1.0 INTRODUCTION
Vibration, very simply put, is the motion of a machine or its part back and forth from its position of rest. Forces generated within the machine cause vibration. These forces may:

1. Change in direction with time, such as the force generated by a rotating unbalance.
2. Change in amplitude or intensity with time, such as the unbalanced magnetic forces generated in an induction motor due to unequal air gap between the motor armature and stator.
3. Result in friction between rotating and stationary machine components in much the same way that friction from a rosined bow causes a violin string to vibrate.
4. Cause impacts, such as gear tooth contacts or the impacts generated by the rolling elements of a bearing passing over flaws in the bearing races.
5. Cause randomly generated forces such as flow turbulence in fluid-handling devices such as fans, blowers and pumps; or combustion turbulence in gas turbines or boilers.

Some of the most common machinery problems that cause vibration include:

i. Misalignment of couplings, bearings and gears
ii. Unbalance of rotating components
iii. Looseness
iv. Deterioration of rolling-element bearings
v. Gear wear
vi. Rubbing
vii. Aerodynamic/hydraulic problems in fans, blowers and pumps
viii. Electrical problems (unbalance magnetic forces) in motors
ix. Resonance
x. Eccentricity of rotating components such as "V" belt pulleys or gears

In industry or academia there is a great need to understand the phenomena of vibration and the problems due to it (some of them are discussed above). In this paper an attempt is made to explain the development of an experimental setup which can simulate the conditions of vibrations and the procedure or technique to minimize it. The said setup can be equipped with FFT analyzer which further gives the edge to vibration analysis. Fourier analysis is another term for the transformation of a time waveform into a spectrum of amplitude vs frequency values. Fourier analysis is sometimes referred to as spectrum analysis. The special feature of the developed setup is that it can create a soft foot condition, which is also a cause of vibration and which may lead towards the catastrophic failure of the system. In the next section a soft foot phenomena is explained.

2.0 SOFT FOOT
The term “soft foot” is actually a misnomer. There is nothing "soft" about a "soft foot". Soft foot, is a condition that results when one or more feet of a machine do not sit in the same plane as, are angled differently from, or are different lengths than, the rest of the machine’s feet. Soft foot conditions can also be induced by forces applied to the machine by fixtures that are attached to it. Soft foot is a term used to describe conditions that manifest themselves as machine frame distortion. This non-uniformity causes stress on the machinery when the foot is forced into place by tightening the hold-down bolt. Missing shims under a foot, a bent foot, or a deteriorating base plate or foundation can cause this condition. Soft foot generally describes any condition where poor surface contact is being made between the underside of the machine casing ‘feet’ and where they contact the base-plate or frame. Following figure shows the types of soft foot exist in the machinery.

![Figure 1: Classification of soft foot condition](image)

Causes of Soft Foot - As stated earlier a soft foot condition is caused by bad bases; uneven and/or bent motor feet; bent, dirty, or too many shims; dirt and/or rust under the motor feet; and pipe strain. Apart from these factors following are the hidden dangers for installation of machines without soft foot:

- overhung machines or attachments;
- belt, gear or chain loads;
- hoses or stressed conduit;
- structural bracing attached to the machine;
- jack bolts left tight against the machine base;
- poorly finished foundations;
- piping that fails to meet zero-cold-spring tolerances at flange connections.

In the following section a brief detail of the various elements present in the developed setup is given.

TEST SETUP FOR VIBRATION ANALYSIS
To visualize the hidden details and making necessary changes before manufacturing, solid model of experimental setup (refer figure 2) is created which gives a good insight about the project and saves the resources in the form of material and man hours.
1) BASE PLATE
The major part of this test setup is base plate which is made up from a C – Channel having dimensions 200x100x25mm the C – Channel have been taken for base of “Demonstration Setup”. It has been machined on vertical milling machine to obtain the desired dimensions as per the drawings. We have a flat surface finish On the top of the C- channel to provide rigid and firm support to the bearing base plates. Also facilitated with number of holes to change the bearing support positions according to the requirement at various locations.

2) Bearing’s Base Plate
The main objective of this component is to give rigid and firm support to the bearings of the test setup the dimensions of plate are 200 mm x 100 mm x 33 mm.

3) Bearing’s Support Plate

4) Bearings
Specification
1. Type – Self-Aligning ,
2. Manufacturer – NTP ,
3. Inner Diameter – 15 mm ,
4. Center Height – 30.1 mm.

5) Bearings

6) Center Disc and End Disk

7) Shaft
Stainless steel bar of $\Phi$ 15 mm diameter of full length 630 mm.

8) Jaw Couplings with Spider
Cast iron type jaws coupling (A90) with gasket has been taken.

9) Coupling cover & Protection Cage
As far as safety concerns are considered we have been taken
the care of the operator in case of the failure of any compo-
ent in the "Test Setup". It provides two way protections to
the operator. First we have coupling cover of metal plates
who covers the jaw couplings and secondly protection Cage
which envelops entire setup. It is made up of the MS plates
of 5mm thickness and welded in such a way like mesh which
assures that any failure will not harms to the operator.

Soft Foot Arrangement

Figure 10. MOTOR BASE WITH SOFT FOOT
Figure 10 shows the deformation of the electric motor base
foot takes place due to bolt tightening and soft foot condi-
tion. There is the placement of shim to fill up the gap be-
tween electric motor base and machine base.

Conclusion:-
In today’s stringent eco-friendly and legal requirements of
industrial environment, mitigation of vibration and the subse-
quent noise created by it is the utmost priority. Knowing the
vibration phenomena, its causes and remedial measure is the
key requirement of any professional engineer. To understand
this facts, the developed experimental setup will help for en-
gineering students and professional engineers and helps im-
prove their proficiency in the said subject. The flexibility and
different adjustments available in this setup makes it versatile
instrument.
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