ENGRD 2020 H.W. 5 LABHYA MEHTA (lm946)

COLLABORATION STATEMENT:

I worked with Lisa and attended Akula's office hours.

PORTFOLIO

Given a 2D design space of 150cm long and 50cm tall, a rigid bar of a fixed length (your choice), 3 pin supports of which two need to be mounted on the ground and a linear actuator (pick from this online catalog, use max force values only), design a frame/mechanism to lift the maximum possible weight to the highest possible height. Assume all the supports and bar/actuator are rigid.

OBJECTIVE: Design a mechanism within a 150 cm x 50 cm space using a rigid bar, 3 pin supports (2 fixed on the ground), and a linear actuator to lift max weight to max height.

ASSUMPTIONS:

(i) The bar is rigid (L = 140 cm)

(ii) The pins are perfect hinges with no friction or backlash

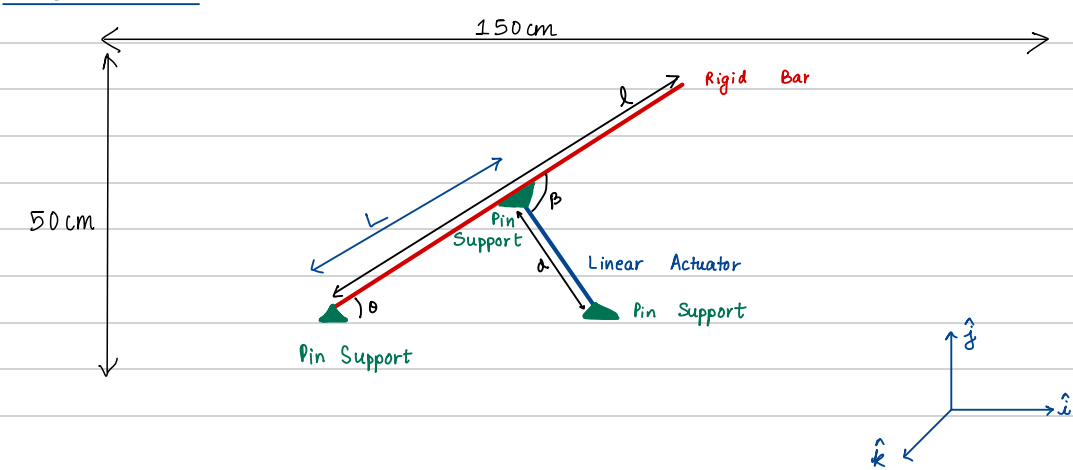
(iii) The weight rests on the bar with friction coefficient μ_s

(iv) No additional platforms or fixtures are used

(v) The bar is tied to the bar so it doesn't fall to the ground when the bar is lifted.

(vi) $\beta = 90^\circ$

CONCEPT DESIGN:



Length of the bar = 140 cm = 1.4m

Actuator Used: IMA55

Peak Thrust = F_{max} = 35.81 KN = 35 810N

Maximum tilt angle = θ_{max}

Actuator pin distance from pivot = d = 0.80m

Actuator Stroke — 152.4mm to 457.2mm (0.152 4m to 0.4572 m)

Location of the actuator on the bar = L

CALCULATIONS:

$\sin \theta_{max} = ?$

$h_{max} = L \sin\theta_{max}$

Optimum values for θ_{max} and h_{max} found using code.

Torque Balance for W_{max}

$$W_{max} = \frac{F_{max}\, d \sin\beta}{L \sin\theta_{max}}$$

$(\sin\beta = 1)$

$\therefore W_{max} = 164621.67N$, $h_{max} = 17.4cm$, $\theta_{max} = 7.14°$