3. Easy to handle	3. Large diameters necessary for sufficient strength
4. Easy to splice	4. Weak or clumsy hooking method
5. Bright colour - easy to see	5. Difficult to get strop under butt of log

(ii) Wire Rope Strops

This is this most common type of strop used in New Zealand, and possibly throughout the world. It is readily available in a wide range of sizes and constructions for various applications. However, a balanced requirement for flexibility and strength normally restricts the options, with 6 x 31 ordinary lay being the usual choice (\*Ref.4). The logging environment is regarded as one of the most severe situations that wire rope is used in (\*Ref.5), and the strop receives the most abuse.

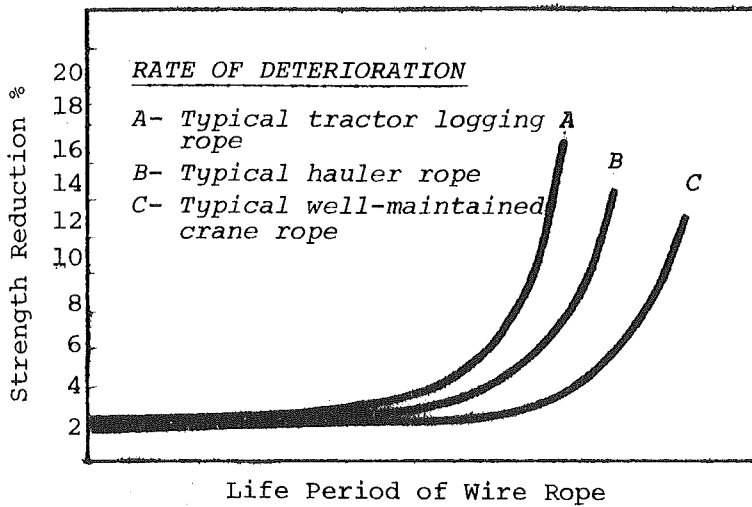


Figure 1 - Overall Deterioration of Wire Rope

When subject to stress and wear, the wires within strands break and through pressure are forced out of position. These sprags can cause painful injuries. Head pulling is considered much harder on wire rope than butt pulling, because it tends to curl the strop to the shape of the small diameters making it difficult to attach. It also accelerates the occurrence of sprags.

The chart below indicates the advantages and disadvantages of wire rope strops.

<u>Advantages</u>	<u>Disadvantages</u>
1. Strength	1. Strops spring undone, when new
2. Rigidity	2. Sensitive to abrasion
3. Wide variety of sizes	3. Tend to curl, when worn
4. Variations in rope structure	4. Difficult to handle
5. Relative economy	5. Unusable once broken
	6. Tend to tangle

(iii) Chain Strops

Chains are being used with increased regularity in New Zealand, particularly in the Nelson and Hawkes Bay areas. They are a common sight in Scandinavia but not so popular in the United States or Canada. The two main advantages found with chains used in the

United Kingdom were durability and the ability to adjust strop length by using sliders with keyhole plates (\*Ref.1). However, the latter is not used in New Zealand. LIRA has conducted trials in skidder thinning operations and promising results have been recorded. The anticipated problems of getting strops under logs and unhooking during break-out have not materialised, and instead improved efficiency, durability, and handling characteristics have emerged. One distinct advantage of chains is the ability to quickly repair a break by inserting a hammerlock or chain connector. This process takes roughly 30 seconds.

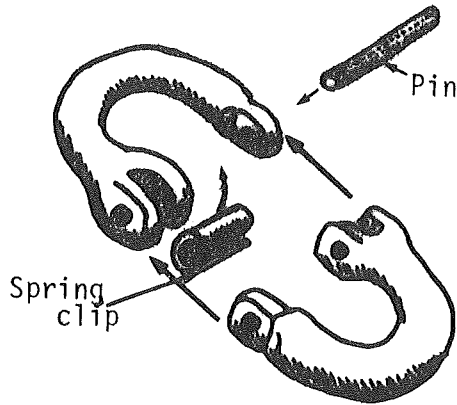


Figure 2 - Hammerlock for Repairing Broken Chain

The controversial aspect of chains being prone to unhooking during winching (\*Ref.6) has been predominantly resolved by modification of the hooks. This was clearly apparent in one of LIRA's trials which aimed to determine the best type of hook. A variety of types were purchased, ranging in price from \$49.00 for a Canadian ER 8, to approximately \$10.00 for a home-made hook fashioned out of a larger chain link - refer diagram below.

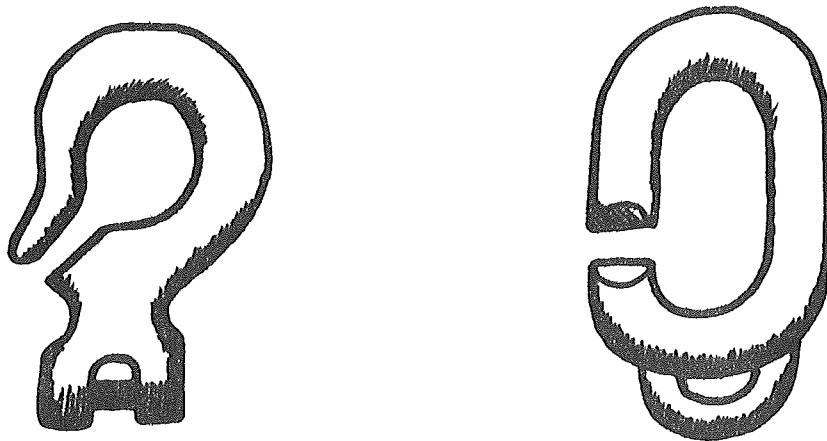


Figure 3 - Canadian ER 8 Hook      Home-made Hook Made From Larger Chain Link

Although the Canadian hook was easy to handle and attach, it did occasionally come off during winching, and sometimes tangled during strop sorting. The home-made hook, on the other hand, seldom came off and never tangled. However, it took longer to attach and unhook. Hooks which attach directly onto one link were found to be unsuitable because they caused shock loading to that particular link and frequently came unhooked. Two essentials for hook configurations then are: - the gap be as narrow as possible without restricting attachment, and the chain slide freely through the hook once attached to allow the chokering effect.

Naturally, chains have limitations. They are difficult to get under dug-in butts and are sensitive to severe shock loading. But simple system modifications could rectify these problems. For example: more blading with the skidder; the hauler breaker-out carrying a light-weight trenching tool (\*Ref.7); avoiding obvious shock loading situations by better training of operators. Overall, chains are best suited to head pulling because they are not affected by small diameters, stropping-up is easier, and the severity of shock loading is reduced. Consequently, they last twice as long as they do in butt pulling.

The following chart summarises the advantages and disadvantages of chain strops.

<u>Advantages</u>	<u>Disadvantages</u>
1. Efficiency of operation	1. Tend to unhook*
2. Resistance to abrasion	2. Difficult to get under butts - isolated cases
3. Durability	3. Higher weight per strength ratio
4. Easy to mend	4. Higher cost
5. Reduced tangling*	5. Unable to withstand severe shock loading
6. Easy to handle	

\* Depending on hook

To draw a more direct comparison, the following chart indicates the size, cost, strength, efficiency, and anticipated life of polypropylene, wire rope, and chain strops, that would be applicable for average 13 year old thinning.

<u>Strop Type</u>	<u>Size</u>	<u>Strength*</u>	<u>Cost</u>	<u>Efficiency**</u>	<u>Life</u>
Kuplex chain	7 mm	6309 kg	\$61.18	24.9	25 wks
6 x 31 wire rope	11 mm	7123 kg	\$48.16	27.4	12 wks
Polypropylene	20 mm	5330 kg	\$28.38	Not Available	3 wks

\* Expressed as minimum breaking force

\*\* Expressed as % of productive cycle

### RIGGING SYSTEMS

There are two type of rigging systems used in logging: fixed and detachable. The difference between the two is that one has the strops permanently attached to the mainline or butt rigging, and the other has detachable strops which are used for pre-stropping. Both systems are used extensively throughout the world and both have particular

advantages and disadvantages. The fixed system, however, is by far the most common in New Zealand. There are many variables, such as double-drum winches on skidders, or slack-pulling carriages on haulers, that can dramatically affect the viability of either system. All options would be impossible to cover in this brief paper, but the following summaries should identify key points.

(i) Fixed Systems

The fixed system is the best option for a ground-based extraction cycle where the machine operator strops up his own drag, or in a highlead situation where erratic rope movement would undoubtedly throw detachable strops off. It also reduces the opportunities for logs to become unhitched during break-out. The disadvantages are: if a strop breaks, the slider or ring has to be removed for repair (except when using chain); the limitations on long stropping; and idle time or effective lower productivity of fallers or breaker-outs while the extraction unit is extracting the previous drag.

A summary of the advantages and disadvantages in a fixed rigging system is shown below.

<u>Advantages</u>	<u>Disadvantages</u>
1. Fewer strops required	1. Less productive, theoretically
2. No loss of strops	2. Inability to long strop
3. Less manpower involved	3. More difficult to repair broken strops - wire rope

(ii) Detachable Systems

The advantages of pre-stropping in the detachable systems are that it enables the faller or breaker-out to attach strops to the next drag while the previous one is being extracted, hence reducing the stropping-up element. It also gives the faller or breaker-out more time to locate the logs and think about the extraction direction, thus reducing the occurrence of logs being lost under slash and minimising the damage to residual crop trees in thinnings. This is particularly successful in small piece size operations where a high number of stems are accumulated for one drag (\*Ref.3). Another, not so obvious advantage, is the ability to long strop to reach a log in a difficult position by joining two strops together.

The obvious disadvantages are the need for two or three sets of strops; the possibility of losing strops in the bush or coming unhooked off the mainline; and the difficulty a skidworker has in unstropping logs that are jammed together. There is also a need for more manpower, or a higher work load is placed on existing workers, depending on the logging method used. This is normally offset by increased productivity.

The advantages and disadvantages of detachable systems are shown in the chart on Page 6.

Advantages

1. Increased productivity
2. Improved log recovery
3. Easy to replace broken strops
4. Possible reduced damage - thinnings
5. Ability to long strop

Disadvantages

1. More manpower required
2. Extra strops necessary
3. Possibility of losing strops
4. Congestion on the skids
5. Possible unhooking off the mainline

A recent modification to some skidder and tractor systems has been the inclusion of a section of heavy duty chain at the end of the mainrope. This reduces the abuse the eye receives as sliders or rings are winched through the fairlead. Eye life has been increased by as much as three times in some instances. It is also suitable for pre-stropping operations where a simple "A" link is used as a terminal stop. This can be held parallel with the rest of the chain for attaching strops, but when released falls back into its position as a terminal stop.

CONCLUSION

Both the strop type and the system used have direct influences on the productivity of a logging operation.

The three alternatives for strops are polypropylene, wire rope, or chain. Polypropylene is relatively cheap, easy to splice, and light weight, but has limitations on the shock loading it can withstand. Wire rope is strong and readily available in a wide range of sizes, but is difficult to handle when worn. Chains, although more expensive are durable, easy to handle, quick to mend, and appear to be more efficient.

Fixed strops, the most common system used in New Zealand, are best suited to skidder logging, where the operator breaks out, or on a highlead hauler system. Detachable strops can be used where fallers fell and strop drags concurrently. This method is suitable for smallwood operations.

New developments are constantly improving the type of rigging available. The success or failure of these developments usually rests with the approach taken in the initial testing of them. New ideas should therefore be given a fair trial.

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