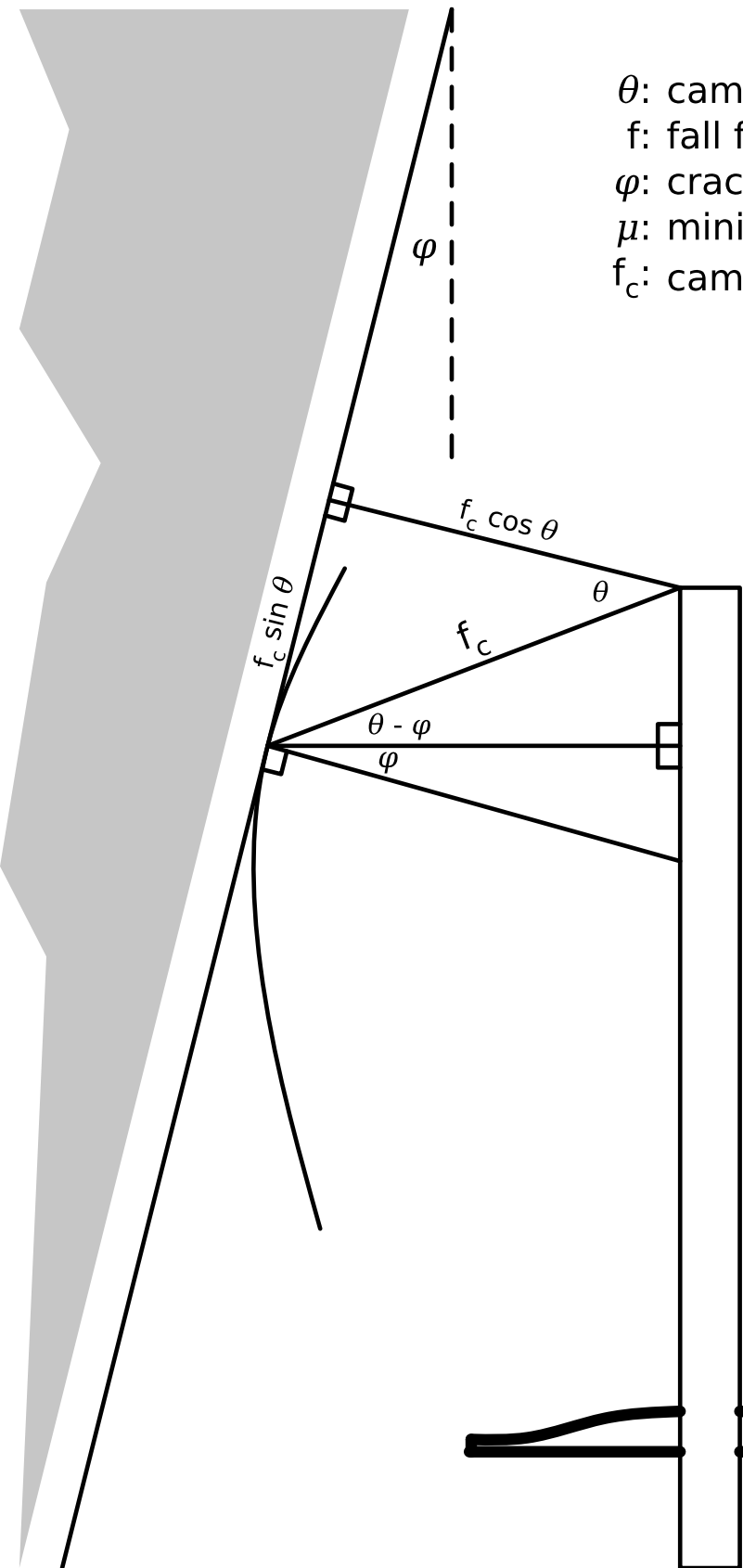


Cam Force Diagram

Force diagram for a cam in a symmetrical vertically flaring crack



- θ : camming angle
- f: fall force
- φ : crack flare angle
- μ : minimum coefficient of friction
- f_c : cam force (per crack side)

$$f_c \sin \theta = \mu f_c \cos \theta$$

$$\mu = \tan \theta^*$$

$$2 f_c \sin(\theta - \varphi) = f$$

(2 b/c crack has two sides)

$$f_c = f / (2 \sin(\theta - \varphi))$$

For typical camming angles, about twice the supported force is exerted on the sides of a parallel crack. Higher forces are needed in flaring cracks.

* Theoretical minimum coefficient of friction for cam to hold. Caveats from cam manufacturers: cam may grind soft rock surfaces into dust and skate out on that dust layer. (That is why Fat Cams exist.) Also, in a flare, if the cam loses contact with the rock and is pulled out fast enough, it may never reestablish contact.