Important Effect of Inertia of Constraint in Longitudinal and Transverse Vibrations Formulas PDF

Formulas
Examples
with Units

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

1) Longitudinal Vibration Formulas

1.1) Length of Constraint for Longitudinal Vibration Formula

Evaluate Formula

Formula

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

Example with Units

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

1.2) Longitudinal Velocity of Free End for Longitudinal Vibration Formula

Evaluate Formula

Formula

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

Example with Units

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

1.3) Natural Frequency of Longitudinal Vibration Formula

Evaluate Formula

Formula

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

Example with Units

$$0.1824\,\text{Hz} = \sqrt{\frac{13\,\text{N/m}}{0.52\,\text{kg} + \frac{28.125\,\text{kg}}{3}}} \cdot \frac{1}{2 \cdot 3.1416}$$

1.4) Total Kinetic Energy of Constraint in Longitudinal Vibration Formula

Evaluate Formula

Formula

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

Example with Units

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

1.5) Total Mass of Constraint for Longitudinal Vibration Formula

Evaluate Formula

Formula

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

Example with Units

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

1.6) Velocity of Small Element for Longitudinal Vibration Formula

Evaluate Formula

Formula

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

Example with Units

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

2) Transverse Vibration Formulas

2.1) Length of Constraint for Transverse Vibrations Formula

Evaluate Formula

Formula

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

Example with Units

$$7.32\,\text{mm} = \frac{28.125\,\text{kg}}{3842.2\,\text{kg/m}}$$

2.2) Natural Frequency of Transverse Vibration Formula

Evaluate Formula

Formula

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

Example with Units

$$0.2146\,\text{Hz} = \frac{\sqrt{\frac{13\,\text{N/m}}{0.52\,\text{kg} + 28.125\,\text{kg} \cdot \frac{33}{140}}}}{2 \cdot 3.1416}$$

2.3) Total Kinetic Energy of Constraint for Transverse Vibrations Formula

Evaluate Formula

Formula

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

Example with Units

$$75\,\text{J} = \frac{33 \cdot 28.125\,\text{kg} \cdot 4.756707\,\text{m/s}^2}{280}$$

2.4) Total Mass of Constraint for Transverse Vibrations Formula

Evaluate Formula

Formula

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

Example with Units

$$28.125\,\text{kg} = \frac{280 \cdot 75\,\text{J}}{33 \cdot 4.756707\,\text{m/s}^2}$$

2.5) Transverse Velocity of Free End Formula

Evaluate Formula

Formula

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

Example with Units

$$4.7567\,\text{m/s} = \sqrt{\frac{280 \cdot 75\,\text{J}}{33 \cdot 28.125\,\text{kg}}}$$

2.6) Velocity of Small Element for Transverse Vibrations Formula

Evaluate Formula

Formula

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

Example with Units

$$1.4865\,\text{m/s} = \frac{\left(3 \cdot 7.32\,\text{mm} \cdot 3.66\,\text{mm}^2 - 3.66\,\text{mm}^3\right) \cdot 4.756707\,\text{m/s}}{2 \cdot 7.32\,\text{mm}^3}$$

Variables used in list of Effect of Inertia of Constraint in Longitudinal and Transverse Vibrations Formulas above

- **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 in list of Effect of Inertia of Constraint in Longitudinal and Transverse Vibrations Formulas above

- constant(s): **pi**, 3.14159265358979323846264338327950288 *Archimedes' constant*
- Functions: **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*

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- Important Frequency of Free Damped Vibrations Formulas
- Important Frequency of Under Damped Forced Vibrations Formulas
- Important Natural Frequency of Free Transverse Vibrations Formulas
- Important Values of length of beam for the various types of beams and under various load conditions Formulas
- Important Values of static deflection for the various types of beams and under various load conditions Formulas
- Important Vibration Isolation and Transmissibility Formulas

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