Safety Factors

By Bruce W. Smith
On Rope 1, Inc.
Harrison, TN 37341
www.onrope1.com

Safety Factors and performing System Safety Checks Prior to Life Loading

is a concern and important consideration and requirement everytime we rig to save a life.

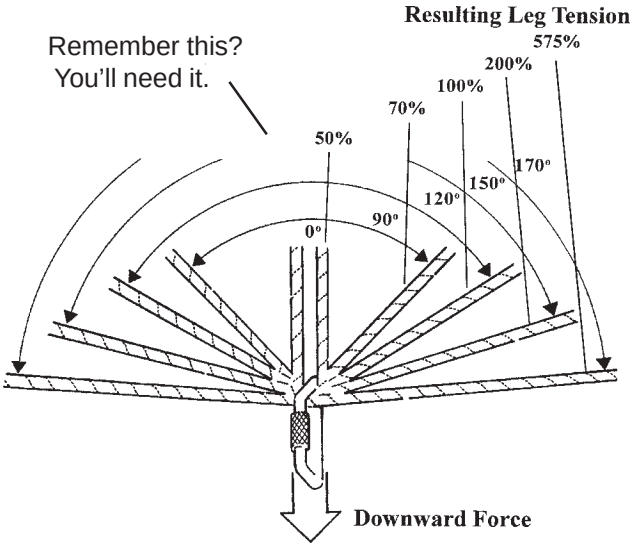
- NFPA asks that we complete a physical and visual check, and verbally confirm that all safety checks have occurred.
- We need to ensure that each element that is to be life loaded, be checked to ensure it is locked, or of the proper size and has a Safety Factor that complements the goals of the situation.

  e.g. An NFPA G rated pulley hs a 36 kN rating. If 1 kN is to be suspended from this pulley, the Safety Factor would be 36 : 1 -- Right?

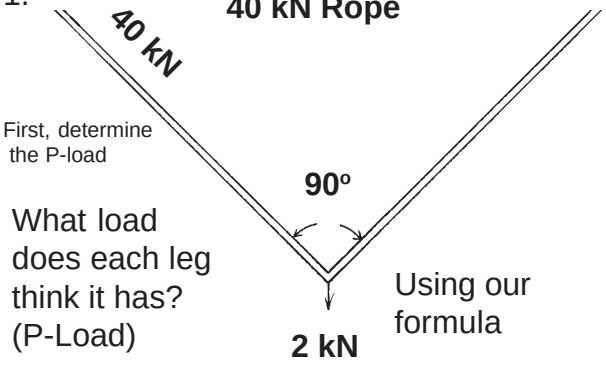
- Critical angles are not so intuitive. Here is a new way to look at solving this part of **"What's happening when we rig?"**

Safety Factor = All you've got (support strength) / Perceived Load (P-Load)

{P-Load is the load your rig thinks you have}



1.



First, determine the P-load

What load does each leg think it has? (P-Load)

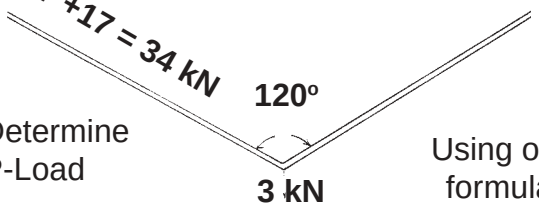
Using our formula

2 kN x 70% = 1.4kN

$$\frac{40}{1.4} = 28.5 : 1$$

2.

W3P2 w/1" tubular webbing



Determine P-Load

Using our formula

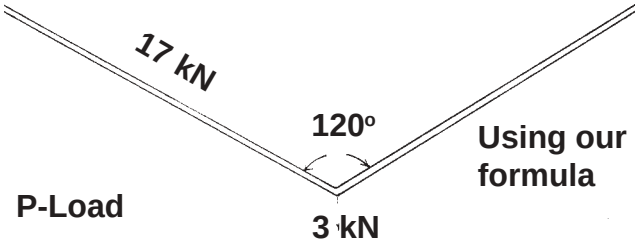
3 kN X 100% = 3kN

$$\frac{34}{3} = 11.33 : 1$$

More Safety Factors on the Critical Angle

3.

W2P1 w/1" tubular webbing



Using our formula

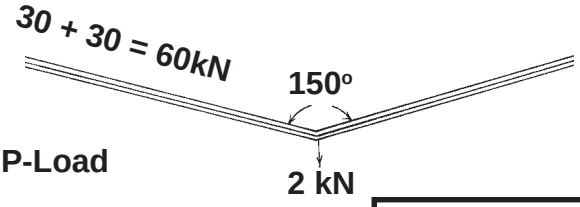
P-Load

3 kN x 100% = 3 kN

$$\frac{17}{3} = 5.67 : 1$$

4.

Double Rope High Line w/ 30 kN rope



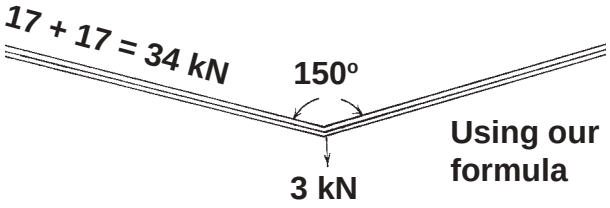
P-Load

2 kN x 200% = 4 kN

$$\frac{60}{4} = 15 : 1$$

5.

W3P2 w/ 1" tubular webbing



Using our formula

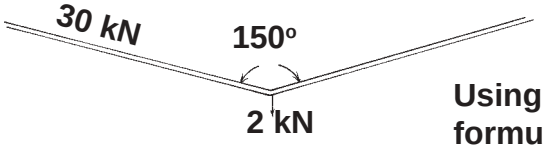
P-Load

3 kN x 200% = 6 kN

$$\frac{34}{6} = 5.7 : 1$$

6.

Single rope High Line w/30 kN rope



Using our formula

P-Load

2 kN X 200% = 4kN

$$\frac{30}{4} = 7.5 : 1$$

7. **40 kN Rope**

Knot 2/3 X 40 kN = 26.7 kN

$$\frac{26.7}{2} = 13.3 : 1$$

Biner $\frac{40}{2} = 20 : 1$

Pulley $\frac{36}{2} = 18 : 1$

Critical Angle

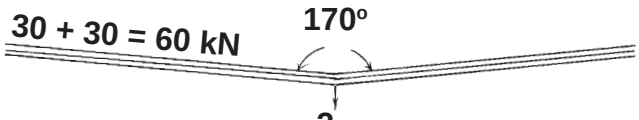
P-Load **0° = 50%**

2 kN x 50% = 1 kN

$$\frac{40}{1} = 40 : 1$$

Safety factor identifies with the weakest link--- In this case, The Knot!

8. **Double High Line w/30 kN rope**



P-Load

2 kN x 575% = 11.5%

Using our formula

$$\frac{60}{11.5} = 5.2 : 1$$

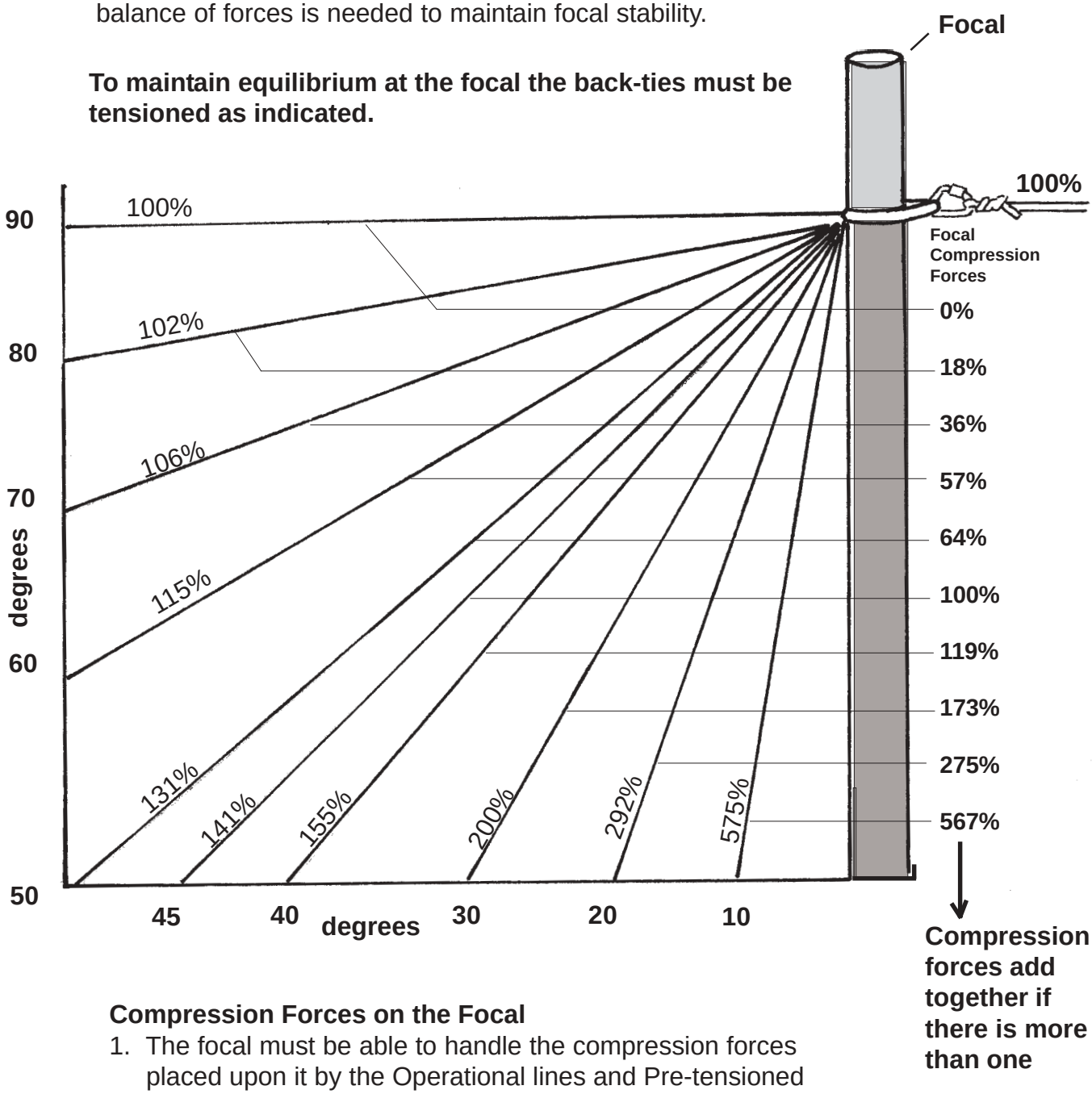
Note: The ultimate safety factor will be lowest of all the individual components--the weakest link so-to-speak. But here is a way to determine a not so intuitive elusive link that is not always obvious. If you're not sure of the angle, get a **goniometer.**

Bonus Page

Pre-tensioned Back-tie Forces and Compression Forces

The steepness of the pre-tensioned back-tie determines its necessary force. Low angle = low forces, steep angle = high forces. This balance of forces is needed to maintain focal stability.

To maintain equilibrium at the focal the back-ties must be tensioned as indicated.



Compression Forces on the Focal

1. The focal must be able to handle the compression forces placed upon it by the Operational lines and Pre-tensioned back-ties.
2. **"Focals in space"** have no compression forces to worry about. Orbs provide the opportunity for clean Focals in space.