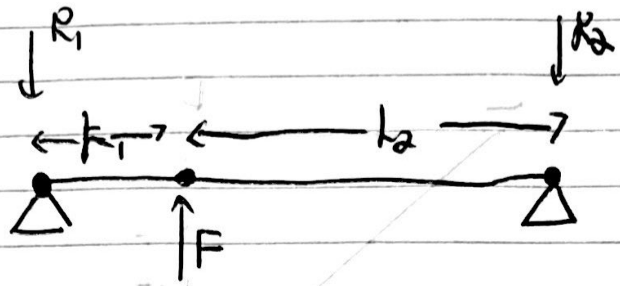
Q1.



$\Sigma F_x = 0$

$\Sigma F_y = 0 \qquad F - R_1 - R_2 = 0 \qquad ①$

$\Sigma M_{R_1} = F \cdot L_1 - R_2 \cdot L_2 . \qquad ②$

2 Eq & 2 unknown.

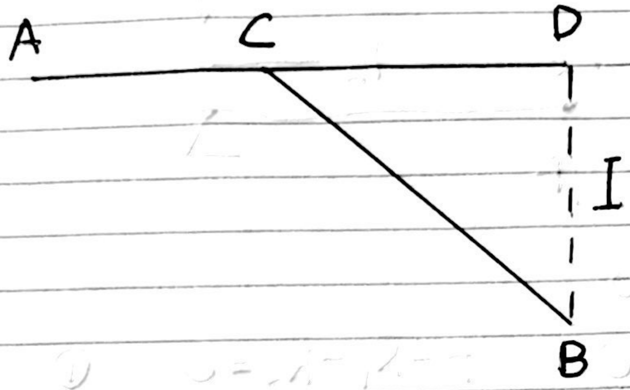
$L_2 R_2 = F \cdot L_1$

$\left[R_2 = \frac{F \cdot L_1}{L_2} \right]$

$\left[F - \frac{F \cdot L_1}{L_2} = R_1 \right]$

Scanned with CamScanner

Q2



Assume velocity r

$$t = \frac{AD - CD}{r} + \frac{CB}{r\frac{1}{n}}$$

$$CB = \sqrt{CD^2 + I^2}$$

$$t = \frac{AD - CD}{r} + \frac{\sqrt{CD^2 + I^2}}{\frac{1}{n}r}$$

Take derivatie write respect

$$0 = \frac{d}{dCD}\left(AD - CD + \frac{\sqrt{CD^2 + I^2}}{\frac{1}{n}}\right) \quad r \text{ cancels out.}$$

$$= -1 + n \cdot \frac{1}{2}(CD^2 + I^2)^{-\frac{1}{2}} \cdot 2 \cdot CD$$

$$= -1 + n \cdot (CD^2 + I^2)^{-\frac{1}{2}} \cdot (CD)$$

$$CD = \left[\left(I \cdot \sqrt{(n-1)(n+1)}\right) / (n^2 - 1)\right]$$

Scanned with CamScanner

Question Two

```
syms CD I n

b = -1 + n*(CD^2 + I^2)^(-1/2) * (CD) ==0;
pretty(solve(b,CD)) %Solves for the differentiated equation and ouputs
 in pretty form
```

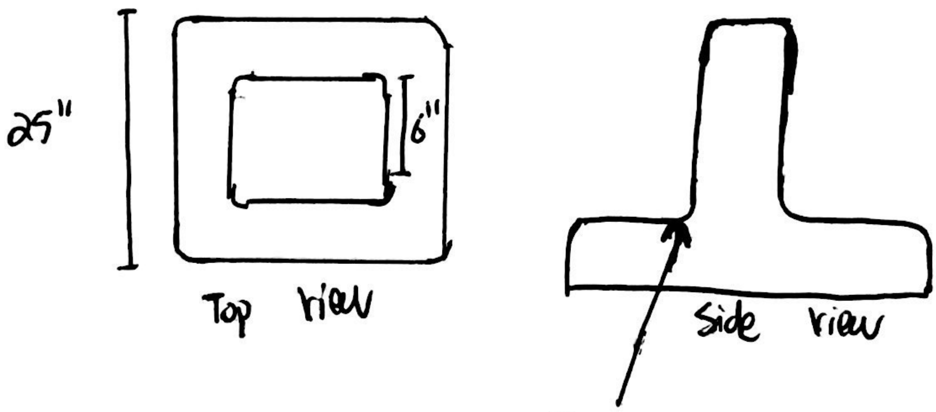
```
Warning: Solutions are valid under the following conditions: (n^2 -
 1)^2 + (n -
1)*(n + 1) ~= 0 & I ~= 0 | n == -1 | n == 1;
(n^2 - 1)^2 + (n - 1)*(n + 1) ~= 0 & I ~= 0 | n == -1 | n == 1. To
 include
parameters and conditions in the solution, specify the
 'ReturnConditions' value
as 'true'.
/  I sqrt((n - 1) (n + 1))  \
|  -----------------------  |
|            2              |
|           n  - 1          |
|                           |
|   I sqrt((n - 1) (n + 1)) |
| - ----------------------- |
|             2             |
\            n  - 1         /
```

Published with MATLAB® R2019a

Q3. Under the following constraints:

1. similar mass
2. shoulder bolt position the same, therefore <u>no height</u> changes.
3. move connection point A & B only

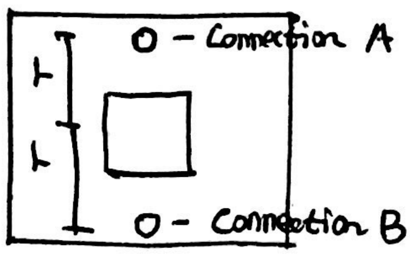
1. The edges must be rounded since the entire machine is CNCed out of shape. The fillet radius depends on the tool radius.



Important as sharp corners concentrate stress. The corner with fillet decreases stress concentration.

2. Connection A in this case does not provide any support against the moment. To maximize fixed support effectiveness:

This maximize the fixed support effectivness.

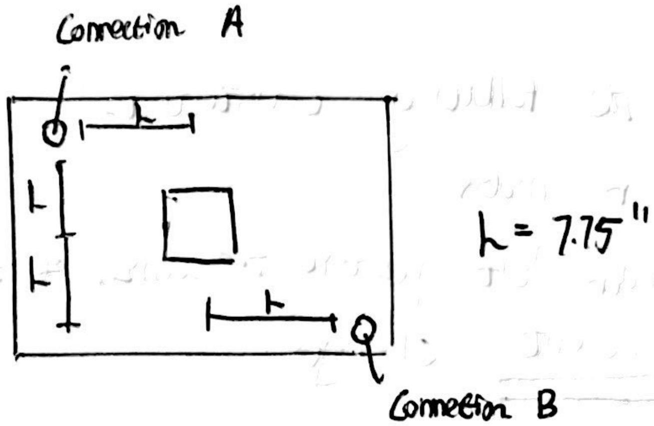


$L = 7.75''$

Scanned with CamScanner

Q5

In ~~additn~~ addition



This configuration maximize moment bearing capability in all directions.

Question 4

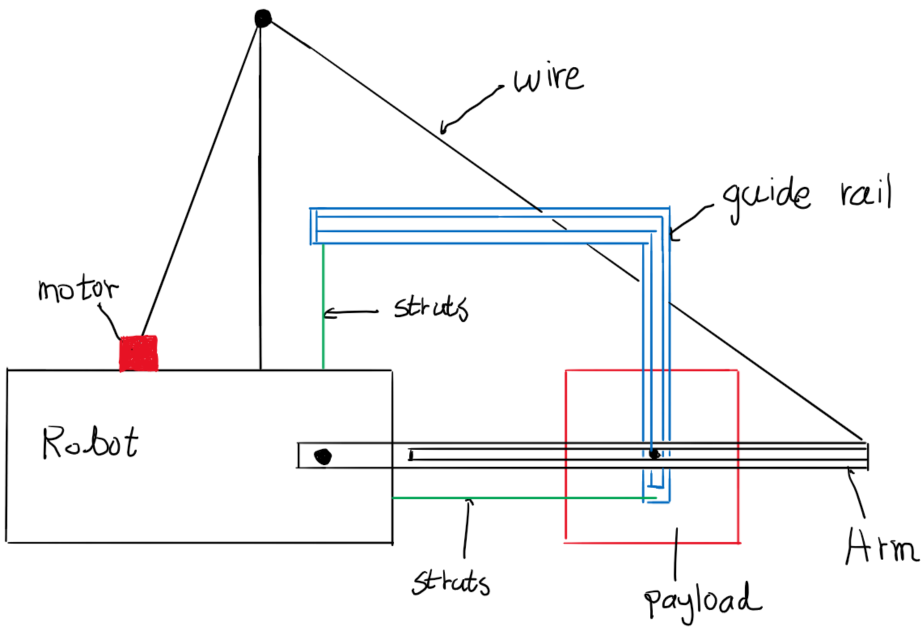


Figure 1 Side View

The attachment mechanism that I developed employs a guide rail that helps to keep the module to move in one direction at a time. As the arm rotates, the empty slot within the robotic arm allows the payload to slide and move in the direction of the guide rail. From a global perspective, the payload would first move up then move left towards its designated retracted position.

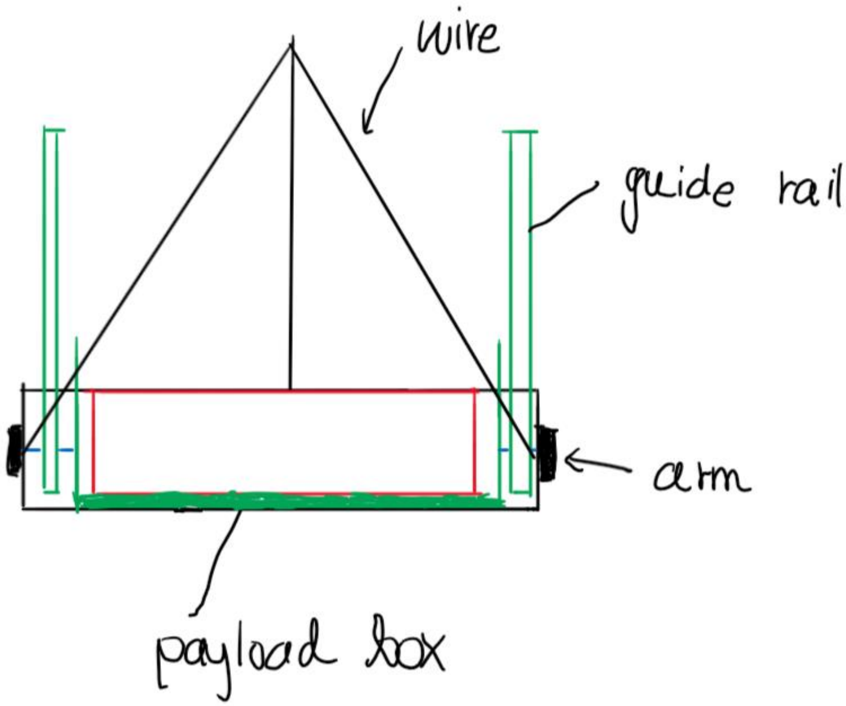


Figure 2 Front View

One component that I did not employ in the side view of the mechanism (to avoid confusion) is the payload box. The box carries the module and allows it to sit firmly as the arm rotates up and down. Once the arm reaches the bottommost deployment position, the robot could drive away, allowing the module to be fully deployed. To retrieve the module, one simply has to slide the bottom surface of the box under the module and activate the robot arm.

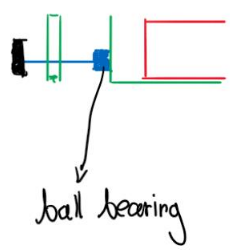


Figure 3 Connection Mechanism

The blue line depicted in Figure 2 symbolizes the connection mechanism that connects the robot arm to the payload deployment box. In Figure 3, the mechanism is magnified. The ball bearing is a critical component of the system as it allows the payload box to stay upright as the arm rotates.

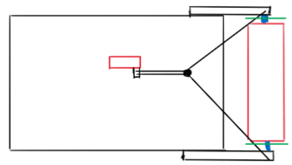


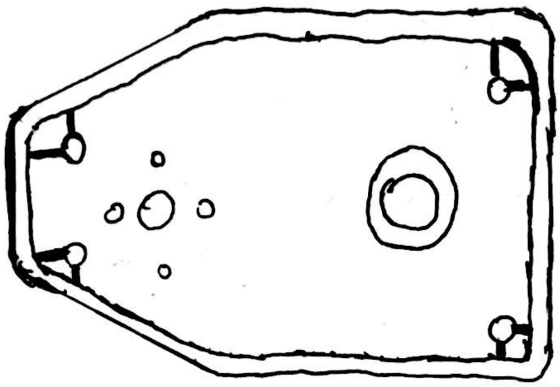
Figure 4 Top View

Figure 4 demonstrates the top view of the attachment mechanism. The robotic arm is actuated by a motor (drawn in red on the robot itself) that is placed sideways, and the two strings tied to the motor could lift and lower the robotic arm as controlled by the operator.

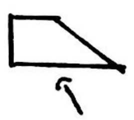
25

a) Injection molding could be used to manufacturing the said part.

However, the following adjustments should be made:



All edges that are ~~90° angle / st~~ suddenly transitioned need to be well rounded. Holes should be separated from the wall ~~border~~ in order to have constant thickness → ~~constant~~ better cooling characteristics. Rib support for holes are preferable. The walls on the outside have to be chamfered, meaning a slight slope extend outwards



chamfered wall.

This allows for better ejection characteristics.
The wall on the outside could also be hollowed out and replace with ribs internal structure. However it is too thin and therefore not recommanded.

b) Plastic Injection Molding are used quite commonly to ~~accomodate~~ manufacture complex shape such as gear boxes. ~~It pro~~ Once the mold is complete, the gear box could be mass manufactured with relative ease and low cost. Perfect for robots that are to be deployed in many homes across the country.

The hardest part about injection molding is manufacturing the mold. By including the fixes that I mentioned above, the mold could be CNCed out of shape.

Scanned with CamScanner