ISSN (Online) : 2319 – 8753
ISSN (Print) : 2347 - 6710

International Journal of Innovative Research in Science, Engineering and Technology

An ISO 3297: 2007 Certified Organization *Volume 3, Special Issue 4, April 2014*

Two days National Conference – VISHWATECH 2014

On 21st & 22nd February, Organized by

Department of CIVIL, CE, ETC, MECHNICAL, MECHNICAL SAND, IT Engg. Of Vishwabharati Academy's College of engineering, Ahmednagar, Maharastra, India.

Frequency Response Curve For Forced Vibration under Different Damping for Steel Beam

Miss. Kachare Savita , Miss. Mhaske Priyanka , Miss. Phate Jyoti

Lecturer, Dept of Mechanical Engg., Vishwabharati Academy's College of Engg. / Pune university, Sarola baddi, Ahmednagar, Maharashtra, India.

Lecturer, Dept of Mechanical Engg., Shri Chhatrapati shivaji maharaj College of Engg. / Pune university, Nepti, Ahmednagar, Maharashtra, India..

Abstract: Vibration problem occurs where there are rotating or moving parts in machinery, apart from the machinery itself surrounding structure also faces vibration hazards because of this vibrating machinery. The undesirable vibration creates excessive stress in machine element undesirable noise looseness is a part partial complete failure of parts and also affects a human comfort. Hence, reductions of undesirable vibration are essential in machinery[1]. In this paper vibration of fixed beam analyzed and measured at different damping condition and at various speed by strip chart recorder and electronic circuit .frequency response curve are obtained from experimental result and analyze for reduction in vibration .The paper investigate the nature of beam vibration at various condition for plain and coated mild steel beam material.

Keywords: Forced damped vibration, Frequency response curve, Beam, Amplitude etc

I. INTRODUCTION

When external forces act on a vibrating system during its motion, it is termed Forced Vibration. Under this condition, the system will tend to vibrate at its own natural frequency superimposed upon the frequency of the exciting force. After a short time, the system will vibrate at the frequency of the exciting force only, regardless of the initial conditions natural frequency of the system. The latter case is termed steady state vibration. In fact, most of vibration phenomena present in life are categorized under forced vibration. When the excitation frequency is very close to the natural frequency of the system, vibration amplitude will be very large and damping will be necessary to maintain the amplitude at a certain level. The latter case is called "resonance" and it is very dangerous upon mechanical and structural parts. Thus, care must be taken when designing a mechanical system by selecting proper natural frequency that is sufficiently spaced from the exciting frequency[3]. Aanalysis of beam vibration now a day is very important as beam is being widely used in various applications. These beams are continuously subjected to various types of loading. If these vibrations exceed beyond certain Limits there will be danger of beam breakage or failure[4]. So it is necessary to study the vibrations which are set up or build up in the beam and try to reduce them. The analysis of moving loads on a beam structure has been a topic of interest for well over a century[5]. Interest in these problem originated in civil engineering also for the design of railroads, bridges and highways structures. The problem arises from the observations that as a beam structure is subjected to moving loads, the dynamic deflections, as well as stresses are significantly higher than those for static loads. Most of the previous analysis work in this area was directed at the dynamic behaviour of simple structure, such as simply supported beam, subjected to a simple loading, e.g. a concentrated load. The main causes of vibration are unbalanced forces in the machine, dry friction between the two mating surfaces, external excitations may be periodic, random, or the nature of an impact produced external to the vibratory system . In spite of harmful effects, the vibration phenomenon does have some uses also, e.g. in musical instruments, vibrating screens, shakers, stress relieving, shock absorbers etc[2].

ISSN (Online) : 2319 – 8753
ISSN (Print) : 2347 - 6710

International Journal of Innovative Research in Science, Engineering and Technology

An ISO 3297: 2007 Certified Organization Volume 3, Special Issue 4, April 2014

Two days National Conference – VISHWATECH 2014

On 21st & 22nd February, Organized by

Department of CIVIL, CE, ETC, MECHNICAL, MECHNICAL SAND, IT Engg. Of Vishwabharati Academy's College of engineering, Ahmednagar, Maharastra, India.

II. THEORETICAL ANALYSIS

Design of Beam Fixed at both ends:
Consider fixed beam carrying an eccentric point load,
Length of beam= 1030mm
Width of beam= 24mm
Thickness of beam= 10mm
Mass of beam =1.75kg
Force on the beam=107.9 N
Distance between the fixed end and Axis of the load=540mm
Maximum deflection:
Equation I: $Y_{max}= 2Wa^3b^2/3EI\,(3a+b)^2$ ….. at x=2al/3a+b
Y_{max}= 1.527mm
At running condition:
Low damping-one hole open
Speed of motor=250 rpm
Damping coefficient:c=$6.643*10^{-6}$N/mm
Amplitude of forced vibration[2]:
Equation II: $X = Fo/(\sqrt{(k-mw^2)^2}+\sqrt{(cw)^2})$
X= 0.09mm
Specification:
Motor: Full horse power, 50Watt, 50 Hz
Electronic circuit: LED (HDNS-2200) lens (HDNS-2100),Potentiometer,
Integrated Circuit-16 pin optical plastic package, 20 per tube, 1000 pieces in a box
Viscous damper: two piston one cylinder arrangement

III.EXPERIMENTAL METHODOLOGY

The aim is to find frequency response curve for transverse vibration of fixed supported plane and coated beam under different damping condition and at various speed. A motor is used to create vibration on beam. The Electronic circuit and pen holder arrangement is attached to beam at same point to obtain a graph on strip chart recorder and on computer screen.

ISSN (Online) : 2319 – 8753
ISSN (Print) : 2347 - 6710

International Journal of Innovative Research in Science, Engineering and Technology

An ISO 3297: 2007 Certified Organization *Volume 3, Special Issue 4, April 2014*

Two days National Conference – VISHWATECH 2014

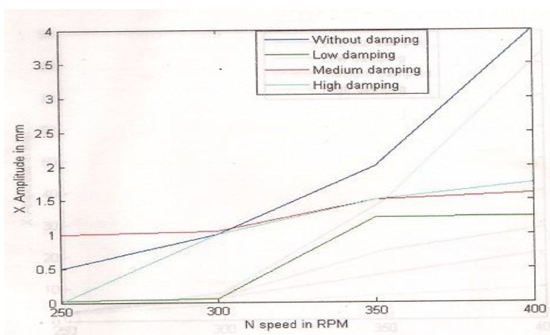
On 21st & 22nd February, Organized by

Department of CIVIL, CE, ETC, MECHNICAL, MECHNICAL SAND, IT Engg. Of Vishwabharati Academy's College of engineering, Ahmednagar, Maharastra, India.

Fig.1. Experimental Set up

Viscous damper (Piston and Cylinder type) is attached to motor below the beam to resist the vibrations. The amount of damping can be varied according to the lobe position For example one hole open in low damping, two hole open in medium damping and three hole open in High damping. For different condition of damping frequency response curve plotted for plane and coated steel beam.

II. FREQUENCY RESPONSE CURVE



Graph 1: frequency response curve for plane M.S beam at different damping condition by strip chart recorder.

ISSN (Online) : 2319 – 8753
ISSN (Print) : 2347 - 6710

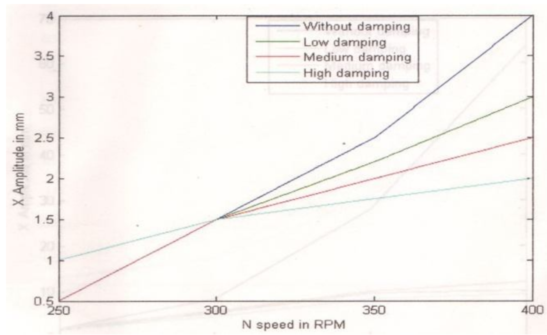
International Journal of Innovative Research in Science, Engineering and Technology

An ISO 3297: 2007 Certified Organization Volume 3, Special Issue 4, April 2014

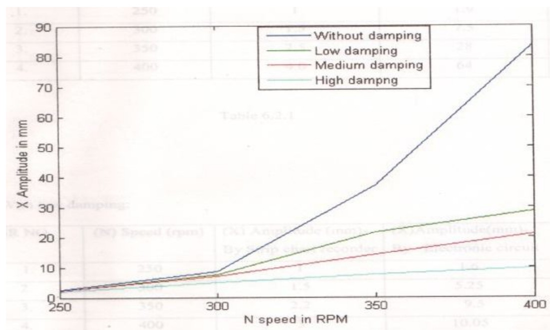
Two days National Conference – VISHWATECH 2014

On 21st & 22nd February, Organized by

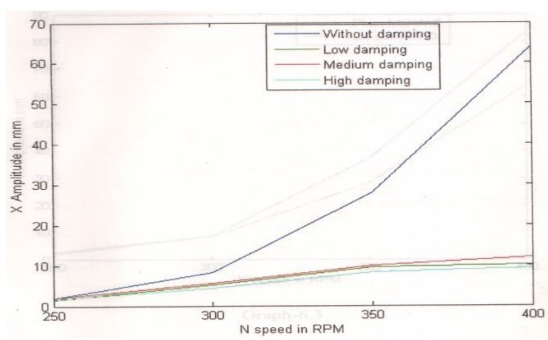
Department of CIVIL, CE, ETC, MECHNICAL, MECHNICAL SAND, IT Engg. Of Vishwabharati Academy's College of engineering, Ahmednagar, Maharastra, India.



Graph 2: frequency response curve for coated M.S beam at different damping condition by strip chart recorder.



Graph 3: frequency response curve for plane M.S beam at different damping condition by electronics circuit.



Graph 4: frequency response curve for coated M.S beam at different damping condition by electronics circuit.

Above Graphs are plotted in MATLAB from Experimental reading at various speed and different damping condition. In all cases Amplitude of vibration increases with increase in speed and Amplitude of vibration decreases with low, medium and high damping.

III. RESULTS

Following graphs shows the comparison of frequency response curve for plane and coated M.S. beam at no, low, medium, high, damping condition. At this different damping condition the amplitude of vibration for plane M.S. beam is more than the coated M.S. beam.

ISSN (Online) : 2319 – 8753
ISSN (Print) : 2347 - 6710

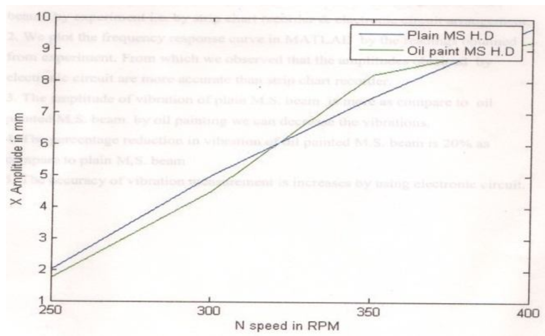
International Journal of Innovative Research in Science, Engineering and Technology

An ISO 3297: 2007 Certified Organization *Volume 3, Special Issue 4, April 2014*

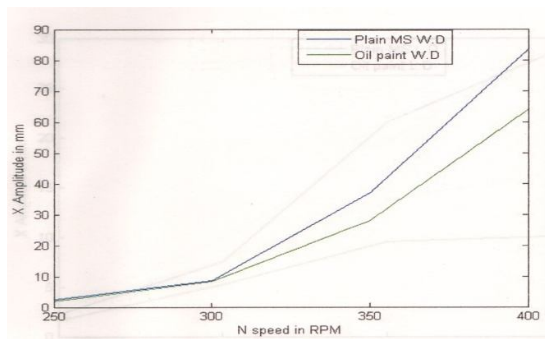
Two days National Conference – VISHWATECH 2014

On 21st & 22nd February, Organized by

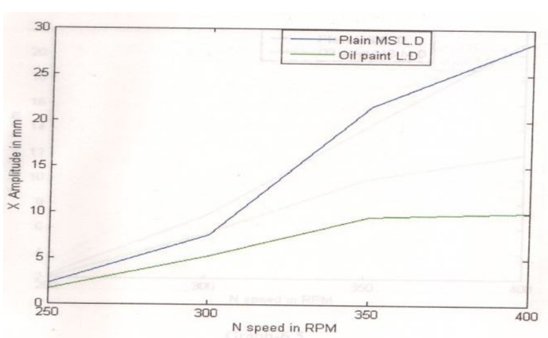
Department of CIVIL, CE, ETC, MECHNICAL, MECHNICAL SAND, IT Engg. Of Vishwabharati Academy's College of engineering, Ahmednagar, Maharastra, India.

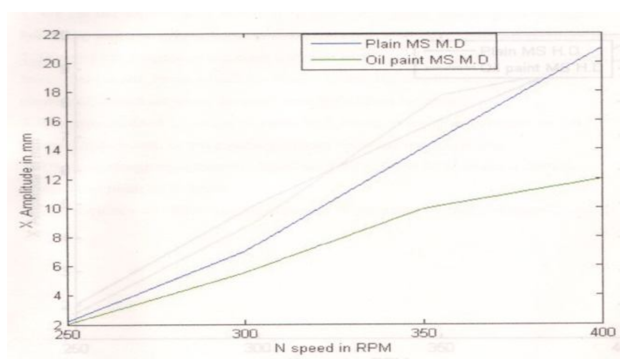


Graph 5: Comparision of frequency response curve for plane and coated M.S beam at without damping condition



Graph 6: Comparision of frequency response curve for plane and coated M.S beam at low damping condition.





Graph 7: Comparision of frequency response curve for plane and coated M.S beam at medium damping condition.

Graph 8. Comparison of frequency response curve for plane and coated M.S beam at high damping condition.

IV. CONCLUSION

Analysis for the reduction in vibration made from frequency response curves which are obtained from the observations.. From graphs the amplitude of vibration of plane M.S. beam is more as compare to coated M.S. beam. . In

ISSN (Online) : 2319 – 8753
ISSN (Print) : 2347 - 6710

International Journal of Innovative Research in Science, Engineering and Technology

An ISO 3297: 2007 Certified Organization Volume 3, Special Issue 4, April 2014

Two days National Conference – VISHWATECH 2014

On 21st & 22nd February, Organized by

Department of CIVIL, CE, ETC, MECHNICAL, MECHNICAL SAND, IT Engg. Of Vishwabharati Academy's College of engineering,

Ahmednagar, Maharastra, India.

practical circumstances, the amplitude may be very large but doesn't become infinite due to small amount of damping that is always present in any system.The reduction in vibration of coated beam is 20% than that of plane M.S.beam.Thus coating of material to reduce vibrations are available at a stage where no changes in design are possible, anticipation in the original planning and designs can make possible the avoidance of vibration problems at a little cost. By measurement of amplitude using electronics circuit accuracy of measurement is increased. It also eliminates the measurement error in mechanical strip chart recorder.

REFERENCES

[1] G.K. Grover, Mechanical Vibrations, Nem Chand & Bros. Roorkee (India) ,Seventh Edition,Page No.1

[2] Singiresu S. Rao Mechanical Vibration,Dorling Kindersley (India) Pvt.Ltd.,Fourth Edition

[3] Mr.Jaafar Khalaf Ali and Mr Ali Hassan Abdelali :Experiments of Mechanical vibration Laboratory, 2008 College of Engineering, University of Basrah

[4] W.L.LI:Free vibration of beam with journal boundary conditions, Journal of sound and Vibration Volume237,issue 4,2000,pages 709-72.

[5] Benning,R.D. Hodgings, M.G.and George G.Z.,Active control of mechanical vibration Bell labs Technical Journal 1997

[6] Force damped vibrations:Frequency Response Curve for steel and Aluminimum Bars, Ravindra R.Navthar,International Journal of engineering Science and technology 2011.

Nomenclature:

X= Amplitude of forced vibration, mm

F_0= Magnitude of external exciting harmonic force ,N

Ymax= Deflection of Beam in mm

E= Modulus of elasticity for beam

w= Frequency of external exciting force, rad/sec

C=Damping coefficient, N/mm

m = mass of beam

W= load in N

ὡn= Natural Frequency

M.S.=mild steel