**Tipping in the roll direction**

* This decision is directly informed by our requirement which states that the chair is able to roll over an obstacle of 30cm with one wheel without tipping (b = 0.3m).
* For a standard wheelchair the tipping roll angle can be found from a FBD with all of the weight on one wheel.
* The wheelchair tips when center of mass is vertical above the point of contact.
* This occurs when (1), where
  + e is the horizontal distance from the contact wheel to the center of mass
  + h is the vertical distance from the ground to the center of mass
  + ϕ is the roll angle from vertical
* The angle of the chair over a bump of size b is also a function of the width of the chair, 2e. (2)
* Combining equations (1) and (2), it follows that
* Given that the wheel diameter is 26” (66cm) and the center of mass is estimated to sit at 0.75\*66 = 49.5cm above the ground, h = 49.5cm.
* Plugging in the previously stated values for b and h and using an equation solver gives e = 0.26m.
* Assuming that the COG is in the center of the width of the chair, 0.26\*2 = **0.54m** is the minimum wheel width of our device to meet the established tipping requirement.
* 0.7m is chosen for comfort. This calculation also shows that tipping - a high severity failure mode - is of sufficiently low likelihood

**Footplate Dimensions**

* 14” width, taken as the average value between GRIT chair (11.5”) and the footplate width needed for big feet (19.5”).
  + <https://chairinstitute.com/grit-freedom-chair/>

**Tipping backward**

* This decision is directly informed by the requirement which states that the front caster should be able to be li