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Critical or Whirling Speed of Shaft Formulas

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List of 12 Critical or Whirling Speed of Shaft Formulas

Critical or Whirling Speed of Shaft

1) Additional Deflection of Centre of Gravity of Rotor using Natural Circular Frequency

Open Calculator

fx $$y = \frac{\omega^2 \cdot e}{\omega_n^2 - \omega^2}$$

ex $$0.795031\text{mm} = \frac{(11.2\text{rad/s})^2 \cdot 2\text{mm}}{(21\text{rad/s})^2 - (11.2\text{rad/s})^2}$$

2) Additional Deflection of Centre of Gravity of Rotor using Whirling Speed

Open Calculator

fx $$y = \frac{e}{\left(\frac{\omega}{\omega_c}\right)^2 - 1}$$

ex $$0.805009\text{mm} = \frac{2\text{mm}}{\left(\frac{11.2\text{rad/s}}{6}\right)^2 - 1}$$

3) Additional Deflection of Centre of Gravity of Rotor when Shaft Starts Rotating

Open Calculator

fx $$y = \frac{m \cdot \omega^2 \cdot e}{S_{shaft} - m \cdot \omega^2}$$

ex $$0.74988\text{mm} = \frac{5\text{g} \cdot (11.2\text{rad/s})^2 \cdot 2\text{mm}}{2.3\text{N/m} - 5\text{g} \cdot (11.2\text{rad/s})^2}$$

4) Centrifugal Force Causing Shaft Deflection

Open Calculator

fx $$F_c = m_{max} \cdot \omega^2 \cdot (e + y)$$

ex $$35.1232\text{N} = 100\text{kg} \cdot (11.2\text{rad/s})^2 \cdot (2\text{mm} + 0.8\text{mm})$$

5) Critical or Whirling Speed given Static Deflection

Open Calculator

fx $$\omega_c = \sqrt{\frac{g}{\delta}}$$

ex $$121.8544 = \sqrt{\frac{9.8\text{m/s}^2}{0.66\text{mm}}}$$

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6) Critical or Whirling Speed given Stiffness of Shaft

Open Calculator

fx $$\omega_c = \sqrt{\frac{S_{shaft}}{m}}$$

ex $$21.44761 = \sqrt{\frac{2.3N/m}{5g}}$$

7) Critical or Whirling Speed in R.P.S

Open Calculator

fx $$\omega_c = \frac{0.4985}{\sqrt{\delta}}$$

ex $$19.40409 = \frac{0.4985}{\sqrt{0.66mm}}$$

8) Force Resisting Additional Deflection of Centre of Gravity of Rotor

Open Calculator

fx $$F = k \cdot y$$

ex $$2.4N = 3000N/m \cdot 0.8mm$$

9) Mass of Rotor given Centrifugal Force

Open Calculator

fx $$m_{max} = \frac{F_c}{\omega^2 \cdot (e + y)}$$

ex $$99.64923kg = \frac{35N}{(11.2rad/s)^2 \cdot (2mm + 0.8mm)}$$

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10) Natural Circular Frequency of Shaft

Open Calculator

fx $$\omega_n = \sqrt{\frac{S_{shaft}}{m}}$$

ex $$21.44761\text{rad/s} = \sqrt{\frac{2.3\text{N/m}}{5\text{g}}}$$

11) Static Deflection of Shaft

Open Calculator

fx $$\delta = \frac{m \cdot g}{S_{shaft}}$$

ex $$21.30435\text{mm} = \frac{5\text{g} \cdot 9.8\text{m/s}^2}{2.3\text{N/m}}$$

12) Stiffness of Shaft for Equilibrium Position

Open Calculator

fx $$S_{shaft} = \frac{m \cdot \omega^2 \cdot (e + y)}{y}$$

ex $$2.1952\text{N/m} = \frac{5\text{g} \cdot (11.2\text{rad/s})^2 \cdot (2\text{mm} + 0.8\text{mm})}{0.8\text{mm}}$$

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Variables Used

- **e** Initial Distance of Centre of Gravity of Rotor *(Millimeter)*
- **F** Force *(Newton)*
- **F_c** Centrifugal Force *(Newton)*
- **g** Acceleration due to Gravity *(Meter per Square Second)*
- **k** Stiffness of Spring *(Newton per Meter)*
- **m** Mass of Rotor *(Gram)*
- **m_{max}** Maximum Mass of Rotor *(Kilogram)*
- **S_{shaft}** Stiffness of Shaft *(Newton per Meter)*
- **y** Additional Deflection of C.G of Rotor *(Millimeter)*
- **δ** Static Deflection of Shaft *(Millimeter)*
- **ω** Angular Velocity *(Radian per Second)*
- **ω_c** Critical or Whirling Speed
- **ω_n** Natural Circular Frequency *(Radian per Second)*

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Constants, Functions, Measurements used

- Function: **sqrt**, sqrt(Number)
  A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.
- Measurement: **Length** in Millimeter (mm)
  Length Unit Conversion
- Measurement: **Weight** in Gram (g), Kilogram (kg)
  Weight Unit Conversion
- Measurement: **Acceleration** in Meter per Square Second (m/s²)
  Acceleration Unit Conversion
- Measurement: **Force** in Newton (N)
  Force Unit Conversion
- Measurement: **Surface Tension** in Newton per Meter (N/m)
  Surface Tension Unit Conversion
- Measurement: **Angular Velocity** in Radian per Second (rad/s)
  Angular Velocity Unit Conversion

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Check other formula lists

- Load for Various Types of Beams and Load Conditions Formulas
- Critical or Whirling Speed of Shaft Formulas
- Effect of Inertia of Constraint in Longitudinal and Transverse Vibrations Formulas
- Frequency of Free Damped Vibrations Formulas
- Frequency of Under Damped Forced Vibrations Formulas
- Natural Frequency of Free Transverse Vibrations Formulas
- Values of length of beam for the various types of beams and under various load conditions Formulas
- Values of static deflection for the various types of beams and under various load conditions Formulas
- Vibration Isolation and Transmissibility Formulas

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