HARVESTING TECHNOLOGY WATCH

HTW-014
July 2014

Summary

TECHNOLOGY WATCH is a biannual report outlining research and technology developments that are occurring outside the FFR Harvesting Theme, frequently from overseas. This report investigates the guy rope sheave systems for tower haulers and swing yarders, and proposes a modification to the tower hauler sheave system to improve hauler shifting operations and reduce production delays.

S Hill, Scion

NEW HAULER TECHNOLOGY

Figure 1: (a) Tower yarder guy rope sheave system; and (b) swing yarder guy rope roller system

Tower Guy Rope Sheave/Roller System Modification

One of the major differences between tower yarders and swing yarders is their set-up and shifting time. Tower yarders take longer to set up and shift for several reasons:

- They typically have more guy ropes (up to eight for some yarders) and more stringent requirements regarding their angles and placement.
- They are usually static and can log only a certain area before having to be either shifted or turned in order to be able to log the adjacent area.

This additional time for set-up and shifting of the tower yarder is a production delay and a potential opportunity to improve production if the design could be modified.

The in-line fixed arrangement of the tower yarder guy rope sheaves (Figure 1a) implies that all guy lines have to be moved and re-secured every time the tower needs to be turned. This is not the case with the swing yarder guy rope roller system (Figure 1b). Here the arrangement comprises so-called “walk-over guy lines” where

Future Forests Research Ltd, PO Box 1127, Rotorua. Ph: 07 921 1883 Email: info@ffr.co.nz Web: www.ffr.co.nz

moving and re-securing only one of the guy lines is required to turn the yarder.

STUDY METHOD

The idea for further investigating the possibility of modifying the tower yarder guy rope system to allow for faster turning and shifting was generated during one of a series of workshops held to develop concepts for an innovative yarding system.

The improvement idea ranked relatively high (receiving nine votes of support from the 20 workshop participants). Subsequently, harvesting researchers at Scion developed three ideas for modifying tower guy rope systems to facilitate faster hauler turning and shifting:

1. Twin swing yarder roller system.
2. Stacked rotating ring sheave system.
3. Flared pipe fairlead system.

These ideas were then presented to and discussed with logging equipment design manufacturers in New Zealand to assess their technical and economic feasibility.

RESULTS

1. Twin Swing Yarder Roller System

This concept of the Twin Swing Yarder Roller System (Figure 2) was naturally seen as one of the favourites given that it is similar to the current design for swing yarders and is proven technology existing in practice. Installing only one roller system would not be sufficient to provide the required stability for a tower yarder because of the differences between tower yarders and swing yarders. However, installing two roller systems at certain angles to the skyline fairlead would likely provide the stability without compromising the integrity of the tower mast by creating twisting forces and moments during operation.

Figure 2: The twin swing yarder roller system concept.

When the tower needs to be turned, for example counter clockwise, the guy line that is furthest to the left of the tower from each of the two roller systems needs to be shifted “over” the others and secured farthest to the right. Thus, a tower yarder turn is completed by moving and re-securing only two guy lines instead of all six (or eight depending on the type of tower).

The time needed to turn the tower and the physical strain on workers performing this task will be reduced dramatically. This will also likely lead to safer operations, as the tower is more likely to be repositioned at the proper time required (i.e. before the hauler is “out of lead”) rather than continuing for a few more hauler cycles without turning, which could compromise the safety of the operation and the integrity of the tower.

This was the preferred concept from the design manufacturers, receiving the highest ranking because of its simplicity and existing know-how. Further technical evaluation would be needed to properly design the specifications and location of the roller systems on the towers, depending on the size, technical specifications and brand of the tower. It is possible that some types of tower may not be suited to modification and may not work properly with a system like this in place.

Future Forests Research Ltd, PO Box 1127, Rotorua. Ph: 07 921 1883 Email: info@ffr.co.nz Web: www.ffr.co.nz

If suitable, the cost of this twin roller system was estimated to be less than NZ$20,000.

Regarding production gains, it was estimated that a cable harvesting crew would gain approximately one hour of extra productive time per week based on an estimated reduction of 30 minutes per shift and two shifts per week on average. At average crew daily productivity exceeding 210 tonnes per day over 7.0 productive hours this would result in additional production of 30 tonnes per week. At daily crew cost of NZ$8,000, this would translate to approximately NZ$1,140 per week, and the modification would be paid off in 18 weeks.

2. Stacked Rotating Ring Sheave System

This concept design, called the Stacked Rotating Ring system involves retaining the existing arrangement of the tower guy-line sheaves (Figure 3). It allows each sheave to rotate around the tower pole independently of the others.

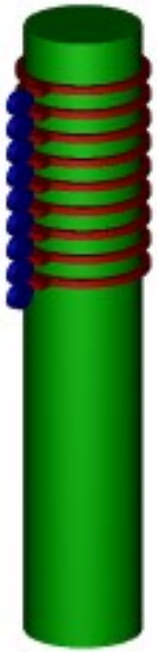

Figure 3: The Stacked Rotating Ring Sheave system.

These sheaves would be connected to rotating rings that would be installed in purpose-built grooves on the pole, and rotate around it when needed. When the tower yarder needs to be turned (for example, counter-clockwise) the bottom one or two rings with the sheaves attached to them will have to be rotated counter clockwise and re-secured in the new positions farthest to the right of the yarder. In order to prevent tangling of the guy lines, these will have to be driven between the pole and the rest of the guy lines located above them.

The potential benefits of this modification would likely be the same as those of the first concept. The hauler turning time and physical strain on workers performing this task would be reduced dramatically, and overall safety improved by relocating the tower at the proper time required.

This concept received the second highest ranking among the equipment design manufacturers.

It was considered the most technically feasible as being the closest in design to the existing arrangement of the tower yarder guy line sheaves. It would provide evenly distributed forces, and thus would keep the system within the proper guy-line installation guidelines and prevent potentially hazardous twisting moments on the tower during hauler operations.

Disadvantages noted were mainly because of the possibly higher costs and additional labour required for the machining the grooves and designing and manufacturing the rings.

Given that it is technically feasible, the cost of this stacked ring sheave system was estimated at NZ$25,000 – $30,000. It was estimated that the productivity benefits were the same as the first option, translating to a payback period of approximately six months (26 weeks).

Future Forests Research Ltd, PO Box 1127, Rotorua. Ph: 07 921 1883 Email: info@ffr.co.nz Web: www.ffr.co.nz

3. Flared Pipe Fairlead System

This concept design came about by looking for ways to prevent guy lines from tangling with one another when relocating one or two of them and moving them across the others.

The concept would involve the design and manufacture of a fairlead shaped like a pipe flared at the top (Figure 4).

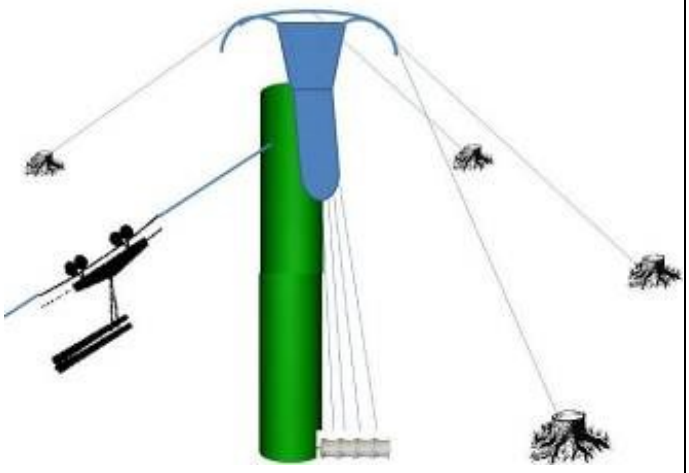

Figure 4: Flared Pipe Fairlead system

The guy ropes would pass through the pipe and spread out at the top at the required angles. The device would have to be solidly attached to the tower to prevent failure and ensure its integrity and safety.

When the tower yarder needs to be turned counter clockwise, then the guy line that is farthest to the left will have to be moved and secured properly in a new spot farthest to the right. Grooves into the device will possibly be needed to ensure they stay in place and do not slip during operation. Possibly some combination of small sheaves would be required to prevent the guy ropes from getting damaged by friction on the metal edge of the flared pipe.

This concept was seen as a good one in terms of its versatility and even distribution of guy rope support forces. Additional thoughts and technical assessment would be needed to properly design the device to prevent damage to the ropes or create grooves in the device during operation, as well as creating a lead for the ropes so they do not rub on one another.

The potential benefits would be comparable to the other two concepts. If technically feasible, the cost of this flared pipe fairlead system was estimated at NZ$35,000 – $40,000 which translates to a payback period of approximately eight months.

A summary of cost estimates and simple payback period calculations is presented in Table 1.

Table 1. Summary of options and costs.

Option	Cost (NZ$000)	Payback (months)
Twin Roller	15 - 20	4
Rotating Ring	25 - 30	6
Flared Pipe	35 - 40	8

CONCLUSION

In conclusion, turning and shifting a tower yarder is a time-consuming and physically strenuous task. Due to production pressure, cable logging crews sometimes continue logging for a few more hauler cycles before shifting the hauler, which may compromise the safety of the operation and the integrity of the tower. Some options to reduce the production delays involved in shifting tower haulers were developed and discussed with New Zealand logging equipment design manufacturers. Initial concept designs have been presented for further development, and costs estimated, indicating relatively short payback periods.

Future Forests Research Ltd, PO Box 1127, Rotorua. Ph: 07 921 1883 Email: info@ffr.co.nz Web: www.ffr.co.nz