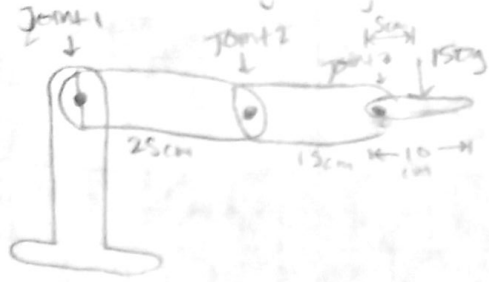
Robot Arm Engineering Analysis



Moment From Force

Assumptions:
- Weight of arm is 0
- Joints in one straight line
- No weight from servos

1kg → 9.8N
150g → 1.47N

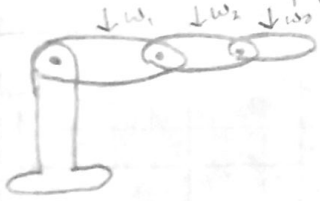
Objective:
- Find the torque acting on each joint just from the weight
- Find the Max stress and shear on each link from the weight

Joint 3
1.47N
5cm
$M_3 = 1.47N \times 5cm$
$= 1.47N \times 0.05m$
$M_3 = 0.0735\ N \cdot M$

Joint 2
1.47N
15cm
5cm
$M_2 = 20cm \times 1.47N$
$M_2 = 0.294\ N \cdot M$

Joint 1
1.47N
6cm
12cm
15cm
45cm
$M_1 = 45cm \times 1.47N$
$M_1 = 0.6615\ N \cdot m$

Moment From Link Weight



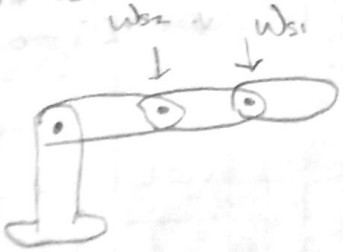
Find Equations for the Moment with Weights as Variables

Joint 3
$M_3 = W_{L3} \times 5cm$

Joint 2
$M_2 = 7.5cm \times W_{L2} + 20cm \times W_{L3}$

Joint 1
$M_1 = 12.5cm \times W_3 + 32.5cm \times W_2 + 45cm \times W_3$

Moment From Servo Weight



Joint 2
$M_2 = 15cm \times W_{S3}$

Joint 3
$M_1 = W_{S3} \times 40cm + W_{S2} \times 25cm$

Necessary Torque:

Joint 3:
$\tau = 7.35\ N \cdot cm + W_{L3} \times 5cm$

Joint 2:
$\tau = 29.4\ N \cdot cm + 7.5cm \times W_{L2} + 20cm \times W_{L3} + 15cm \times W_{S3}$

Joint 1:
$\tau = 66.15\ N \cdot cm + W_{S3} \times 40cm + 12.5cm \times W_3 + 32.5cm \times W_2 + 45cm \times W_3 + W_{S2} \times 25cm$