SINGLE DEGREE OF FREEDOM SYSTEMS (SDOF)

- VIBRATION CALCULATOR

INPUT PARAMETERS:

Parameter	Value	Unit
Mass [m]	5.0	kg
Spring rate (Stiffness) [k]	31.0	N/m
Damping ratio (coefficient) [ζ]	0.01	--
Harmonic input frequency [Ω]	0	Hz

RESULTS:

Parameter	Value	Unit
Cicular frequency [wn]	2.49	rad/s
Natural frequency [fn]	0.4	Hz
Period of oscilattion [T]	2.52	s
Critical damping [cc]	24.9	Ns/m
Damping factor [c]	0.25	Ns/m
Damped natural angular frequency [wd]	2.49	rad/s
Damped natural frequency [fd]	0.4	Hz
Quality factor [Q]	50.0	--
Transmissibility [TR]	--	--

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Definitions:

Critical damping: The minimum amount of viscous damping that results in a displaced system returning to its original position without oscillation.

Damped natural frequency: In the presence of damping, the frequency at which the system vibrates when disturbed. Damped natural frequency is less than undamped natural frequency.

Damping ratio: The ratio of actual damping to critical damping. It is a dimensionless measure describing how oscillations in a system

decay after a disturbance.

Forced vibrations: Oscillations about a system's equilibrium position in the presence of an external excitation.

Free vibrations: Oscillations about a system's equilibrium position in the absence of an external excitation.

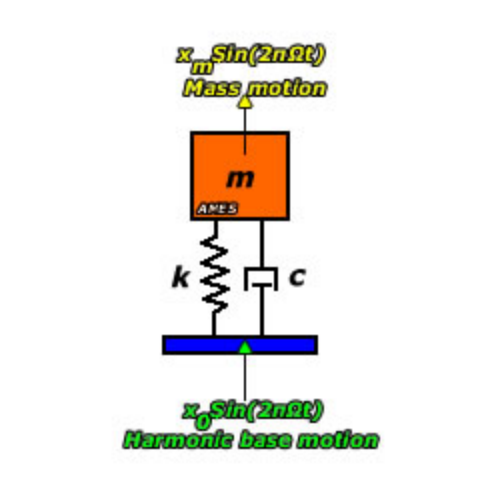
Natural frequency: The frequency at which a system vibrates when set in free vibration.

Undamped natural frequency: In the absence of damping, the frequency at which the system vibrates when disturbed.

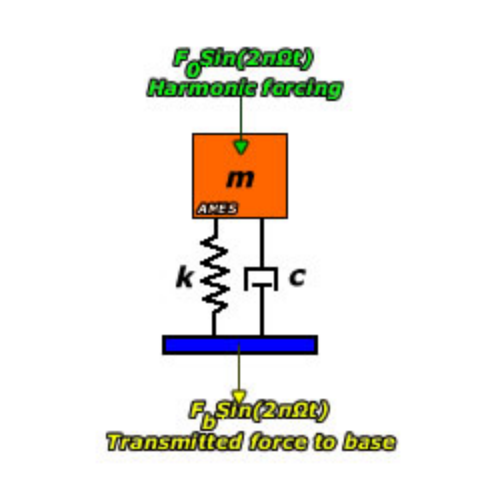
Period of Oscillation: The time in seconds required for one cycle.

Transmissiblity: The ratio of output amplitude to input amplitude at same frequency. Following 2 conditions have same transmissiblity value.

-- Transmissiblity between harmonic motion excitation from the base (input) and motion response of mass (output) Ex: Car runing on the road. Car body is m, base motion excitation is road disturbances.



-- Harmonic forcing excitation to mass (Input) and force transmitted to base (output). Ex: A rotating machine generating force during operation and transmitting to its base.



Quality Factor: Transmissibility at resonance, which is the system's highest possible response ratio.

Single Degree of Freedom Vibration Equations:

Parameter	Equation
Natural angular frequency (w_n)[rad/s]	$w_n = \sqrt{\frac{k}{m}}$
Natural frequency (f_n) [Hz]	$f_n = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$
Period of oscillations (T) [s]	$T = \frac{1}{f_n}$
Critical damping (c_c)	$c_c = 2mw_n$
Damping factor (c)	$c = \zeta c_c$
Damped natural frequency (w_d)	$w_d = w_n\sqrt{1-\zeta^2}$
Quality factor (Q)	$Q = \frac{1}{2\zeta}$
Transmissibility (TR)	$TR = \sqrt{\frac{1+(\frac{2\zeta\Omega}{w_n})^2}{[1-(\frac{\Omega}{w_n})^2]^2+(\frac{2\zeta\Omega}{w_n})^2}}$

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