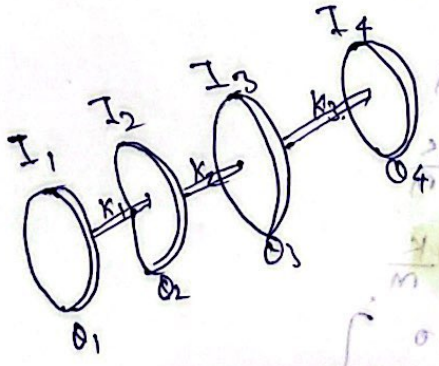
HOLZER'S METHOD :- UNIT (4)

This is Trial and error method used to find the natural frequency and mode shape of multimass lumped parameter system. This can be applied to both free and forced vibration. This method can be used for the analysis of damped, Undamped, semidefinite system with fixed ends having linear or angular motions.

First of all a Trial frequency of the system is assumed. A solution is found when the trial frequency satisfies the constraints of the system.

for example,

four disc semidefinite system, the equation of motion of the disc can be derived as.



$$I_1\ddot{\theta}_1 + k_1(\theta_1 - \theta_2) = 0$$

$$I_2\ddot{\theta}_2 + k_1(\theta_2 - \theta_1) + k_2(\theta_2 - \theta_3) = 0$$

$$I_3\ddot{\theta}_3 + k_2(\theta_3 - \theta_2) + k_3(\theta_3 - \theta_4) = 0$$

$$I_4\ddot{\theta}_4 + k_3(\theta_4 - \theta_3) = 0.$$

The motions are harmonic at a principal mode of vibration. Assuming $\theta_i = \phi . \sin\omega t$ and substituting it in the above equation.

$$\omega^2 I_1 \phi_1 = k_1(\phi_1 - \phi_2)$$

$$\omega^2 I_2 \phi_2 = K_1(\phi_2 - \phi_1) + K_2(\phi_2 - \phi_3)$$

$$\omega^2 I_3 \phi_3 = K_2(\phi_3 - \phi_2) + K_3(\phi_3 - \phi_4)$$

$$\omega^2 I_4 \phi_4 = K_3(\phi_4 - \phi_3)$$

Summing the various terms of the above equation

$$\sum_{i=1}^{4} \omega^2 I_i \phi_i = 0$$

for a set of n discs.

$$\sum_{i=1}^{n} \omega^2 I_i \phi_i = 0$$

In the above equation, it is explained that the sum of the inertia Torques $K_1(\phi_1 - \phi_2)$, $K_2(\phi_3 - \phi_2)$ etc must be zero and assumed Trial frequency ω must satisfy this equation.

Procedure:-

1). Assume a trial frequency ω

2). Take ϕ_1 as unity arbitrarily

3). Calculate ϕ_2 from equation motion

$$\phi_2 = \phi_1 - \frac{I_1 \omega^2 \phi_1}{K_1}$$

$$= \left(1 - \frac{I_1 \omega^2}{K_1}\right) \phi_1$$

$$\phi_3 = \phi_2 - \frac{\omega^2 (I_1 \phi_1 + I_2 \phi_2)}{K_2}$$

$$\phi_4 = \phi_3 - \frac{(I_1 \phi_1 + I_2 \phi_2 + I_3 \phi_3)\omega^2}{K_3}$$

4). The values of ϕ_1, ϕ_2, ϕ_3 and ϕ_4 are put in equation $\sum_{i=1}^{4} \omega^2 I_i \phi_i = 0$ equation is satisfied or not. If is not satisfied new Trial value of ω is assumed and the whole process is repeated.