Force diagram for a cam in a symmetrical vertically flaring crack

\( \theta \): camming angle  
\( f \): fall force  
\( \varphi \): crack flare angle  
\( \mu \): 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)

\[
f_c = \frac{f}{2 \sin(\theta - \varphi)}
\]

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.