Chapter- 4

Vibration measurement and applications

4.1 General

Ground vibrations arising from man-made sources including construction activities, blasting, and vehicle and rail traffic may interfere with surrounding residential and commercial activities. Ground-home vibrations can also cause cosmetic and structural damage to nearby structures. The problems may occur as a result of large amplitude vibrations, from repeated occurrences of smaller amplitude vibrations, or from differential settlement induced by particle rearrangement. Ground-borne vibrations are often accompanied by air-borne noise, annoying and heightening the sensitivity of humans. Their concerns often result in legal complaints alleging disruption with daily activities or damage to existing. To assess the impact of ground-borne vibrations on humans and to ensure the safety of existing structures, vibrations arising from construction activities, blasting, and vehicle and rail traffic are often monitored, especially in congested urban and suburban areas.

4.2 Vibration measurement using sensor

There are various sensor used to detect the vibration in civil structures. The sensor used for vibration measurement is piezoelectric sensor and accelerometer sensor. In our study we try to use the low cost piezo knock sensor to detect the vibration. Piezo knock sensor are made up of ceramic material which gives electric signal on application of vibration.

Case study

A steel simply supported beam of dimension (70x2.5x0.3 cm) was instrumented with PZT knock sensor at mid-point of beam , and tested under different loading . The beam was loaded at single point load. The hanger was at a distance of 30 cm from the left support on which different load was made to fall at a specific height. The initial output value was recorded just after load hanger is placed on the beam .First, the load 450 N was made to fall on hanger to produce vibration on the steel beam and then output value of aurnido was observed on the monitor. To increase the vibration, the 503 N load was further added to

hanger and the output value was observed. This process is repeated to take at least 4 observation value. The output value of arduino shows the linear response as the vibration increases.

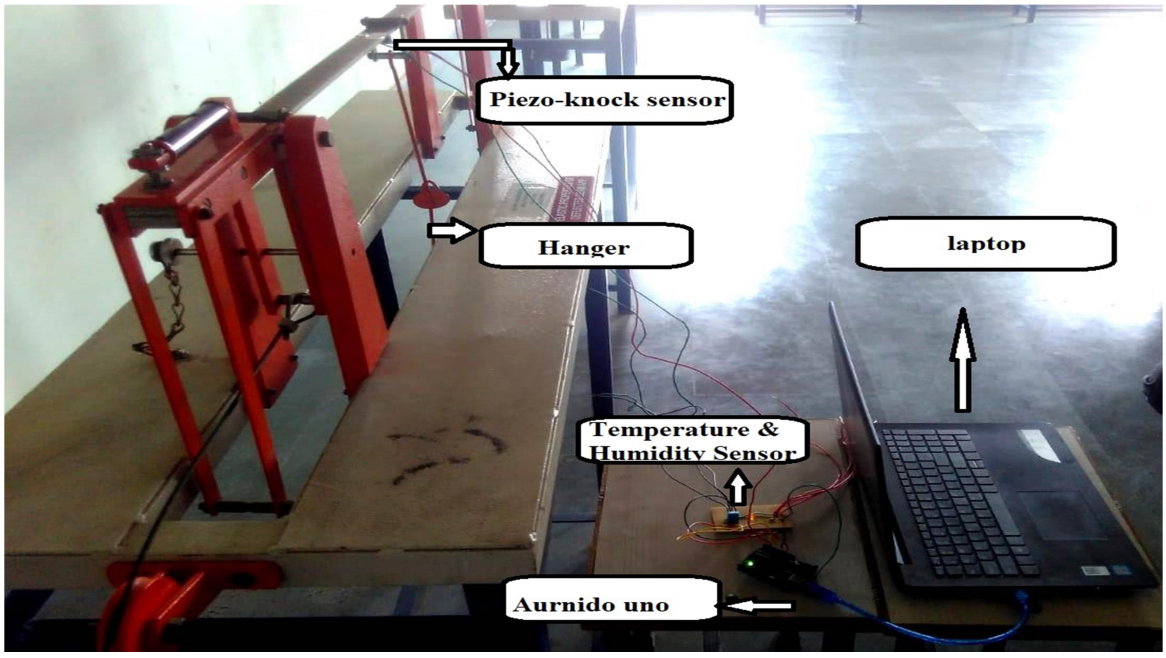

Figure 4.1 Experimental setup for vibration measurement\

The output value was just the sample number between 0 to 1023 having no unit. Whenever vibration was incorporated in the beam , it shows some number on the monitor which increases as the vibration increases. These sample number are given corresponding to the output voltage generated between 0 to 5V due to vibration in Beam.

Table 4.1 Sample value recorded by PZT sensor for steel beam under single point load

S.NO	LOAD (N) (applied on hanger from specific height)	TOTAL LOAD (N)	OUTPUT VALUE (Sample no)
1	450	450	23
2	505	955	36
3	505	1460	54
4	466	1926	69

Result

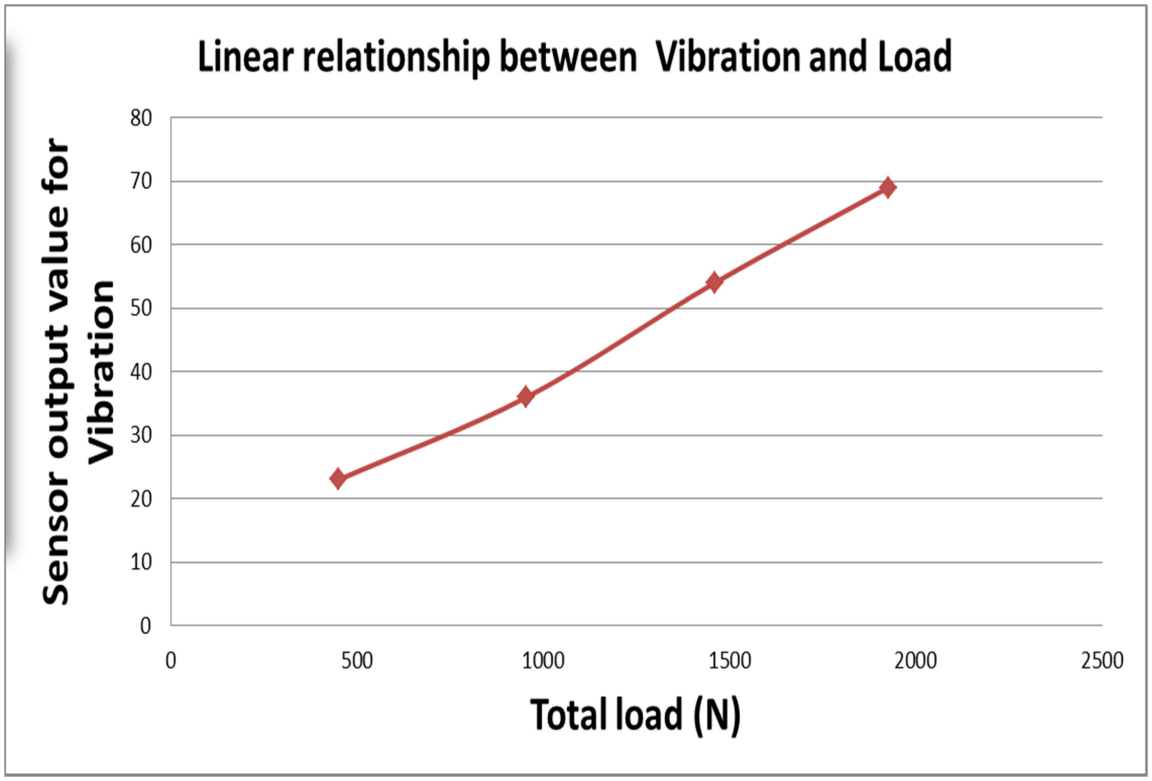

Figure 4.2 Graph showing linear response of vibration with load

It can be observed that the sensors have captured the natural frequencies of the experimental structures reasonably well and the vibration induced in experimental structure are directly proportional to the effect of load. From cost point of view, Piezo knock sensor are very cheap as compared to strain gauges and PZT patches.