

# NV SAGE

## Noise & Vibration Newsletter

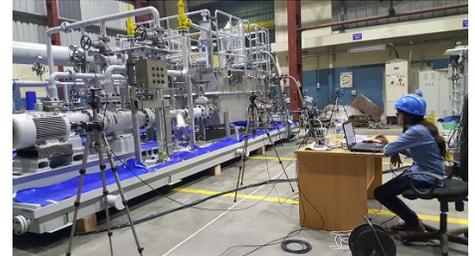
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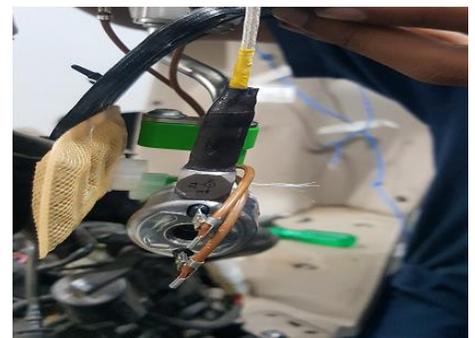
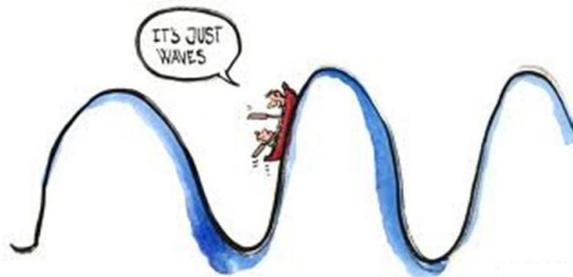
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Dolphins hear from long distance



#### Tit Bits



## Dear Valued Customer

*On behalf of NV Dynamics team, I sincerely thank all our customers who made us achieve and surpass the targets for the year 2017-18. In fact, the year concluded with most technical varieties of tasks and as well the highest revenues ever made by NV Dynamics since its inception. We could look into a lot of new avenues for business and this is setting the new benchmarks for the year 2019.*

*Our Metro Rail activities and services are now pitched to customers beyond Indian shores. We have proposed our activities to Metro Rail projects in Mauritius and Vietnam and are working with a number of international project management consultants and Lead Contractors to offer Noise and Vibration services as an upfront inclusive package.*

*The year also began with 2 good service orders, one from a Metro Rail Coach manufacturing company for complete testing and validation of N&V parameters and the other from a large Turbine-Generator company for conducting Modal tests. We have also built a credible number of leads and prospects that are much likely to translate to consulting business.*

Some of the interesting and important tasks we handled in the previous months are highlighted below

*One of the well-known Lubrication system manufacturing company in Bangalore has engaged NV Dynamics to evaluate their systems for Sound Power determination; in all, 8 systems are being tested and the results will be used for the certification of the product by the end user. The task is interesting in terms of the site adaptability for conducting the tests and to establish correct boundary conditions amidst rest of shop floor activities. The results produced by NV Dynamics will be audited by the end user team in Europe.*

*Telecom high rise towers are subjected to high winds and other elements of nature; it is essential to understand dynamic response of these towers as to how the oscillations of the tower due to wind affect their operational life and of any unwarranted failures. Working with a large company that manages these telecom towers, NV Dynamics conducted tests at site using inertial sensors and special instrumentation to quantify and assess the movement of the tower; the plan is to install continuous monitoring systems at multiple towers pan India and to setup remote monitoring stations. The final intent of the activity is to generate design data for tower production based on the topographic and geographic conditions.*

*A large International Automotive safety and control OEMProducts Company is designing fuel pump for a reputed 2 Wheeler brand; the pump is submerged in the fuel tank and is float-suspended from the top end of the tank. NV Dynamics conducted Road Load Data recording activities followed by generating PSD data for use in their accelerated testing on electro-dynamic shaker. In all, about 80km of run data is collected and analysed for generating PSD curves.*

Presently, we are working on technical schedules that include Modal analysis and some cases of Wind Turbine analysis, I would come back with the details of the activity in the next supplement of NVsage.

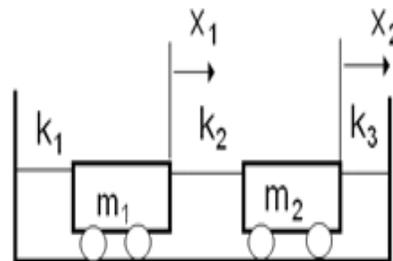
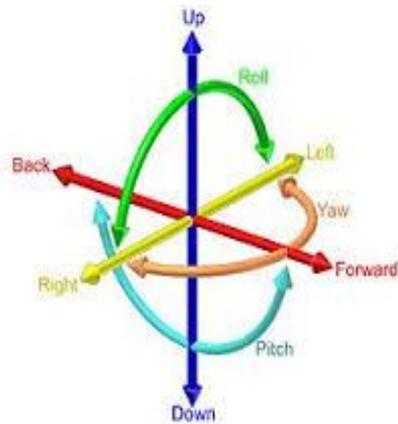
Warm Regards  
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In our previous edition, we discussed the Single Degree of Freedom, SDOF Differential Equation, and Types of Vibration. For the present edition we shall discuss Multi Degree of Freedom its Equation Definition of Damping and its types, damping factor.

### Multi Degree of Freedom System- Definition

A Multi degree of freedom (MDOF) requires two or more coordinates to describe motion of a system. These coordinates are called generalized coordinates when they are independent of each other and equal in number to the degrees of freedom of the system. The MDOF system differs from the single DOF system in that it has multi natural frequencies, and for each of the natural frequencies there corresponds a natural state of vibration with a displacement configuration known as the normal mode. Normal mode vibrations are free vibrations that depend only on the mass and stiffness of the system.

Typical pictorial representation of MDOF are shown below



Equation for Multi Degree of Freedom

$$m_1\ddot{x}_1 + (k_1 + k_2)x_1 - k_2x_2 = 0$$
$$m_2\ddot{x}_2 + k_2x_1 + (k_2 + k_3)x_2 = 0$$

The equation is explained as below

- The two masses ( $m_1$  &  $m_2$ ) can be obtained by considering the deflected position at some time  $t$ .
- $k$  is the spring stiffness
- $x_1$  &  $x_2$  is the vector of co-ordinates

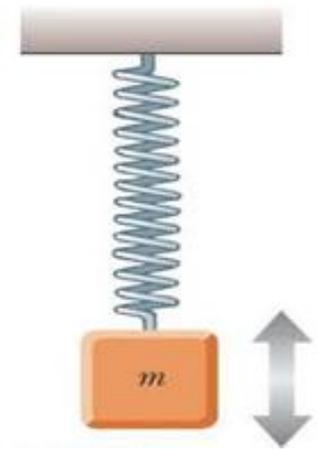
## Damping

When an external force applied on an oscillatory system, the intensity of oscillations is reduced or restricted completely. The effect of reduced oscillation over a period of time is called damping. Damping is generally occurs in damper which is a part of mechanical system.

In viscous damping, the damping force is proportional to the velocity but opposite in direction.

That is,  $F = -C \times V$

Where 'C' is called the viscous damping coefficient in N-s/m



### Damping Ratio:

It is the ratio of actual damping to critical damping. Usually denoted by  $\zeta$  (zeta)

That is  $\zeta = c/c_c$

## Types of Damping

Damping can be classified into 3 types they are.

1. **Critical Damping:** The system does not oscillates and returns to its equilibrium position in the shortest possible time When  $\zeta=1$ , the system is said to be critically damped.

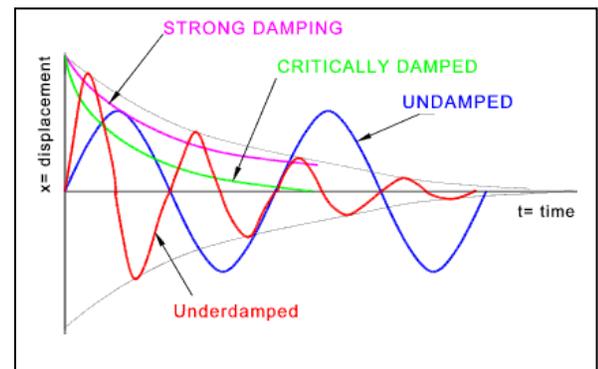
*Automobile shock absorbed is an example of critically Damped device.*

2. **Over Damping:** The system does not oscillates but returns to its equilibrium position very slowly when  $\zeta > 1$ , the system is said to be over damped.

*Example Door closer will take longer to close the door.*

3. **Under Damping:** The system oscillates about the equilibrium position with reduced amplitude over a period of time. When  $\zeta < 1$ , the system is said to be under damped.

*A stringed musical instrument is an example of under*



## ! The Thundering Sound!!

- Sounds produced by thunder loud sounds lasting 0.2 to 2 seconds. 90% of the electrical energy of lightning is released in the form of heat, which is quickly dissipated into the atmosphere. Less than 1% of lightning's energy is converted into sound and the rest released in the form of light.
- A clap of thunder typically registers at about 120 dB in close proximity to the ground stroke. This is 10 times louder than a garbage truck or pneumatic jackhammer drill. By comparison, sitting in front of speakers at a rock concert can expose you to a continuous 120+ dB level.
- Humans hear frequencies of thunder between 20-120 Hertz (Hz).



## Dolphins can hear from as far as 15 miles away!!

- Dolphins are capable of hearing sound more than humans can hear. They can hear frequencies as high as 150 kHz. To hear underwater sound they use echolocation (The location of objects transmitting sound waves) the dolphins have an organ in the head called melon that generate a high-pitched sound waves send into the water.
- The echo produced by the sound helps dolphins can identify locating object, how far away the objects are located. The dolphins sense the returning sound waves by feeling the pulses on their jaws. Each object or animal underwater sends off different echoes, which the dolphins can differentiate.
- Echolocation helps dolphins determine not only the distance of an object but also the texture, shape and size of the object. It works because water is an excellent sound transmitter, which can transmit sound five times faster compared to air.



There are only 4 words in the English language which end in 'dous' (they are: hazardous, horrendous, stupendous and tremendous)