

Friend Design Basics

The following information is meant to give an overview of how and why cams do what they do and the relevance of this to the design of Friends and the usage of Friends and cams in general. It's not the most simple subject so don't worry if you don't understand it first time; Ray Jardine actually was a rocket scientist and it took him a few years...just read it again, but it is worth it...

Friction and Angles

If you place a ladder against a wall you don't need to be a rocket scientist to know that if the angle at which the ladder makes contact with the ground is too big, the foot of the ladder will skid away and you will fall. Friction is what keeps the ladder in place. You can verify this by taking a plastic ruler and leaning it against a wall. The angle between the ruler and the surface you place it on can vary but there is a point beyond which the ruler will always slip.

This device will hold in a parallel sided granite crack, but only if the rods are placed within the 18° angle we have measured - see Fig.1

The material that the ladder - or ruler - is made from, and the surface it is placed on are important. A wooden ladder on a concrete path should not be much of a problem but if an aluminium ladder were used on a polished marble floor you would need to be much more careful. There is less friction between aluminium and polished marble than between wood and concrete: a rubber tipped aluminium ladder would be much safer.

To measure the degree of friction between two materials - take for instance aluminium and granite, a block of aluminium is placed on a slab of granite. The granite slab is then tilted until the aluminium block starts to slide. The angle of tilt is measured and found to be 18° .

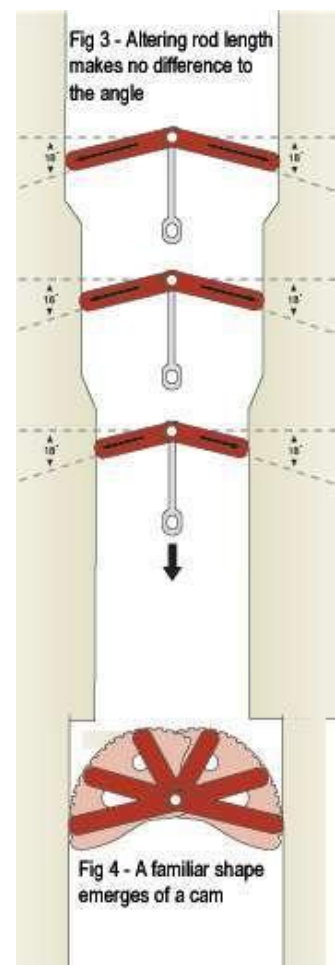
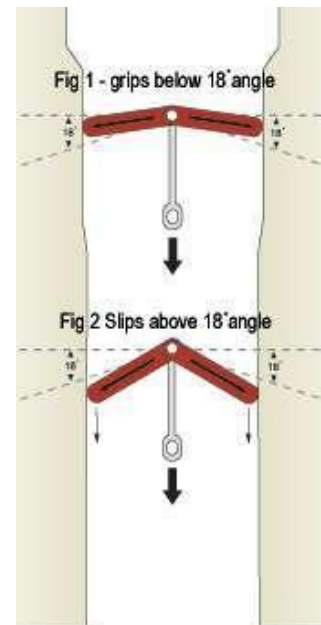
Using this information a device can be made that will illustrate how the angle of contact is critical, - to stay within the friction limit and which will hold in a parallel granite crack. Two rectangular alloy rods are bolted together so that they pivot. For convenience a handle is added to pull on. Aluminium alloy is used because it is strong, lightweight and has better frictional properties than other strong materials.

However just as the ladder will slip if the angle is too great, so also will the aluminium rods slip against the side of the crack if the angle of contact is more than 18° . - see Fig.2.

(We use this principle when stemming a very wide chimney. Climbers can press at a steeper angle because they have rubber-soled shoes.

This device would have limited use as climbing protection as it would only fit one size of crack - but the concept can be developed to fit a variety of crack widths by using several pairs of rods of different lengths - See Fig 3 to the left.

If these rods are fanned out, a familiar shape emerges - that of a cam - see Fig.4 to the left.



Designing the Perfect Cam.

A cam, as used in engineering, is any roller with an asymmetrical shape. What the climber needs is a constant angle cam - a cam that always meets the side of the crack at the same angle.

See Figure 5 below which illustrates this perfectly - in effect replicating the effect of changing the length of rods as shown in diagrams 3 and 4 - without changing the camming angle.

So what is the perfect camming angle? To answer this question one needs to go back to the friction test. Aluminium slips on granite at 18° but if this angle were used the device would be at its absolute limit of friction in a parallel granite crack and would not work in a flared placement or in say, a limestone crack. The angle needs to be reduced a little.

Ray Jardine originally used 15° on his prototype Friends, which was good on granite, the rock he was familiar with, but didn't work as well in some rock types he climbed on in Britain in 1977. After much testing, Ray and Wild Country decided on 13.75° , an angle that worked well on most rock types and allowed for use in quite flared cracks in such rock as granite and gritstone.

Wild Country has never needed to change this angle, which has become internationally acknowledged as the definitive camming angle.

Turning An Angle into a Piece Of Pro

Having designed the perfect cam we need to make a workable piece of protection. A device using two constant angle cams rather than the two rods as used in the first prototype would be very unstable - the slightness of the contact point would mean it would easily rotate and fall out. Thus one of the guiding principles of the original Friends' design was to make it stable....

Stability

Therefore, Friends were designed with four cams, balanced about a central point, which offer much greater stability at rest in the same way that the four wheels arranged on a car are much more stable than the two wheels of a motorbike.

If a bike is not held up it will fall over....a car will not.

The width between the cams also plays a key role in this stability - compare a wide sports car with a narrow van, which is more likely to topple over. Therefore as part of the design of Friends the cam spacing increases proportionately with the cam size, ensuring maximum stability throughout the range of sizes.

This becomes increasingly important in the very big sizes when any loss of width can be seen to affect the placements more radically and more quickly...and this is recognised about the Friend.

"The most impressive feature (Technical Friends 5 & 6) is the cam's broad axle. Combined with its stout cam springs and unique tensioned trigger stop, this cam has unequalled stability --- once placed , they stayed put. I liked to place these solidly built beauties more than any other unit I tested."
Jonathan Thesenga, Climbing 183.

