Balancing of Rotating Masses

Mechanic of Machine
KJS 2233

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INTRODUCTION

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INTRODUCTION

- Rotating components are widely used in modern machine.
- Example of rotating part/component/machine:
  a. Wheel for vehicle
  b. Fan
  c. Quad copter
  d. Engine
  e. Turbine
For a machine rotating at high speed, balancing is very important.

Definition- resultant force acting for component equal to zero.

Types of rotating condition:
  I. Single plane
  II. Multi plane
SINGLE PLANE

- Wheel for train
MULTI PLANE

- Crankshaft
EFFECTS OF NON BALANCED PART

1. Part or component expose to higher load
2. Shaft expose higher load
3. Increase load to bearing
4. Vibration effect to component and system-fatigue failure
THEORY OF ROTATING MASS

- Rotating part/component - expose to centrifugal force
- Equation
  \[ F_c = m \omega^2 r \]
  - \( m \): mass (kg)
  - \( \omega \): angular velocity (rad/s)
  - \( r \): radius (m)
- Balanced part - resultant force equal to zero
- Unbalanced part - resultant force - not zero
SOLVING BALANCING PROBLEM

2 approaches

1. Analytical method
2. Graphical method
EXAMPLE 1

Four masses $m_1$, $m_2$, $m_3$, and $m_4$ are 200 kg, 300 kg, 240 kg and 260 kg respectively. The corresponding radii of rotation are 0.2 m, 0.15 m, 0.25 m and 0.3 m respectively and the angles between successive masses are 45°, 75° and 135°. Find the position and magnitude of the balance mass required, if its radius of rotation is 0.2 m.
EXAMPLE 2

Four masses A, B, C and D are attached to a shaft and revolve in the same plane. The masses are 12 kg, 10 kg, 18 kg and 15 kg respectively and their radii of rotations are 40 mm, 50 mm, 60 mm and 30 mm. The angular position of the masses B, C and D are 60°, 135° and 270° from the mass A. Find the magnitude and position of the balancing mass at a radius of 100 mm.
EXAMPLE 3

Table below shows an unbalance rotating masses system, as an engineer you are asked to propose the solution to correct this unbalanced system.

<table>
<thead>
<tr>
<th>Mass</th>
<th>mass (kg)</th>
<th>r (m)</th>
<th>Angle(deg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>50</td>
<td>1.2</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>75</td>
<td>2</td>
<td>20</td>
</tr>
<tr>
<td>3</td>
<td>55</td>
<td>3</td>
<td>115</td>
</tr>
<tr>
<td>4</td>
<td>45</td>
<td>2.5</td>
<td>255</td>
</tr>
</tbody>
</table>