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CALIBRATION OF A SKYLINE BAND BRAKE

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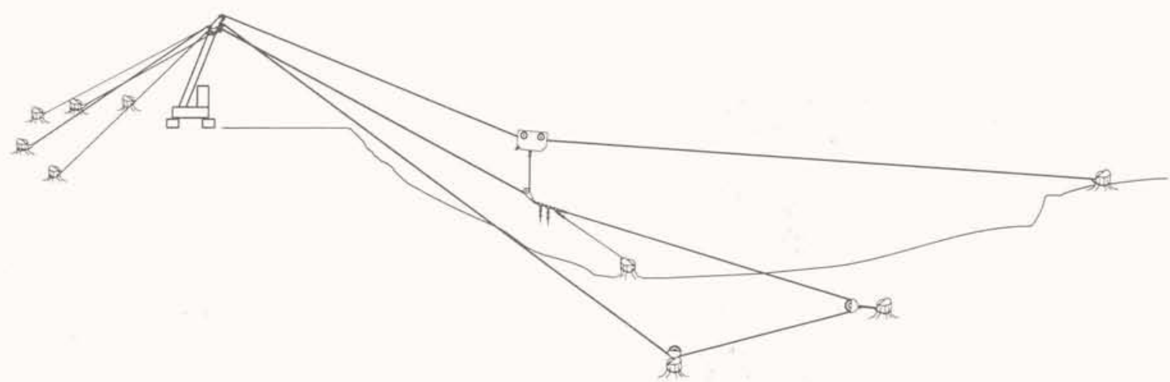

Figure 1 - Setup for the skyline band brake calibration procedure

Summary

For safe operation of integral spar haulers, it is critical that the skyline band brake is set so that it slips, preventing excessive tension in the skyline. This report describes a procedure for calibration and correct use of the skyline band brake on a cable hauler.

Introduction

Successive skyline tensions in excess of the endurance limit reduce the skyline strength and may result in hazardous situations if the skyline breaks. Integral spar haulers use a band brake to hold the skyline in tension while the hauler is working. The band brake is actuated by compressed air. By regulating the air pressure, the torque which the brake is capable of resisting can be adjusted. The torque exerted on the brake depends on the tension in the skyline and the effective radius (r_e) defined by the number of layers on the drum. For safe operation, the band brake should be set so that it will slip before the tension reaches the endurance limit of the rope.

In logging, a further factor of safety must be used which is 1/3 of the breaking strength. This is termed the safe working load (SWL)

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How Band Brakes Work

The holding ability of a band brake depends on:

- the force at which the brake lining presses against the steel (controlled by regulating the air pressure)
- the "coefficient of friction" (or amount of grip) between the brake lining material and the steel with which it is in contact.

The coefficient of friction will vary with wear, corrosion of the steel, amount of "spring" in the band and the presence of foreign matter (e.g. water, grease). This means that two similar brakes may have different operating characteristics.

It is important that the skyline brake is calibrated frequently as these factors will change with time and operating conditions.

Calibration of Skyline Brake

During the calibration process, rope tension is read directly from the tension monitor display, so it doesn't matter which gear is used.

Step 1: Setup

(i) Rig the skyline and carriage/rider block as you would for extraction. Ensure that the anchors are adequate as larger than normal operating tensions will be applied to the skyline. The system used will have to enable the skyline to be loaded by pulling it down with the mainrope. The span length is not crucial, but it is best to have the skyline about half-way through a layer (i.e., the skyline is perpendicular to the drum, as in Figure 2).

(ii) At approximately mid-span, strop a large, notched stump (Figure 1).

Note - If using a clamping carriage, the tension monitor should be attached at the tailhold end of the skyline.

This is necessary because the highest tensions, often during breakout, occur between the carriage and the tailhold. The band brake should therefore be set to slip when the SWL is reached at the tailhold end of the skyline, even though the tension at the hauler may be less than the SWL.

If the tension monitor is located at the hauler end of the skyline, an allowance should be made for the higher tensions at the tailhold end.

Step 2: Establish the effective radius (r_e) for each layer of rope on the drum

(i) Measure the flange radius (mm), r_f (Figure 2).

(ii) Measure the distance (mm) from the flange to the top of the outside layer of rope, l.

(iii) Calculate the effective radius (mm) (r_e), using;

$r_e = r_f - (l + {}^1/2h)$ where h is the rope diameter

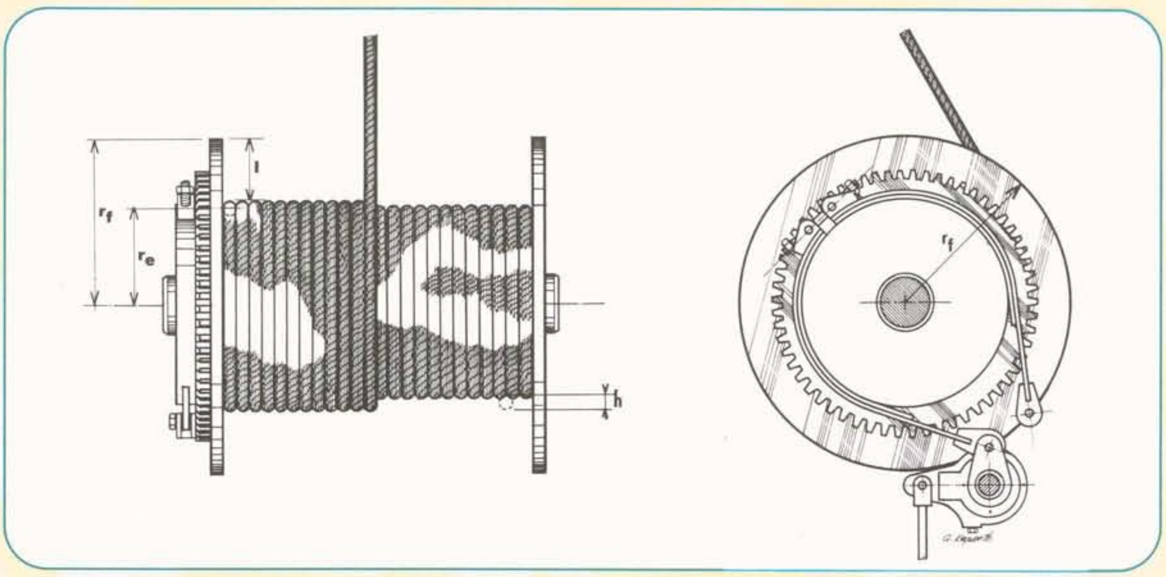

Figure 2 - Skyline drum and rope measurements

Step 3: Measure the skyline tension at which the skyline brake slips (T)

For a range of working brake pressures, (e.g. 10psi to 100psi, in 10psi increments), complete the following steps (without exceeding 50% of the breaking strength):

(i) Raise the skyline to a tension that you think will be just below where the brake would slip.

(ii) Apply the band brake, disengage the skyline clutch and release all other skyline brakes.

(iii) With someone watching the tension monitor display, gradually increase the mainrope tension (go ahead on the mainrope) until the skyline brake slips. Record the skyline tension (T) when the brake began to slip (Table 1)

Brake Pressure (psi)	Slip Tension (tonnes)	Slip Torque
10	T_1	Q_1
20	T_2	Q_2
30	T_3...	Q_3...
40		
50		
60		
70		
80		
90		
100		

Table 1

Step 4: Calculate the slip torque (Q)

For each pressure setting, calculate the torque (in tonne.millimetres) at which the brake slipped using;

$$\text{Slip torque, } Q = T \times r_e$$

Slip tension is in tonnes and r_e is in mm. Add these results to the third column of Table 1.

Step 5: Calculate r_e and l for each layer of rope on the drum

(i) Calculate r_e for each layer that the drum can hold by adding or subtracting multiples of (0.87 x h).

Start with the drum core diameter (mm), add h for the first layer, and then add successive values of (0.87 x h). Alternatively, start with the effective diameter (r_e) measured in Step 2 and add or subtract (0.87 x h) values.

Record the data as in Table 2 (column 2).

rope layer	r_e	l
1 st	r_e1	l_1
2 nd	r_e2	l_2
3 rd	r_e3...	l_3...
4 th		
5 th		
6 th		
7 th		

Table 2

(ii) Calculate the distance from the top of the flange to the top of each layer (l) using the following;

$$l = r_f - r_e \quad \text{where } r_f \text{ is the flange radius}$$

Record the data as in Table 2 (column 3).

Step 6: Calculate slip tension for each brake pressure on each layer

(i) Calculate slip tension for each brake pressure and rope layer using the respective slip torque (Q) and the effective radius (r_e) values as follows:

$$T = \frac{Q}{r_e}$$

(ii) Record the results as shown in Table 3

Table 3 - Calculation of the slip tension for each layer of rope

Brake Pressure (psi)	Slip Tension (tonnes)	Slip Torque
10	T_1	Q_1
20	T_2	Q_2
30	T_3...	Q_3...
40		
50		
60		
70		
80		
90		
100		

Slip tension (T) for layer of rope on drum						
1 st (l_1)	2 nd (l_2)	3 rd (l_3)...				
$= Q_1 / r_e 1$	$= Q_1 / r_e 2$	$= Q_1 / r_e 3$...				
$= Q_2 / r_e 1$	$= Q_2 / r_e 2$	$= Q_2 / r_e 3$...				
$= Q_3 / r_e 1$	$= Q_3 / r_e 2$	$= Q_3 / r_e 3$...				

Step 7: Plot Slip Tension (T) vs Brake Pressure for each layer

- Slip tension and Brake Pressure data from Table 3 is plotted on a scatter graph (Figure 3). A line is plotted for each layer of rope on the skyline drum (i.e, each value of *l* in Table 3). It is best to use a different colour or line style for each of these lines.

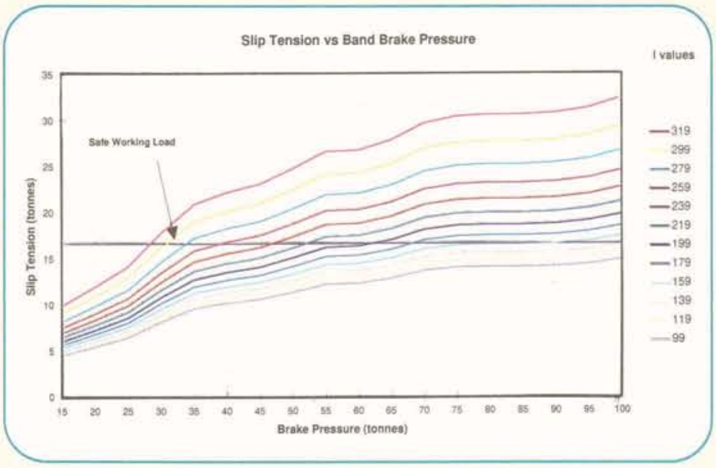

Figure 3 - Example of slip tension vs brake pressure curves

Step 8: Use of the chart

- Keep a laminated copy of these curves in the hauler cab.
- When a new skyline corridor has been set up and the skyline raised, the operator can measure *l* (the distance from the drum flange to the top of the outside layer of rope). This *l* value defines which line on the graph is to be used.
- Decide what tension you want the skyline to slip at and read the corresponding brake pressure off the chart. Set the band brake pressure according to this value.