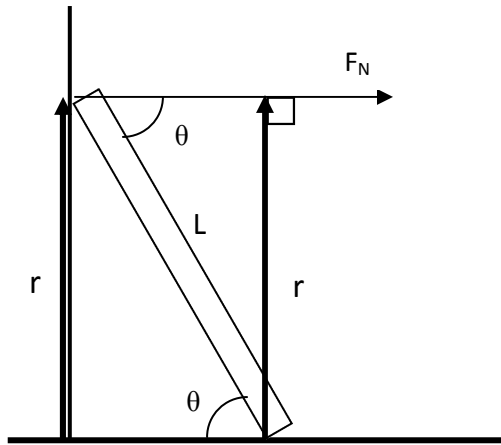Moment Arm explained for Torque of the Normal Force on a Ladder



Torque = perpendicular force times distance: $\tau = F_\perp d$.

Or, torque = perpendicular distance times force: $\tau = d_\perp F$.

They are equivalent. This perpendicular distance is known as the "moment arm". The moment arm is found by drawing the force as an infinitely long line and then finding the distance perpendicular to this line. Which definition of torque should be used? Which one is easier? It is that simple.

In this example the torque provided by the normal force ($F_N$) equals the force times the moment arm. The moment arm = $L\sin\theta$. (Notice the equal interior angles.) It also turns out that in this case the moment arm $r_\perp$ is the same as the distance from the ground to where the ladder touches the wall. Therefore, $\tau_{wall} = F_N L\sin\theta$.