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An Analytical Study of Structure in Seismic Wave by using Damping Beams

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Abstract: This paper was aim to investigate the natural frequency of structure with and without damping beam. Where we found that the maximum deflection on with and without is 31.6 mm and 52.8 mm respectively. To generate the artificial seismic wave we used motor and sliding table which are connected to the crank to linear. The vibration of table was given by rotation of motor. (Motor is 100 rpm) and seismic effect on building was found by ultrasonic sensor, arduino programming.

Keywords: Damping, Vibration, Arduino

I. INTRODUCTION

Earthquakes have always impressed human's life and have played a fundamental role in almost all the constructions and designs. Unfortunately, this hazardous phenomenon causes a high rate of casualty in people's life and wealth all over the world every year. Although seismology and its methods for reducing damages in structural engineering does not have a long history, theories and devices for controlling earthquake effects have developed saliently during recent decades .Damping is restraining of vibratory motion, such as mechanical oscillations, noise, and alternating electric currents, by dissipation of energy. Damping Beams are flexible beam, absorbs the seismic waves and reduces the amplitude of waves. The function of these beams is to reduce the vibration that act on beams and column as it is placed diagonally. The horizontal force that acts on beams and columns during earthquake, it distributes or resolves it into horizontal and vertical components. The spring and liquid damper is used in middle portion of the beam as shown in figure 2.

II. METHODOLOGY

As we study, the building model when it is in the seismic wave. We'll found several important things in our building. Most of the building frames are rectangular or square shape and size. While the diagonal of the frame is consider as D1 and D2 which are equal (D1=D2) And the beam and column angle are always 90 degree in all the corner.

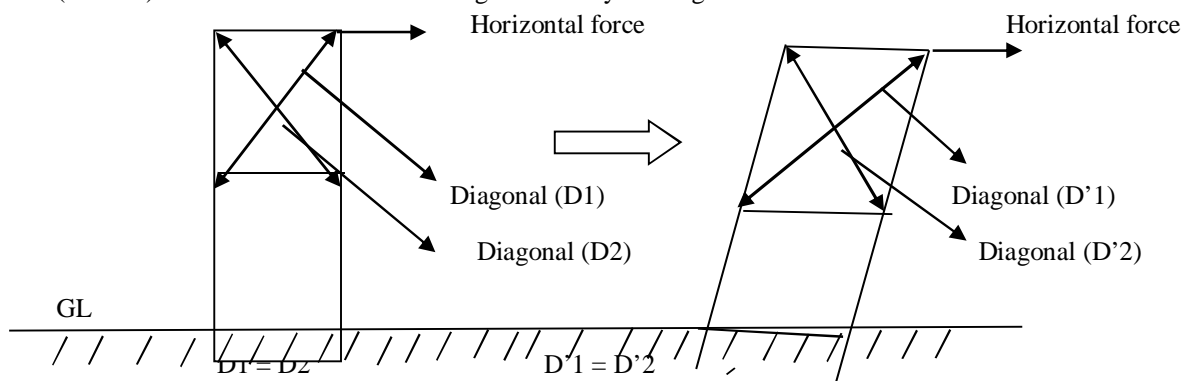


Fig 1: Horizontal loading effect on building

When we pass the seismic wave, horizontal force is generated The rectangular frame is change into parallelogram. Let us consider the diagonal of the building are D1 and D2(D1 =D2). After displacement due to horizontal force it's diagonal members will make angle less than or more than 90 degree with joints of column and beam .If we use damping beam , so that the diagonal members of structure will not displace than vibration of building will get reduced

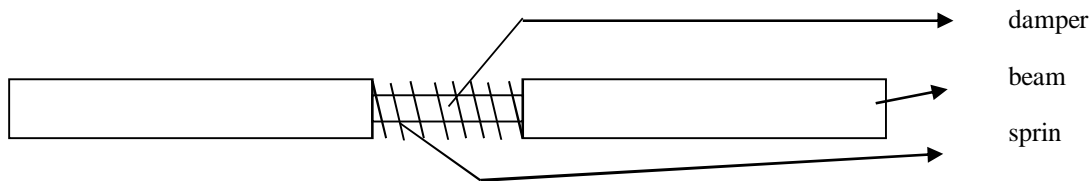


Fig 2 Damping beam

We can use this beam in internal wall and external wall, as shown in figure.

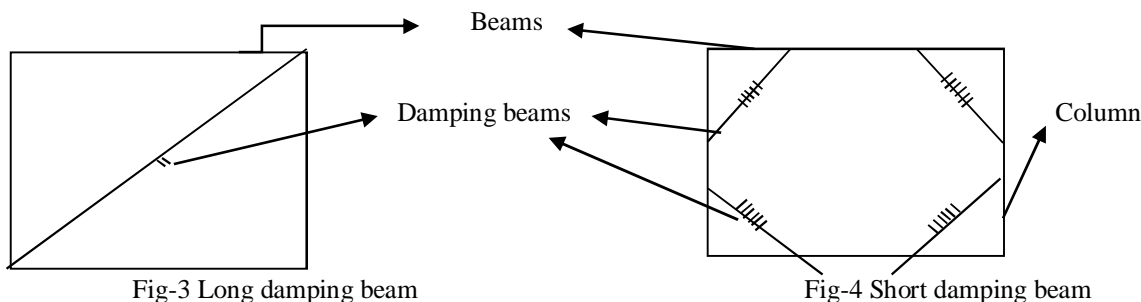


Fig-3 Long damping beam

Fig-4 Short damping beam

The beam above can be used inside the wall material. Long damping beam can only be used in the wall which consist no door and window. And short damping beam can only be used in external wall which consist of door and window.

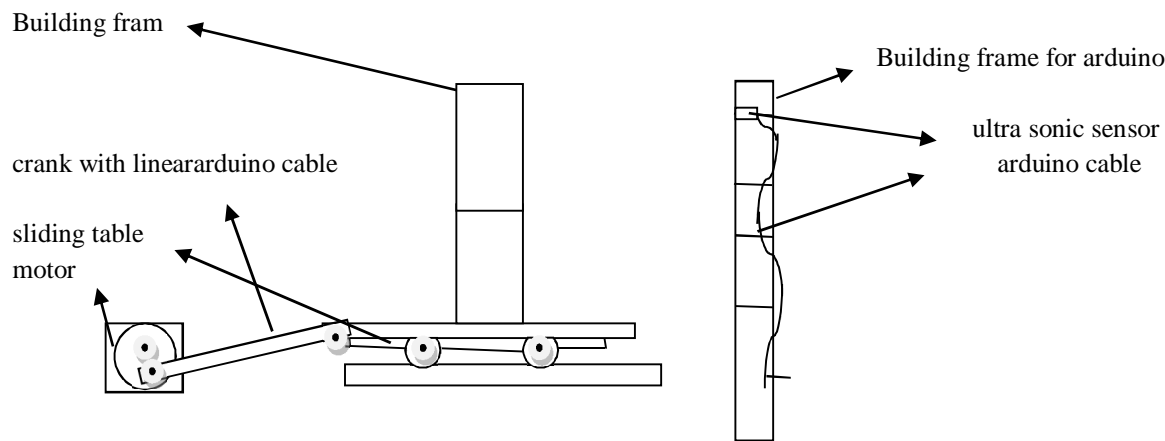


Fig-5 working model

III. PROCEDURE

At first we assemble all the instrument as shown in fig 5. Sliding table and motor are connected with crank to linear. Building and frame is fixed in table, .At similar height the other building frame was made for arduino. When we run the motor by giving a power to it,(i.e. with the help of crank to linear the rotational movement change into linear movement) which make sliding table. move in horizontal direction rapidly. While table is running into horizontal movement the building frame vibrates, with the help of arduino and ultra-sonic sensor we record the data of vibration

A. Ultrasonic Sonar

HC-SR04 is a commonly used module for non-contact distance measurement for distances from 2cm to 400cm. It uses sonar (like bats and dolphins) to measure distance with high accuracy and stable readings. It consists of an ultrasonic transmitter, receiver and control circuit. The transmitter transmits short bursts which gets reflected by target and are picked up by the receiver. The time difference between transmission and reception of ultrasonic signals is calculated. Using the speed of sound and '**Speed** = Distance/Time' equation, the distance between the source and target can be easily calculated.

B. Distance Calculation

Time taken by pulse is actually for to and from travel of ultrasonic signals, while we need only half of this. Therefore time is taken as time/2.

$$\text{Distance} = \text{Speed} * \text{Time}/2$$

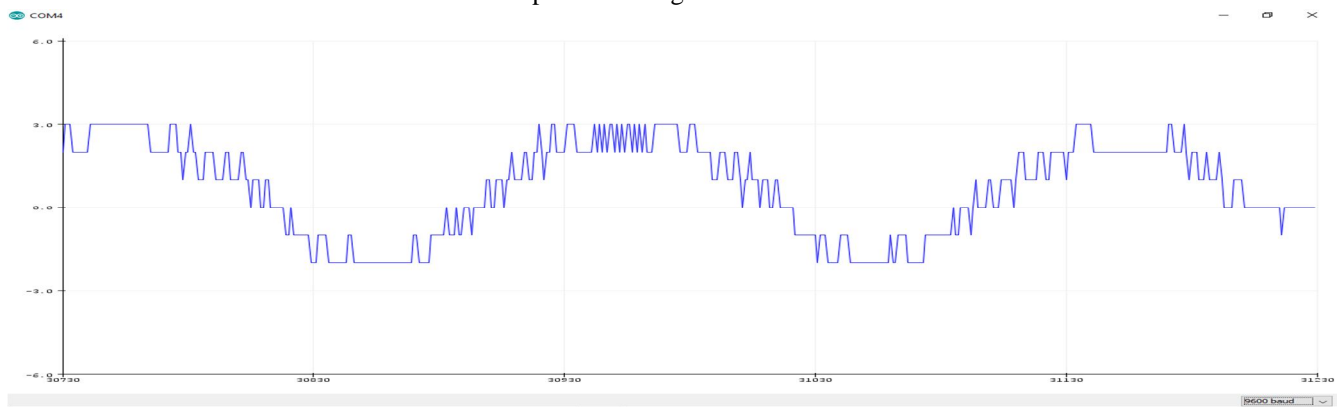
Speed of sound at sea level = 343 m/s or 34300 cm/s

Thus, Distance = 17150 * Time (unit cm)

IV. RESULT

S.N	Deflecting without Damping beams (in mm)	Deflecting with Damping beams (in mm)	Difference in deflection
1	50	30	20
2	46	32	14
2	57	35	22
4	55	31	24
5	56	30	26
AVG	52.8	31.6	21.2

Graph of building while vibration



Here we can see that the deflection with and without damping beam is 31.6mm and 52.8mm the difference between vibration is 21.2 mm.

V. CONCLUSION

In this paper the vibration of building is reduced by damping beam as a vibration reducer beam.,which can be use in any building It can replace tuned mass dampers in future.

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