Balancing Several Rotating Masses in One Plane

Unbalance of up to four masses rotating in one plane, and the balancing mass and its angle at a chosen radius, by vector sum of m·r.

Method: Rattan; Theory of Machines; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Mass 1	12.000	kg
Radius 1	0.20000	m
Angle 1	0	°
Mass 2	8.0000	kg
Radius 2	0.25000	m
Angle 2	60.000	°
Mass 3	15.000	kg
Radius 3	0.15000	m
Angle 3	150.00	°
Mass 4 (0 = none)	0	kg
Radius 4	0.20000	m
Angle 4	240.01	°
Radius of the balancing mass	0.20000	m
Speed (for the unbalanced force)	1,500.0	rpm

Calculated results

Parameter	Value	Unit
Resultant unbalance	3.2046	kg·m
Balancing mass	16.023	kg
Angle of the balancing mass	243.07	°
Unbalanced force before balancing	79.070	kN

Notes for this case

- Static (single-plane) balance only; masses in different planes also need a couple balance (two-plane method).

Formula and method

$$\vec{U} = \sum m_i r_i \angle\theta_i, \quad m_b = \frac{|\vec{U}|}{r_b}, \quad \theta_b = \angle(-\vec{U}), \quad F = |\vec{U}|\omega^2$$

Variables

m_1	Mass 1	kg
r_1	Radius 1	m
θ_1	Angle 1	rad
m_2	Mass 2	kg
r_2	Radius 2	m
θ_2	Angle 2	rad

m_3	Mass 3	kg
r_3	Radius 3	m
θ_3	Angle 3	rad
m_4	Mass 4 (0 = none)	kg
r_4	Radius 4	m
θ_4	Angle 4	rad
r_b	Radius of the balancing mass	m
N	Speed (for the unbalanced force)	1/s
U	Resultant unbalance (kg·m)	-
m_b	Balancing mass	kg
θ_b	Angle of the balancing mass	rad
F	Unbalanced force before balancing	N

Method and standards

Vector sum of unbalances.

Assumptions and limits

- Rigid rotor; one plane.
- The resultant unbalance is in kg·m in every unit system.
- When the masses already balance, the angle of the balancing mass is not applicable and is not shown.

References

• Rattan
• Theory of Machines
• 4th ed. (McGraw-Hill, 2014); Bhandari
• Design of Machine Elements
• 4th ed. (McGraw-Hill, 2017) (balancing of rotating masses in one plane)

Report details

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Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/mechanical/statics-dynamics/rotating-masses-balancing

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.