The basket will separate from the main body of the robot and go down the zipline individually. In order to do this, the basket will be raised until the clip-on supports are pushed against the zipline. (These supports will cover about 8 inches horizontally, which is more than enough to deal with the 5 inches the zipline will move sideways in the 6 inches of length of our basket: the tendency for the zipline to move toward the center creates room for geometric error.) As the zipline is pressed against the supports, they will bend backwards until the zipline moves between them, and then spring back into place. (The supports will have a default position determined by the actual shape of the supporting blocks.) The springs will hold the supports so that when the basket raising mechanism is lowered, the zipline cannot fall through the supports. Finally, since the supports are mounted on bearings (low friction), the downward slope of the zipline (as well as the comparatively light weight of the basket, which stops the zipline from bending significantly) will cause the basket to be carried into the safe zone by gravity.

Estimate (a worst-case scenario estimate):

Estimate :

Taking moments about the rotation pin and assuming that the moment from FN = 0 (very short perpendicular distance):

When the basket is on, the spring actually doesn’t have to pull at all. The force will go into the support and then pin instead, of the order of about 100 N. Given aluminum’s yield strength of 43 MPa, the area has to be less than 0.24 mm2 to cause problems: in the current model the area of contact is over 10 mm2.

Now assuming that (for the case where the zipline is not yet on the basket):

This indicates that the spring needs to apply at least 11 N of force to lift the zipline roller: 30 N is probably advisable in order to allow the mechanism to spring back into place quickly: since the spring can be easily changed we don’t go deeply into this calculation here.

The force on the second spring doesn’t need to be very large to counteract rotation when the basket is on the zipline, as the perpendicular distance from the spring to the lower rotation axis is much larger than the distance for the normal force applied by the rod. Since this normal force is on the order of 100 N, we can estimate that the minimum required force for the second spring is about 20 to 30 N, although higher forces will allow the mechanism to spring back faster.

It is also important that the springs not be too strong, or the lifting mechanism will not be able to push the supports through the zipline. This will be more easily tuned using real springs once the assembly is built, but the forces seem to be small enough to be manageable with a DC motor.