Vector Forces Calculation Guide

User's Manual

Includes explanations and examples on
anchors, directionals, and
slope factors and loads
for your VFCG

SARINZ
SEARCH AND RESCUE INSTITUTE NEWZEALAND
Helping others save lives

Introduction

Scenario: Its 2am and you have been on a rescue mission for several hours. You have been given a tough rigging assignment. The stretcher is going to be arriving in half an hour. Not only do you have a time limitation you also have a site that is going to challenge your rigging ability. Just before the stretcher reaches your rigging site you undertake a quick analysis of the anchors, directions and slope forces to make sure that your system has a suitable safety factor.

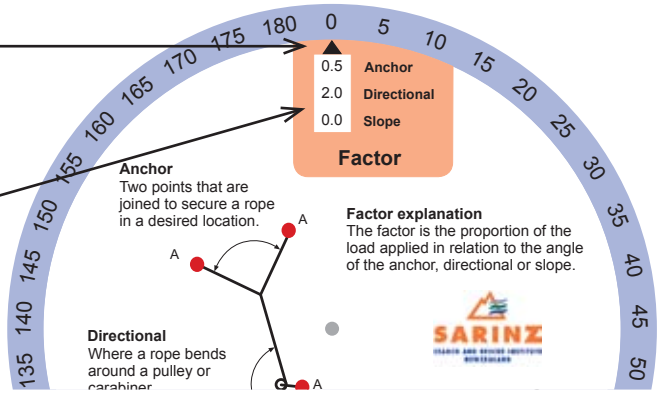
The purpose of this tool is to increase your knowledge of the forces in rigging. As rescuers, in charge of the patients and other rescuers lives, you need only use small part of your overall knowledge and skill so the work you undertake is relatively easy. In the field during a real operation you use a set of simplified information based on a wider knowledge base.

This information needs to be supplemented with regular practice, training from an instructor who has a passion for rope rigging, testing of the system you are using and experience in the application of sound techniques.

How the VFCG works

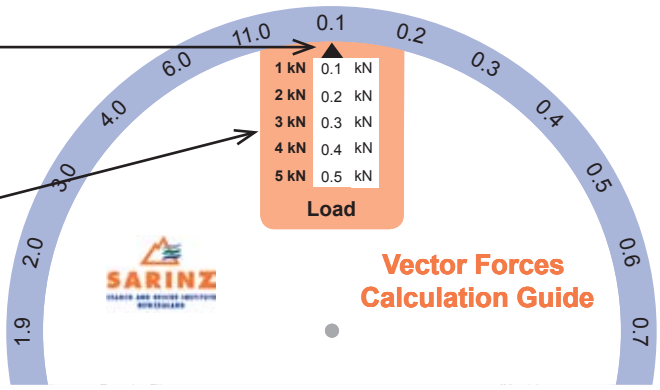
Side One Factor Calculator

1. Line up the black arrow with the angle on the outside of the wheel.
2. Read the anchor, directional or slope factor from the window.
3. Go to side two.

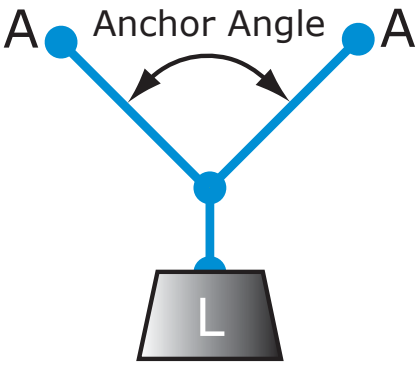


Side Two Load Calculator

1. Line up the black arrow with the factor (from side one) on the outside of the wheel.
2. Choose the load and read the result from the window.



Anchor Vector Forces



An anchor can be two or more points such as side by side snow stakes. This type of anchor is called marginal where one anchor by itself is not able to sustain the load plus additional margin.

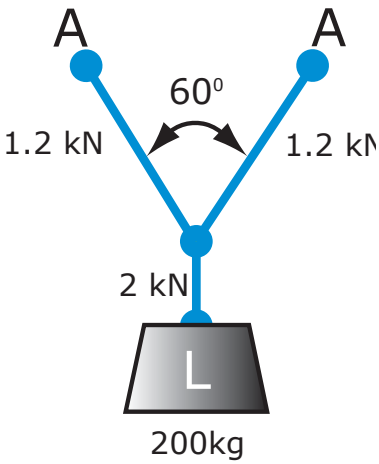
When two side by side marginal anchor points are focused (joined together by rigging) they form between the legs what is called an anchor angle. Understanding what effect the angle has on the loading of marginal anchors is critical. Generally as the anchor angle increases there is a subsequent increase in the load on each leg.

The proportion of the load, as a relationship to the anchor angle, on each leg is expressed as a factor.

Example

Question

For a 60^0 anchor angle and a 200kg load what is the force on each leg of the anchor?

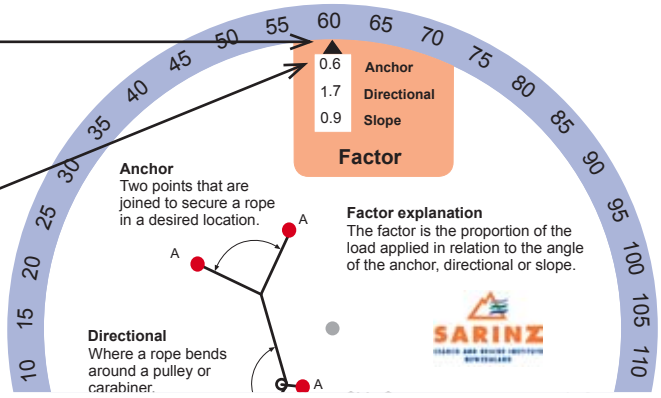


Answer

1.2 kN

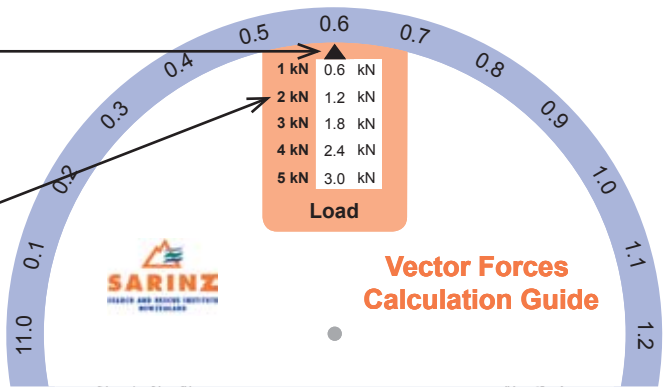
Side 1 Factor

1. Line up the black arrow with 60^0 angle on the outside of the wheel.
2. Read the anchor factor from the window - 0.6
3. Go to side two.



Side 2 Load

1. Line up the black arrow with the factor 0.6 (from side one) on the outside of the wheel.
2. The load is 2kN and force on each anchor leg is 1.2 kN.



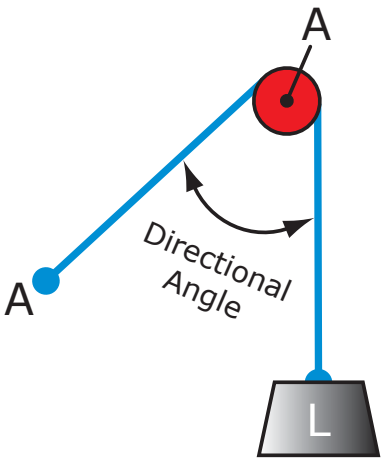
Directional Vector Forces

A directional is created where the rope bends around a pulley or a carabiner.

A directional is used in a rigging system to move the rope around an object, holding the rope above an edge and holding the rope in a particular alignment or fall line to prevent pendulum and allow easier travel for personnel.

The directional angle can range from 0^0 through to 180^0 and will indicate if the force applied to the directional anchor will increase, decrease or stay the same compared to the load.

The proportion of the load, as a relationship to the directional angle, on the directional anchor is expressed as a factor.



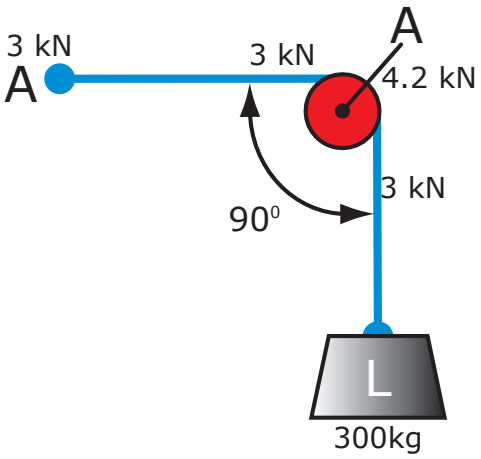
Example

Question

For a 90^0 directional angle and a 300kg load what is the force on the directional?

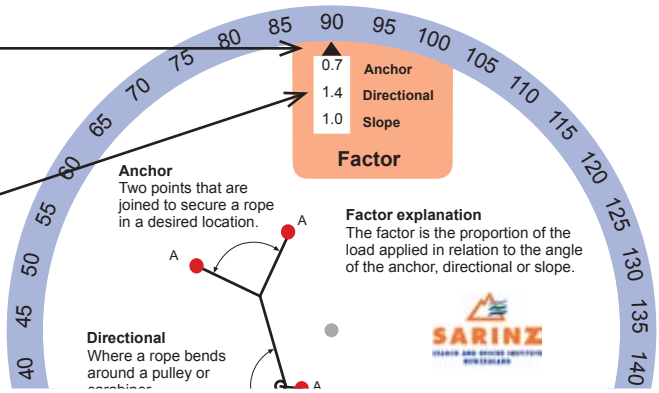
Answer

4.2 kN



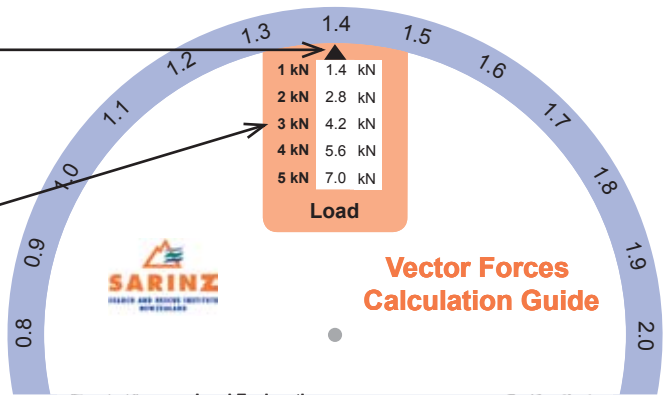
Side 1 Factor

1. Line up the black arrow with 90^0 angle on the outside of the wheel.
2. Read the directional factor from the window - 1.4
3. Go to side two.



Side 2 Load

1. Line up the black arrow with the factor 1.4 (from side one) on the outside of the wheel.
2. The load is 3kN and force on the directional is 4.2kN.



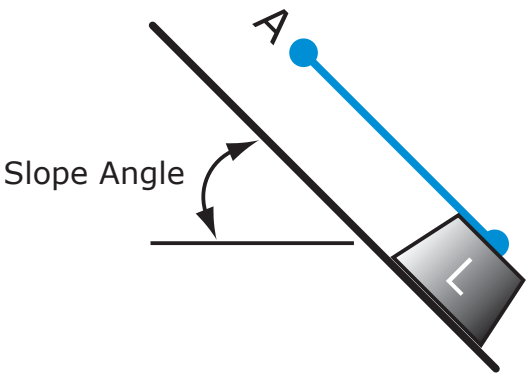
Slope Vector Forces

A slope is part of a hill or mountain with a particular incline.

The slope can range from 0 degrees (flat) though to 90 degrees (vertical).

At 0 degrees there is no load on the system. At 30 degrees there is half the load on the system. At 90 degrees all the load is being applied to the system. We can deduce that with an increasing slope angle with the same sized load we get increasing load on the rope system and decreasing load on the attendants of a stretcher.

The proportion of the load, as a relationship to the slope angle, on the system is expressed as a factor.



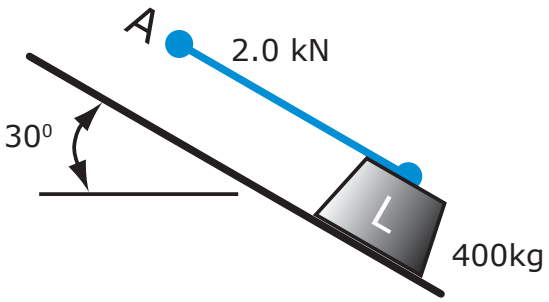
Example

Question

For a 30^0 directional angle and a 400kg load what is the force on the system?

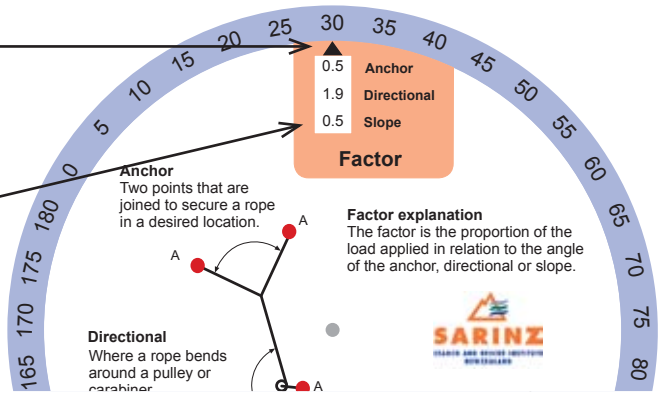
Answer

2.0 kN



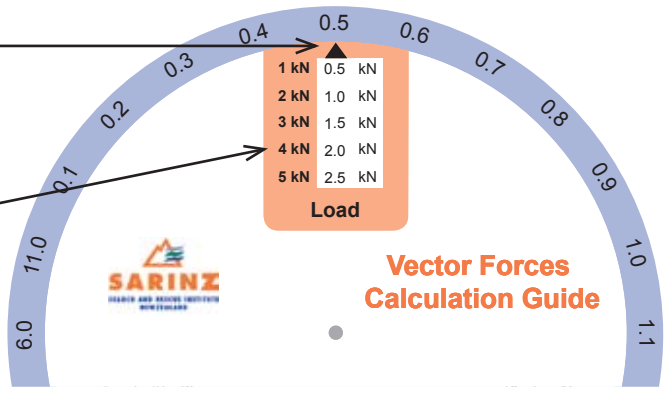
Side 1 Factor

1. Line up the black arrow with 30^0 angle on the outside of the wheel.
2. Read the slope factor from the window - 0.5
3. Go to side two.



Side 2 Load

1. Line up the black arrow with the factor 0.5 (from side one) on the outside of the wheel.
2. The load is 4 kN and force on the system is 2.0 kN.



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PO Box 39067
Harewood
Christchurch, New Zealand
Phone +64 3 359 7669
Fax +64 3 359 7689
www.sarinz.com

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SEARCH AND RESCUE INSTITUTE NEWZEALAND

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