a) Escrevendo na forma matricial

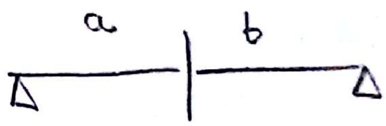
$$[M]\cdot\ddot{z} + ([C] + \Omega[G])\dot{z} + [K]z = f$$

$$[M] = \begin{bmatrix} m & 0 & 0 & 0 \\ 0 & m & 0 & 0 \\ 0 & 0 & J & 0 \\ 0 & 0 & 0 & J \end{bmatrix} \qquad [C] = \begin{bmatrix} c_{11} & 0 & c_{12} & 0 \\ 0 & c_{11} & 0 & c_{12} \\ c_{21} & 0 & c_{22} & 0 \\ 0 & c_{21} & 0 & c_{22} \end{bmatrix}$$

$$[K] = \begin{bmatrix} \alpha & 0 & \gamma & 0 \\ 0 & \alpha & 0 & \gamma \\ \gamma & 0 & \delta & 0 \\ 0 & \gamma & 0 & \delta \end{bmatrix} \qquad z = \begin{bmatrix} x \\ y \\ \theta_x \\ \theta_y \end{bmatrix} \quad \dot{z} = \begin{bmatrix} \dot{x} \\ \dot{y} \\ \dot{\theta}_x \\ \dot{\theta}_y \end{bmatrix} \quad \ddot{z} = \begin{bmatrix} \ddot{x} \\ \ddot{y} \\ \ddot{\theta}_x \\ \ddot{\theta}_y \end{bmatrix}$$

$$[F] = \begin{bmatrix} m u \Omega^2 \cos \Omega t \\ m u \Omega^2 \operatorname{sen} \Omega t \\ (J_p - J) z \Omega^2 \cos(\Omega t + \beta z) \\ (J_p - J) z \Omega^2 \operatorname{sen}(\Omega t + \beta) \end{bmatrix} \qquad [G] = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & J_p \\ 0 & 0 & -J_p & 0 \end{bmatrix}$$

b) Rotor flexível



$\therefore a = b$

↳ Rotor centrado no eixo

$$\alpha = \frac{3EJ_0(a^2 - ab + b^2)l}{a^3 b^3} = \frac{3EJ_0(a^2 - a^2 + a^2)2a}{a^3 \cdot a^3} = \frac{3EJ_0 \times 2}{a^3}$$

$$\alpha = \frac{6EJ_0}{a^3} \,// \qquad \therefore \gamma = 0 \,//$$

$$\delta = \frac{6EJ_0}{a} \,//$$

Com isso, a matriz $[K] = \begin{bmatrix} \alpha & 0 & 0 & 0 \\ 0 & \alpha & 0 & 0 \\ 0 & 0 & \delta & 0 \\ 0 & 0 & 0 & \delta \end{bmatrix}$