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Effect of Inertia of Constraint in Longitudinal and Transverse Vibrations Formulas

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List of 12 Effect of Inertia of Constraint in Longitudinal and Transverse Vibrations Formulas

Effect of Inertia of Constraint in Longitudinal and Transverse Vibrations

Longitudinal Vibration

1) Length of Constraint for Longitudinal Vibration

Open Calculator

fx $$l = \frac{V_{longitudinal} \cdot x}{v_s}$$

ex $$7.32\text{mm} = \frac{4\text{m/s} \cdot 3.66\text{mm}}{2\text{m/s}}$$

2) Longitudinal Velocity of Free End for Longitudinal Vibration

Open Calculator

fx $$V_{longitudinal} = \sqrt{\frac{6 \cdot KE}{m_c}}$$

ex $$4\text{m/s} = \sqrt{\frac{6 \cdot 75\text{J}}{28.125\text{kg}}}$$

3) Natural Frequency of Longitudinal Vibration

Open Calculator

fx $$f = \sqrt{\frac{s_{constrain}}{W_{attached} + \frac{m_c}{3}}} \cdot \frac{1}{2 \cdot \pi}$$

ex $$0.182425\text{Hz} = \sqrt{\frac{13\text{N/m}}{0.52\text{kg} + \frac{28.125\text{kg}}{3}}} \cdot \frac{1}{2 \cdot \pi}$$

4) Total Kinetic Energy of Constraint in Longitudinal Vibration

Open Calculator

fx $$KE = \frac{m_c \cdot V_{longitudinal}^2}{6}$$

ex $$75\text{J} = \frac{28.125\text{kg} \cdot (4\text{m/s})^2}{6}$$

5) Total Mass of Constraint for Longitudinal Vibration

Open Calculator

fx $$m_c = \frac{6 \cdot KE}{V_{longitudinal}^2}$$

ex $$28.125\text{kg} = \frac{6 \cdot 75\text{J}}{(4\text{m/s})^2}$$

6) Velocity of Small Element for Longitudinal Vibration

Open Calculator

fx $$v_s = \frac{x \cdot V_{longitudinal}}{l}$$

ex $$2\text{m/s} = \frac{3.66\text{mm} \cdot 4\text{m/s}}{7.32\text{mm}}$$

Transverse Vibration

7) Length of Constraint for Transverse Vibrations

Open Calculator

fx $$l = \frac{m_c}{m}$$

ex $$7.320025\text{mm} = \frac{28.125\text{kg}}{3842.2\text{kg/m}}$$

8) Natural Frequency of Transverse Vibration

Open Calculator

fx $$f = \frac{\sqrt{\frac{s_{constrain}}{W_{attached}+m_c \cdot \frac{33}{140}}}}{2 \cdot \pi}$$

ex $$0.214613\text{Hz} = \frac{\sqrt{\frac{13\text{N/m}}{0.52\text{kg}+28.125\text{kg} \cdot \frac{33}{140}}}}{2 \cdot \pi}$$

9) Total Kinetic Energy of Constraint for Transverse Vibrations

Open Calculator

fx $$KE = \frac{33 \cdot m_c \cdot V_{traverse}^2}{280}$$

ex $$75J = \frac{33 \cdot 28.125kg \cdot (4.756707m/s)^2}{280}$$

10) Total Mass of Constraint for Transverse Vibrations

Open Calculator

fx $$m_c = \frac{280 \cdot KE}{33 \cdot V_{traverse}^2}$$

ex $$28.125kg = \frac{280 \cdot 75J}{33 \cdot (4.756707m/s)^2}$$

11) Transverse Velocity of Free End

Open Calculator

fx $$V_{traverse} = \sqrt{\frac{280 \cdot KE}{33 \cdot m_c}}$$

ex $$4.756707m/s = \sqrt{\frac{280 \cdot 75J}{33 \cdot 28.125kg}}$$

12) Velocity of Small Element for Transverse Vibrations

Open Calculator

fx $$v_s = \frac{\left(3 \cdot l \cdot x^2 - x^3\right) \cdot V_{traverse}}{2 \cdot l^3}$$

ex $$1.486471\text{m/s} = \frac{\left(3 \cdot 7.32\text{mm} \cdot (3.66\text{mm})^2 - (3.66\text{mm})^3\right) \cdot 4.756707\text{m/s}}{2 \cdot (7.32\text{mm})^3}$$

Variables Used

- **f** Frequency *(Hertz)*
- **KE** Kinetic Energy *(Joule)*
- **l** Length of Constraint *(Millimeter)*
- **m** Mass *(Kilogram per Meter)*
- m_c Total Mass of Constraint *(Kilogram)*
- $s_{constrain}$ Stiffness of Constraint *(Newton per Meter)*
- $V_{longitudinal}$ Longitudinal Velocity of Free End *(Meter per Second)*
- v_s Velocity of Small Element *(Meter per Second)*
- $V_{traverse}$ Transverse Velocity of Free End *(Meter per Second)*
- $W_{attached}$ Load Attached to Free End of Constraint *(Kilogram)*
- **x** Distance between Small Element and Fixed End *(Millimeter)*

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- 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 Kilogram (kg)
  Weight Unit Conversion
- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Energy** in Joule (J)
  Energy Unit Conversion
- Measurement: **Frequency** in Hertz (Hz)
  Frequency Unit Conversion
- Measurement: **Surface Tension** in Newton per Meter (N/m)
  Surface Tension Unit Conversion
- Measurement: **Linear Mass Density** in Kilogram per Meter (kg/m)
  Linear Mass Density Unit Conversion

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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