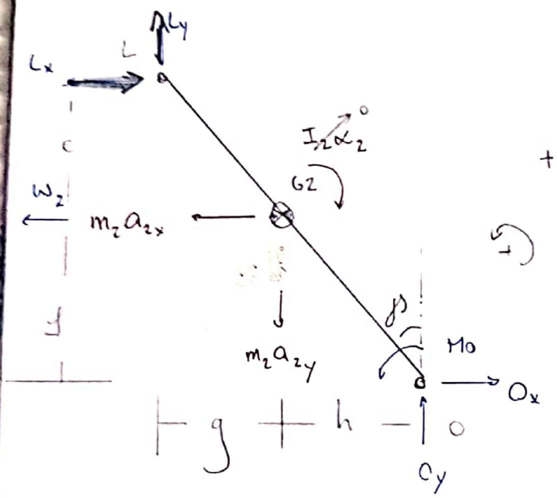
Análisis dinámico

Mo = momento

Eslabón 2



$\sum F = 0$

En x:

$$+L_x - W_2 - m_2 a_{2x} + O_x = 0 \quad (1)$$

En y:

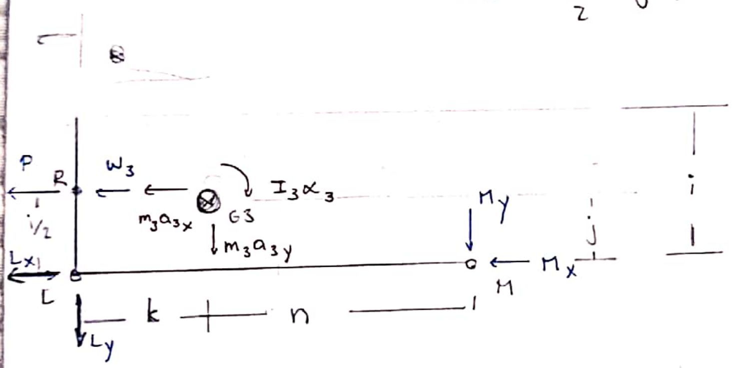
$$+L_y - m_2 a_{2y} + O_y = 0 \quad (2)$$

$$\sum M_{G2} = 0$$

$$-L_x \cdot e - L_y g + O_x \cdot f + O_y \cdot h + Mo = 0 \quad (3)$$

Eslabón 3

$R_{G3} = \frac{i}{2} - j$; Fuerza P conocida ⇒ $P = \frac{\text{peso silla} + \text{peso persona}}{2} g$



$\sum F = 0$

En x:

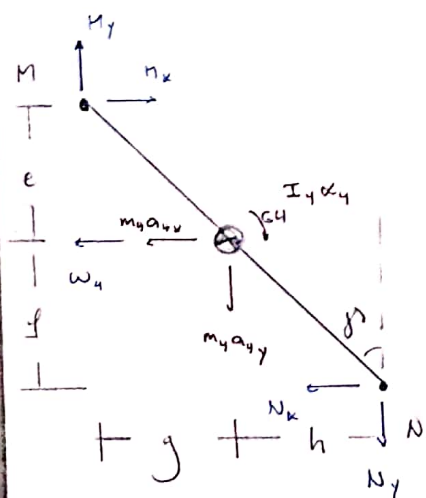
$$-P - L_x - W_3 - m_3 a_{3x} - M_x = 0 \quad (4)$$

En y:

$$-L_y - m_3 a_{3y} - M_y = 0 \quad (5)$$

$$\sum M_{G3} = 0$$

$$P \cdot \overline{RG3} - L_x j + L_y k - I_3\alpha_3 - M_y \cdot n - M_x \cdot j = 0 \quad (6)$$



$\sum F = 0$

En x:

$$M_x - W_4 - m_4 a_{4x} - N_x = 0 \quad (7)$$

En y:

$$M_y - m_4 a_{4y} - N_y = 0 \quad (8)$$

$$\sum M_{G4} = 0$$

$$-M_y g - M_x \cdot e - N_x f - N_y h - I_4\alpha_4 = 0 \quad (9)$$

Distancias

$e = f = \frac{a}{2} \cos \beta$

$g = h = \frac{a}{2} \operatorname{sen} \beta$

i = longitud rampa = 130 cm

$j =$

$k =$

$n =$

$RG3 = \frac{i}{2} - j$

Incógnitas

L_x

L_y

O_x

O_y

M_O

M_x

M_y

N_x

N_y

Conocidos

$m_2 a_{2x}$

$m_2 a_{2y}$

P

$m_3 a_{3x}$

$m_3 a_{3y}$

ω_2

ω_3

$\omega_4 \Rightarrow \omega_2 = \omega_4$

Despeje.

(A) Con las ecuaciones de los eslabones 3 y 4. De (7)

$$N_x = M_x - W_4 - m_4 a_{4x} \quad (10) \quad ★$$

De (8)

$$N_y = M_y - m_4 a_{4y} \quad (11) \quad ★$$

Sust. (10) y (11) en (9)

$$-M_y g - M_x e - (M_x - W_4 - m_4 a_{4x}) f - (M_y - m_4 a_{4y}) h - I_4 \alpha_4 = 0$$

$$\Rightarrow -M_y g - M_x e - M_x f + (W_4 + m_4 a_{4x}) f - M_y h + m_4 a_{4y} h - I_4 \alpha_4 = 0$$

$$\Rightarrow -M_y (g+h) - M_x (e+f) + \underbrace{(W_4 + m_4 a_{4x}) f + m_4 a_{4y} h - I_4 \alpha_4}_{o \text{ (o minúscula)}} = 0$$

$$\Rightarrow -M_y (g+h) - M_x (e+f) + o = 0 \quad (12) \quad (★)$$

De (4).

$$M_x = -P - L_x - W_3 - m_3 a_{3x} \quad (13) \quad (★)$$

De (5):

$$M_y = -L_y - m_3 a_{3y} \quad (14) \quad (★)$$

Sust. (13) y (14) en (12)

$$(L_y + m_3 a_{3y})(g+h) + (P + L_x + W_3 + m_3 a_{3x})(e+f) = -o$$

$$\Rightarrow +L_y (g+h) + m_3 a_{3y} (g+h) + L_x (e+f) + (P + W_3 + m_3 a_{3x})(e+f) = -o$$

$$\Rightarrow +L_y (g+h) + L_x (e+f) + \underbrace{m_3 a_{3y} (g+h) + (P + W_3 + m_3 a_{3x})(e+f)}_{p \text{ (p minúscula)}} = -o$$

$$\Rightarrow +L_y(g+h) + L_x(e+f) = -o - p$$

$$\Rightarrow L_y(g+h) + L_x(e+f) = -o - p \qquad (15) \qquad (\ast)$$

Sust. (13) y (14) en (6)

$$p \cdot \overline{RG3} - L_x j + L_y k - I_3 \alpha_3 - (-L_y - m_3 a_{3y})n - (-p - L_x - W_3 - m_3 a_{3x})j = 0$$

$$\Rightarrow p\overline{RG3} - \cancel{L_x j} + L_y k - I_3\alpha_3 + L_y n + m_3 a_{3y} n + \cancel{L_x j} + (P + W_3 + m_3 a_{3x})j = 0$$

$$\Rightarrow L_y(k+n) + \underbrace{p\overline{RG3} - I_3\alpha_3 + m_3 a_{3y} n + (P + W_3 + m_3 a_{3x})j}_{q} = 0$$

$$\Rightarrow L_y(k+n) = -q$$

$$\Rightarrow L_y = \frac{-q}{k+n} \qquad (16) \qquad (\ast)$$

Sust. (16) en (15)

$$\Rightarrow \left(\frac{-q}{k+n}\right)(g+h) + L_x(e+f) = -o - p$$

$$\Rightarrow L_x = \left[\frac{1}{e+f}\right]\left[-(o+p) + \left(\frac{q(g+h)}{k+n}\right)\right] \qquad (17) \qquad (\ast)$$

De (1)

$$O_x = -L_x + W_2 + m_2 a_{2x}$$

$$O_x = W_2 + m_2 a_{2x} - L_x \qquad (18) \qquad (\ast)$$

De (2)

$$O_y = m_2 a_{2y} - L_y \qquad (19)$$

De (3)

$$M_0 = L_x e + L_y g - O_x f - O_y h \quad (8) \quad (20)$$

Variables adicionales o, p, q → sólo varían con el ángulo

$$o = (W_4 + m_4 a_{4x}) f + m_4 a_{4y} h - I_4 \alpha_4$$

$$p = m_3 a_{3y} (g+h) + (P + W_3 + m_3 a_{3x})(e+f)$$

$$q = P\overline{RG_3} - I_3 \alpha_3 + m_3 a_{3y} n + (P + W_3 + m_3 a_{3x}) j$$

Cte.

$$P \text{ (fuerza)} = \left(\frac{\text{masa silla} + \text{masa persona}}{2} \right) g$$

Reacciones

$$L_y = \frac{-q}{k+n}$$

$$L_x = \left[\frac{1}{e+f} \right] \left[-o - p - L_y (g+h) \right]$$

$$M_x = -P - L_x - W_3 - m_3 a_{3x}$$

$$M_y = -L_y - m_3 a_{3y}$$

$$N_x = M_x - W_4 - m_4 a_{4x}$$

$$N_y = M_y - m_4 a_{4y}$$

$$O_x = W_2 + m_2 a_{2x} - L_x$$

$$O_y = m_2 a_{2y} - L_y$$

$$M_O = L_x e + L_y g - O_x f - O_y h$$

$$L = \sqrt{L_x^2 + L_y^2}$$

$$O = \sqrt{O_x^2 + O_y^2}$$

$$M = \sqrt{M_x^2 + M_y^2}$$

$$N = \sqrt{N_x^2 + N_y^2}$$