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Vibration Absorption in Mild Steel Beam with Insert of Other Metals

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Abstract: **Purpose of this paper is to predict vibration absorption capacity using beams with inserts. The experiment is to be carried out to compare the vibration absorption of the material without inserts and with inserts of different visco-elastic materials of circular cross sections. The specimens are prepared from commercial mild steel and, Bakelite, Teflon as inserts. The experiment results are shown and from the results it has been concluded that the inserts of high Vibration absorption capability in the structures. The graphs obtained from the oscilloscope shows Vibration absorption of the beams.**

Keywords: **Mild steel beam/strip, Bakelite and pearlite rods, Oscilloscope.**

I. INTRODUCTION

Vibration control is a major concern in various industries as aeronautics, automobiles etc. The reduction of vibrations is a major requirement for performance, sound quality, and customer satisfaction. In this paper viscoelastic materials are classically used to control vibration. Use of high vibration absorption capacity inserts in structures of low vibration absorption characteristics is becoming popular.

This class of materials enables manufacturers to cut weight and cost while providing vibration and harshness performance. Inserted structures are now applied in almost all industrial fields.

Vibration absorption is the energy dissipation properties of a material or system under cyclic stress. It is an effect that tends to reduce the amplitude of oscillations in an oscillatory system, particularly the harmonic oscillator.

II. SPECIMEN DESIGN

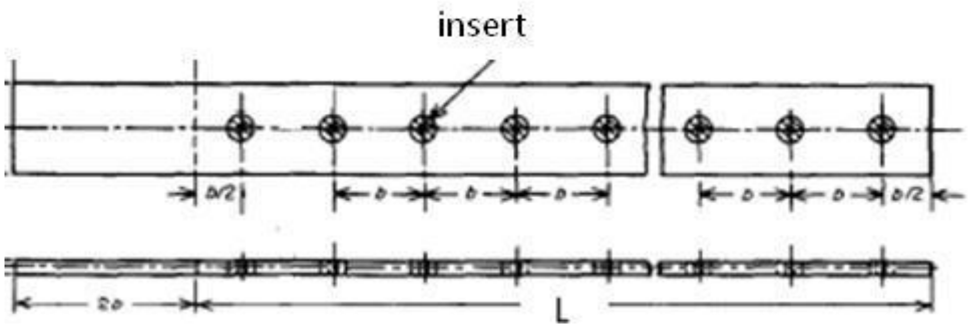

Fig.1: Schematic layout of specimen (b=40 mm, L=400 mm)

Fig.2: Mild Steel Beam with Teflon inserts

Fig.3: Mild Steel Beam with Bakelite inserts

III. INSTRUMENT

Fig.4 Oscilloscope

IV. PROCEDURE

- The specimens prepared from commercial mild steel flats are combined with inserts. Distance between the consecutive connecting inserts to be kept equal (40 mm) Specimens are rigidly fixed to the support and the experiment is to be conducted.
- At the free end excitation is given to produce vibration in the beam.
- The free end deflection at the free end of the solid cantilever is measured by using the oscilloscope and will be compared with the original material.
- The difference between the original material damping and the damping with inserts gives the damping due to inserts.

V. PRECAUTIONS

i. The excitation or impulse to beam should be given instantly.

ii. The beam should be rigidly fixed at the end.

iii. Inserts should be tightly fitted in the holes.

iv. Proper selection of the scale of measurement of the oscilloscope while measuring.

v. The vibration pick up should be properly fixed to the specimen near the tip of the cantilever.

IV. RESULT AND ANALYSIS

➢ The graphs obtained from the oscilloscope during experiment are shown below:

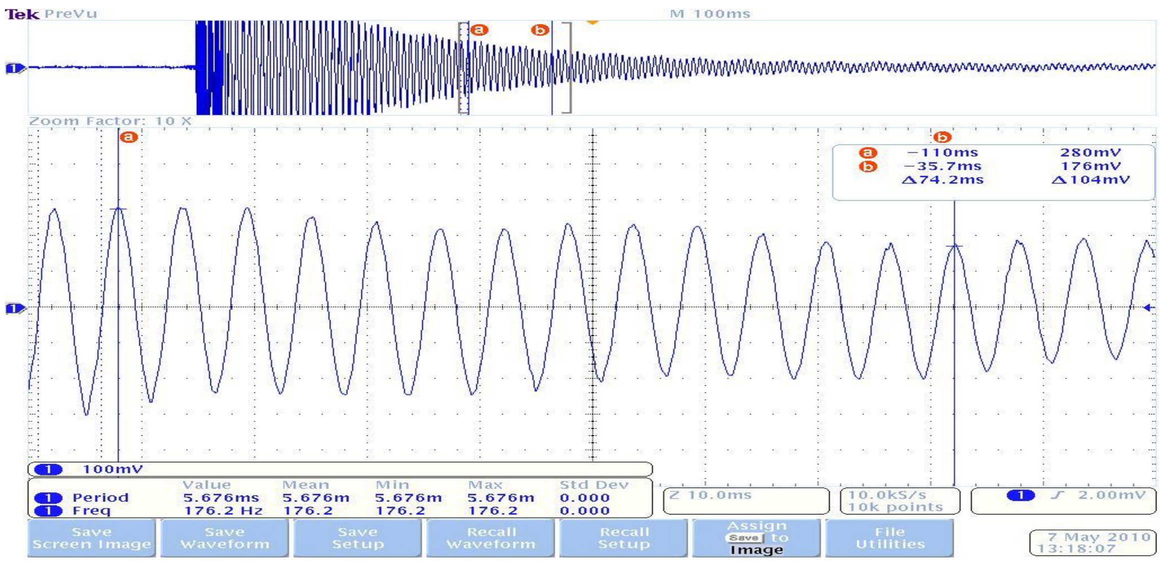

Fig 5: (Section of Amplitude-Time graph of mild steel beam without any inserts)

The logarithmic decrement of amplitude of vibration for n-cycles: $\delta_0 = \frac{1}{n}\ln(y1/yn)$

From the Graph: 5 $y1$ = 280 mV

yn = 176mV

n = 13

Hence, $\delta_0 = \frac{1}{13} ln\left(\frac{280}{176}\right)$

δ_0 = 0.0357

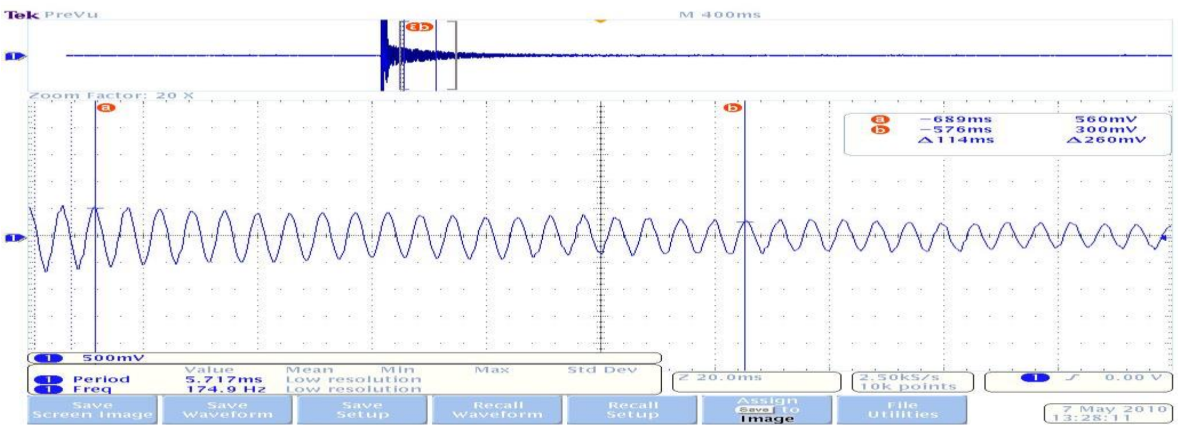

Fig 6: (section of Amplitude-Time graph of mild steel beam without any inserts)

The logarithmic decrement of amplitude of vibration for n-cycles: $\delta_0 = \frac{1}{n}\ln(y1/yn)$

From the Graph: 6 $y1$ = 560 mV

yn = 300 mV

n = 20

Hence, $\delta_0 = \frac{1}{20} ln\left(\frac{560}{300}\right)$

δ_0 = 0.0312

δ_t = 0.0595

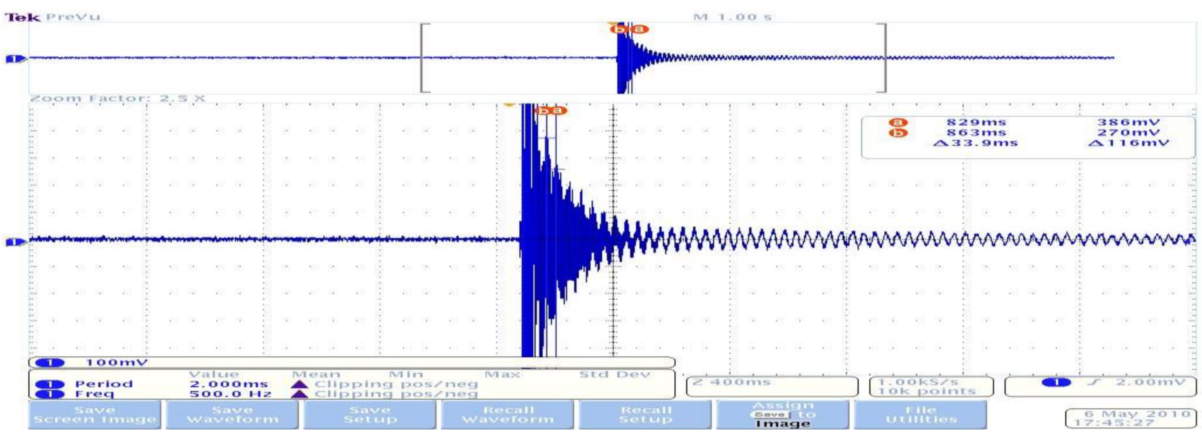

Fig 7: (Graph showing the vibration absorption of a mild steel beam with Teflon inserts)

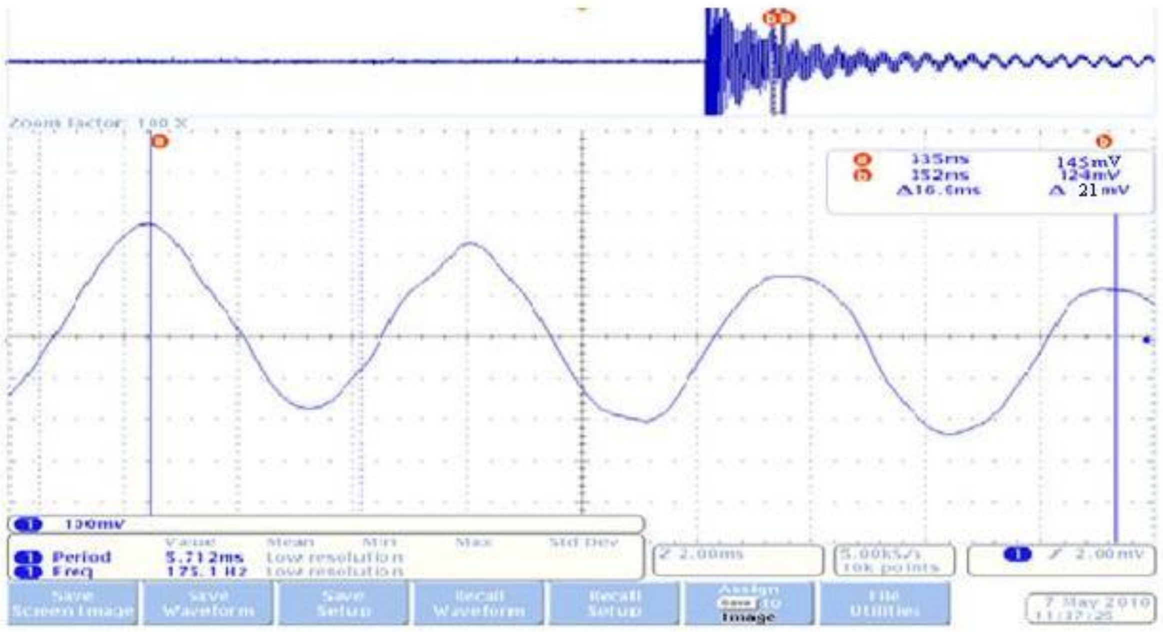

Fig 8: (Section of Amplitude-Time graph of mild steel beam with Teflon inserts)

The logarithmic decrement of amplitude of vibration for n-cycles: $\delta_t = \frac{1}{n}\ln(y1/yn)$

From the Graph: 8 $y1$ = 145 mV

yn = 124 mV

n = 3

Hence, $\delta_t = \frac{1}{3} ln\left(\frac{145}{124}\right)$

δ_t = 0.0521

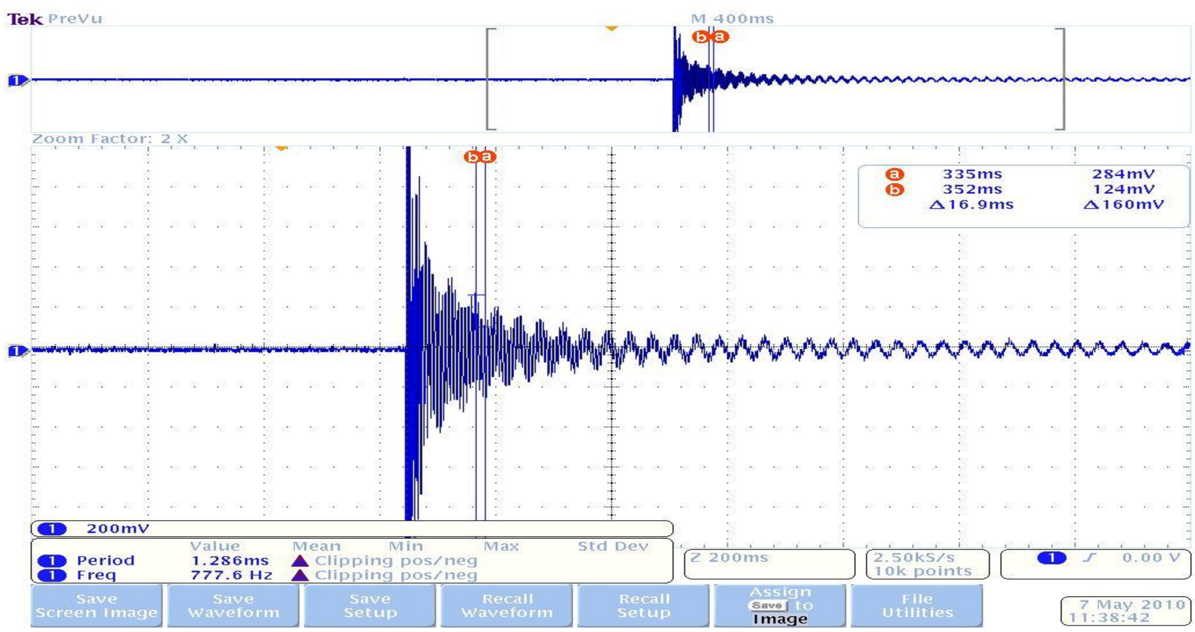

Fig 9: (Graph showing the vibration absorption of a mild steel beam with Teflon inserts)

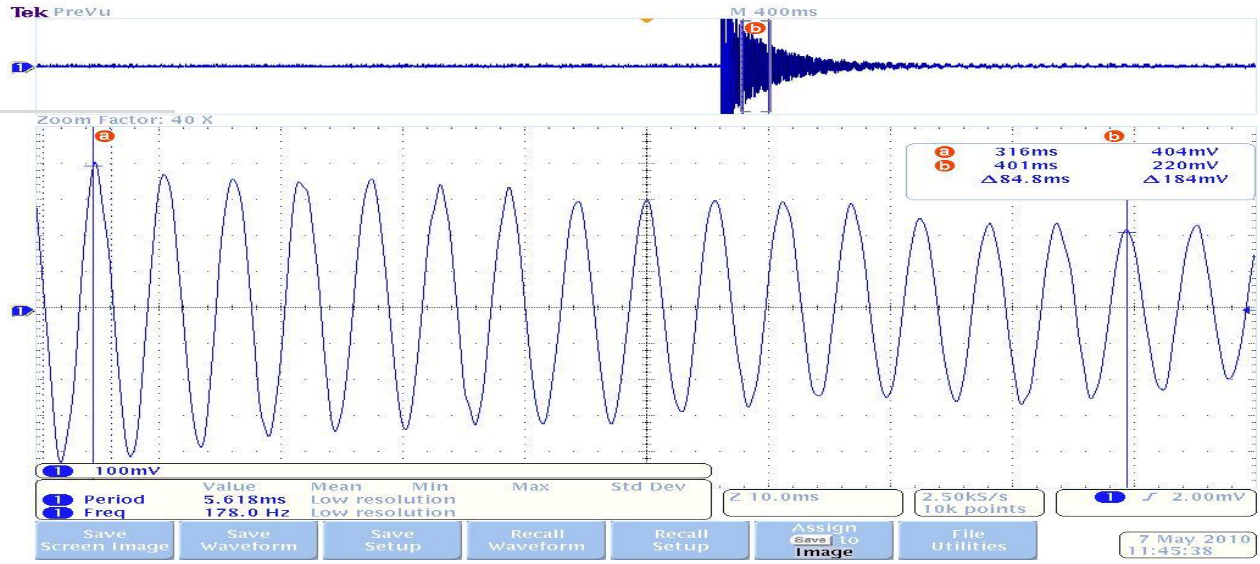

Fig 10: (Section of Amplitude-Time graph of mild steel beam with Teflon inserts)

The logarithmic decrement of amplitude of vibration for n-cycles: $\delta_t = \frac{1}{n}\ln(y1/yn)$

From the Graph: 10

$y1$ = 404 mV

yn = 220 mV

n = 15

Hence, $\delta_t = \frac{1}{15} ln\left(\frac{404}{220}\right)$

δ_t = 0.0405

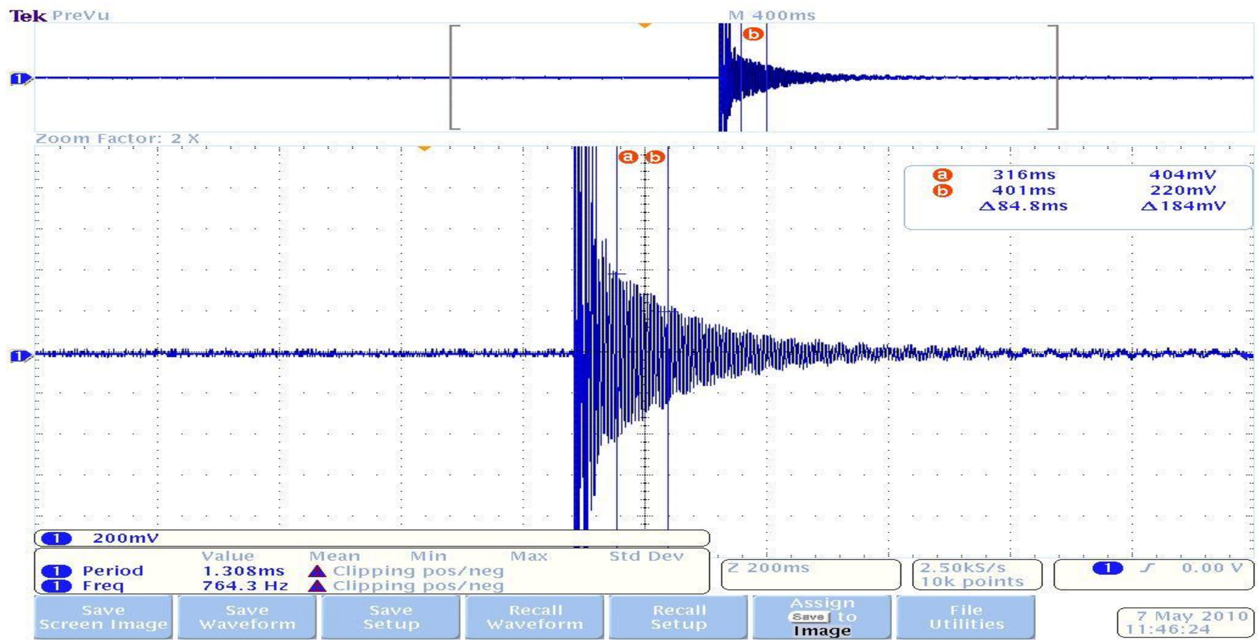

Fig 11: (Graph showing the vibration absorption of a mild steel beam with Teflon inserts)

Table 1

OBSERVATION NO.	NATURAL FREQUENCY OF VIBRATION(Hz)	TIME PERIOD (ms)	Δt	MEAN δ_t
1	176.2	5.675	0.0595	
2	175.1	5.712	0.0521	0.0507
3	178.0	5.618	0.0405	

The logarithmic decrement of vibration of a mild steel beam with Teflon inserts is found to be

δ_t = **0.0507**

So the increase in the damping property of the beam due to Teflon inserts is $\delta_t = \delta_t - \delta_0$

From Table: 1 $\delta_0 = 0.0346$

From Table: 2 $\delta_t = 0.0507$

δ_t = **0.0161**

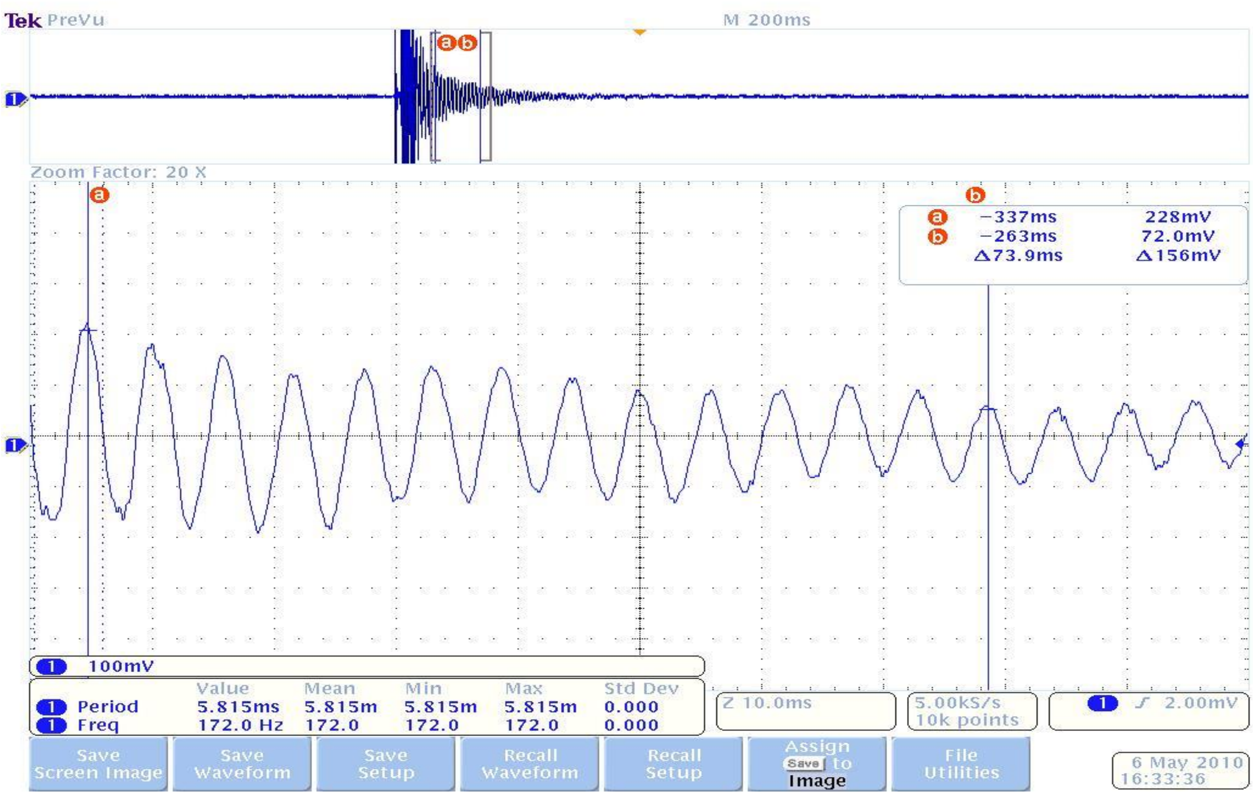

Fig 12: (Section of Amplitude-Time graph of mild steel beam with Bakelite inserts)

The logarithmic decrement of amplitude of vibration for n-cycles: $\delta_b = \frac{1}{n}\ln(y1/yn)$

From the Graph: 12 $y1$ = 228 mV

yn = 72 mV

n = 13

Hence, $\delta_b = \frac{1}{13} ln\left(\frac{228}{72}\right)$

δ_b = 0.0887

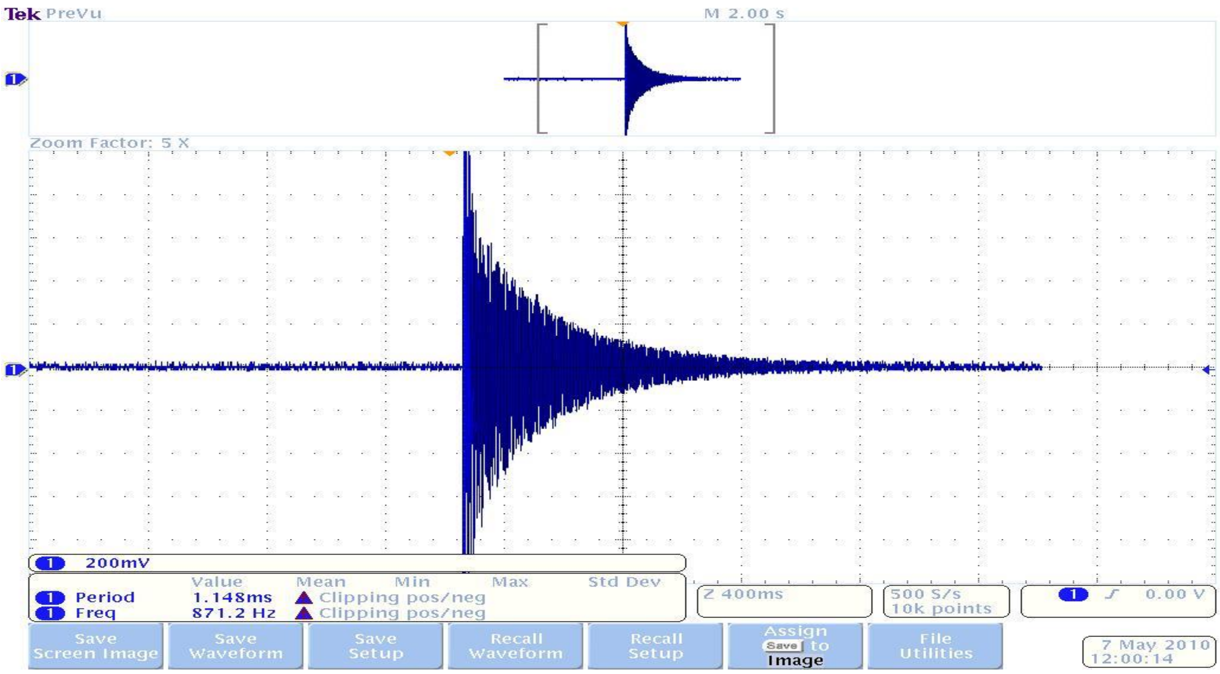

Fig 13: (Graph showing the vibration absorption of a mild steel beam with Bakelite inserts)

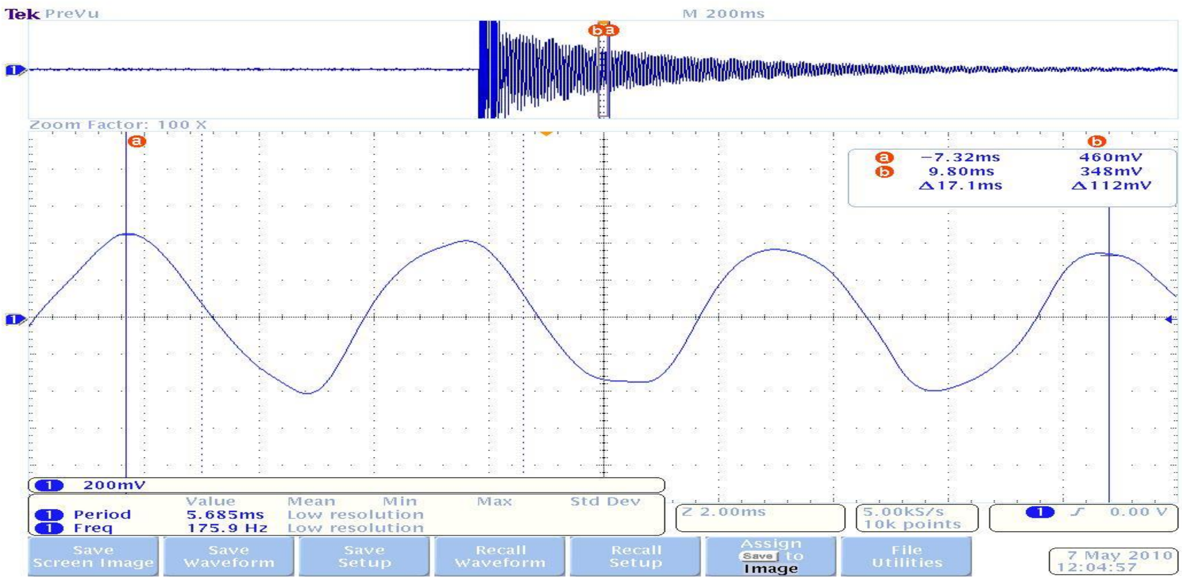

Fig 14: (section of Amplitude-Time graph of mild steel beam with Bakelite inserts)

The logarithmic decrement of amplitude of vibration for n-cycles: $\delta_b = \frac{1}{n}\ln(y1/yn)$

From the Graph: 460 $y1$ = 460 mV

yn = 348 mV

n = 3

Hence, $\delta_b = \frac{1}{3} ln \left(\frac{460}{348}\right)$

$\delta_b =$ 0.093

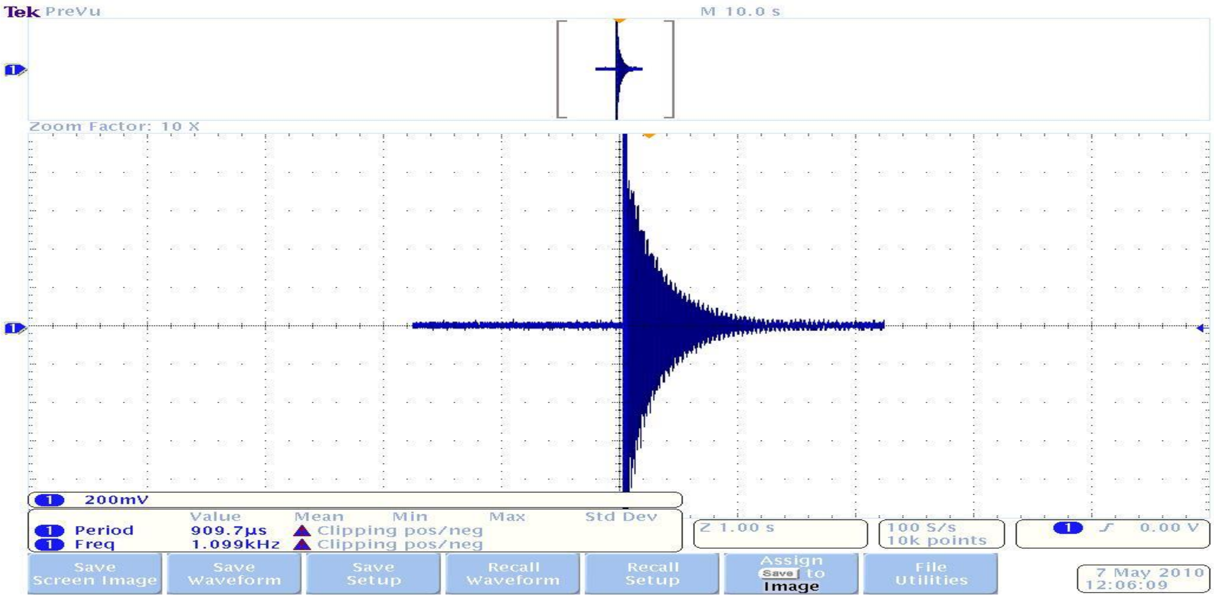

Fig 15: (Graph showing the vibration absorption of a mild steel beam with Bakelite inserts)

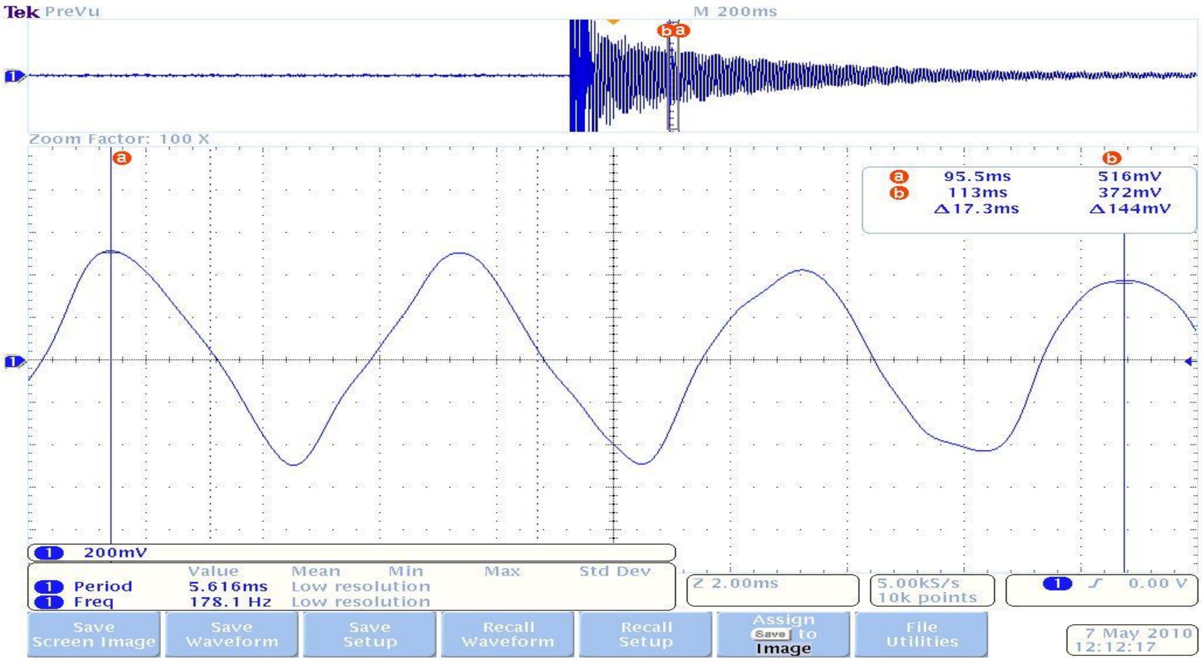

Fig 16: (Section of Amplitude-Time graph of mild steel beam with Bakelite inserts)

The logarithmic decrement of amplitude of vibration for n-cycles: $\delta_b = \frac{1}{n}\ln(y1/yn)$

From the Graph: 25 $y1$ = 516 mV

yn = 372 mV

n = 3

Hence, $\delta_b = \frac{1}{3} ln \left(\frac{516}{372}\right)$

δ_b = 0.109

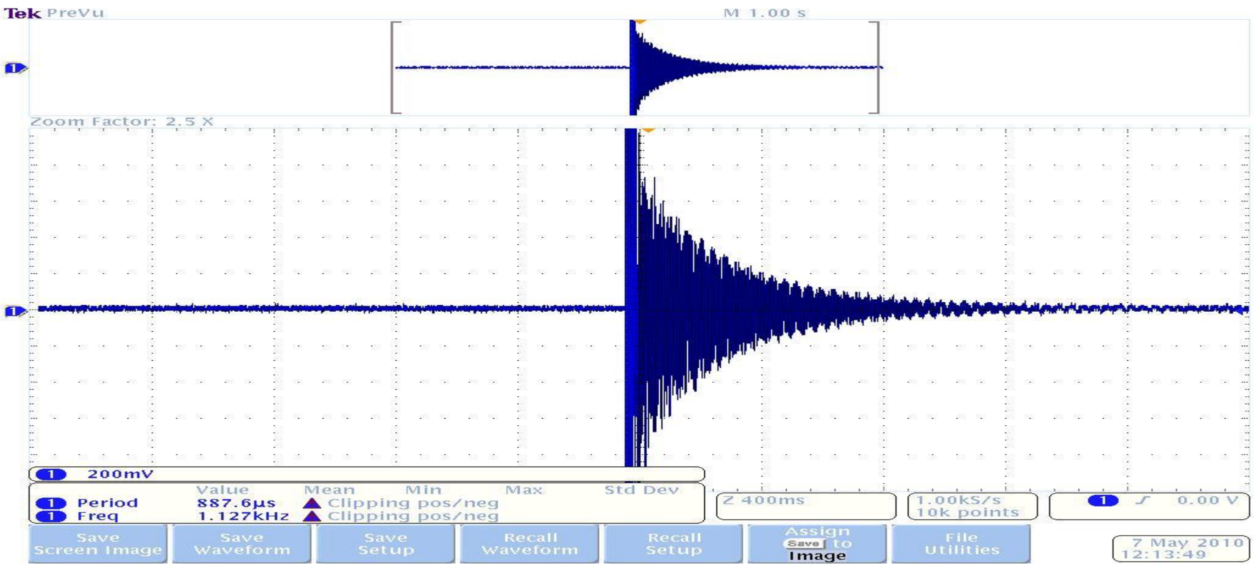

Fig 17: (Graph showing the vibration absorption of a mild steel beam with Bakelite inserts)

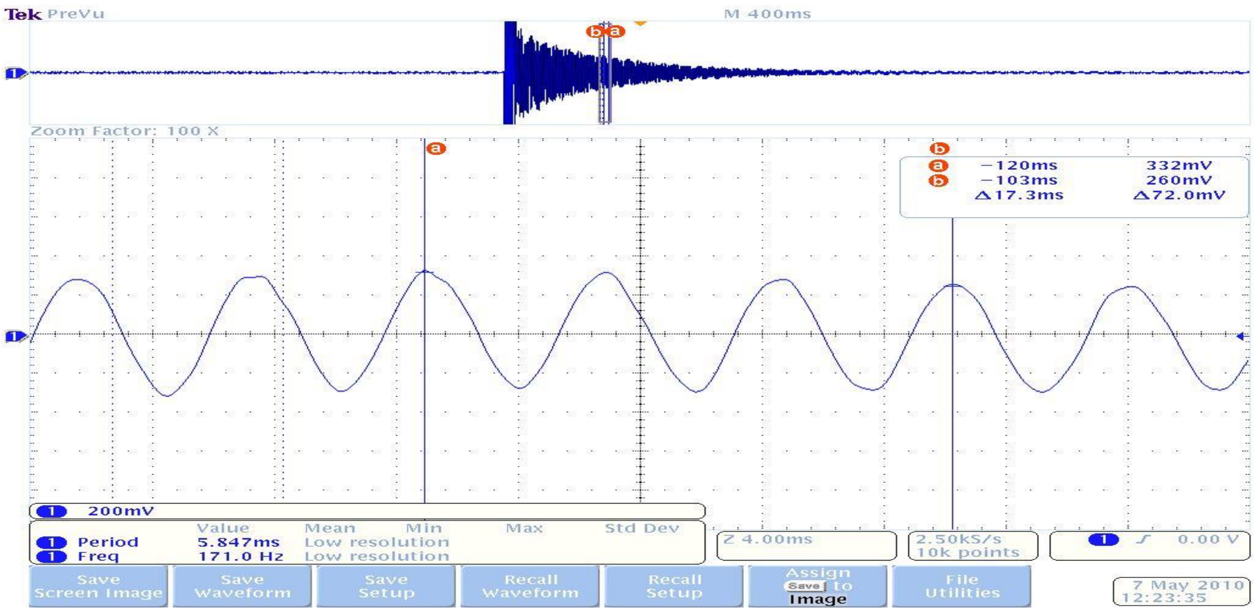

Fig 18: (Section of Amplitude-Time graph of mild steel beam with Bakelite inserts)

The logarithmic decrement of amplitude of vibration for n-cycles: $\delta_b = \frac{1}{n}\ln(y1/yn)$

From the Graph: 18 $y1$ = 332 mV

y_n = 260 mV

n = 3

Hence, $\delta_b = \frac{1}{3} ln \left(\frac{332}{260}\right)$

δ_b = 0.0814

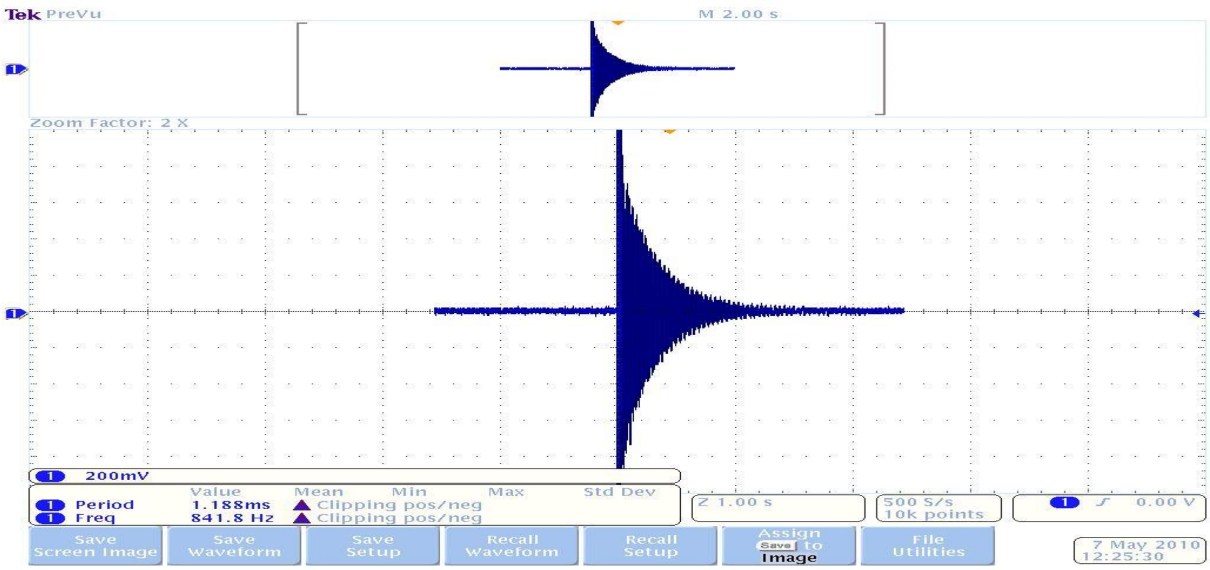

Fig 19: (Graph showing the vibration absorption of a mild steel beam with Bakelite inserts)

Table 2

OBSERVATION NO.	NATURAL FREQUENCY OF VIBRATION(Hz)	TIME PERIOD (ms)	Δb	MEAN δ_b
1	172	5.815	0.0887	0.093
2	175.9	5.685	0.093	
3	178.1	5.616	0.109	
4	171	5.847	0.0814	

The logarithmic decrement of vibration of a mild steel beam with Perspex inserts is found to be

δ_b = **0.093**

So the increase in the damping property of the beam due to Teflon inserts is $\delta_b = \delta_b - \delta_0$

From Table: 1 δ_0 = 0.0346

From Table: 4 δ_b = 0.093

δ_b = **0.0584**

V. CONCLUSIONS

Proper introduction of stress concentration into structural members can considerably increase their vibration absorption capacities and dynamic rigidities with minor sacrifice in their static rigidities. Better vibration absorption characteristics can be achieved when structural members are fitted elastic inserts of materials having higher vibration absorption capacities, almost without sacrificing any static rigidity or slightly compromising with strength of the structure. Proper combination of beam and insert materials, the increase in vibration absorption could be high enough so as to offset the effect of stress concentration. So the inserts of high damping capability in the structures increases the vibration absorption capability of the structure.

From the experiment it is concluded that **Bakelite** inserts enhance the vibration absorption capability of the metal beam more than **Teflon** inserts.

$\boldsymbol{\delta_b > \delta_t > \delta_0}$

δ_b = **0.0584,** δ_t = **0.0161**

The increase in vibration absorption capability of the two types of inserts is in the following order:

$\boldsymbol{\delta_b > \delta_t}$

So the beam with Bakelite inserts shows the maximum vibration absorption capability compared to Teflon

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