Fabrication of Low Cost Digital Spring Pressure Testing Machine

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***Abstract*—** The main objective of this project is to determine the stiffness of spring under the action of different load which can be improved for implementation in industrial work. Mechanical Engineering is useful and inseparable from industry and industry. The production and manufacturing process entails converting raw materials into final items that meet required parameters while utilizing cutting-edge technologies. The stiffness, modulus of rigidity, and bulk modules are determined using a spring load testing machine in our project. A variety of inspection machines are utilized in the spring working business. Because the sector is broad and growing, several types of machinery are employed for various processes. The spring rolling machine in our concept is relatively simple to operate thanks to the use of a microcontroller and a digital display. This machine is used to perform several types of spring load tests on springs of varying diameters and lengths. This equipment has a wide range of applications. The building and operation of this machine are straightforward.

Industries buy springs for their hydraulic valves, but they have a hard time evaluating the rigidity of the springs. We conceived and developed a digital spring stiffness testing machine after learning about the industry's challenges with spring testing. We can determine spring stiffness using only two parameters: load and deflection. The machine is designed to meet the needs of a company that manufactures various valves. As a result, a digital spring testing equipment has been designed to meet the needs of the organisation. In this machine we compress the spring by lever and measure the corresponding load and deflection of spring. With the help of load cell and deflection reading we can easily calculate the stiffness of spring

***Keywords*— Machine fabrication, spring pressure testing machine, low cost fabrication, spring stiffness, digital caliper**

I. *INTRODUCTION*

A spring testing kit is a machine that allows you to stretch or compress springs while monitoring load and displacement. A spring for tensile tests and another spring for compression tests are included in the kit. A spring is a pliable/elastic object that can be used to store mechanical energy. Generally, Spring steel is the common material used to make springs. Small springs can be wound from pre-hardened material, whereas bigger springs are fabricated from annealed steel and then hardened.[4] Phosphor bronze and titanium are utilised for parts that require corrosion resistance, and beryllium copper is utilised for springs that transmit electrical current (because of its low electrical resistance). The force exerted by a spring when compressed or extended is proportional to its length change. A spring's rate, or spring constant, is equal to the change in force and it exerts divided by the change in deflection. That is, it is the force against deflection curve's gradient.[2] The units of force in an extension or compression spring are split by distance,are units of force multiplied by distance divided by angle in torsion springs. Compliance is the inverse of spring rate, therefore if a spring has a rate of 10, it has a plaice of 0.1. The stiffness (or rate) of springs in series is additive to the stiffness (or rate) of springs in parallel. Any material can be used to make a spring, depending on the design and operating environment, as long as the material has the requisite combination of stiffness and elasticity: theoretically, a wooden bow is a type of spring.

The spring constant testing kit we created in this experiment will be able to determine the stiffness value of a spring. By implementation in digital machine through coding, alternative techniques of spring constants were examined.[5] For the determination of the spring constant, several research projects and experiments were carried out. For atomic force microscopy, a method for calculating the spring constant of cantilevers was developed. Machine operation is vey simple. Only operate the machine for readings, load and deflection we can calculate spring stiffness.[1]

II. *LITERATURE SURVEY*

- **AVDHUT R JADHAV** signed in the year of 2014 a digital spring stiffness testing machine. It consists of two hydraulic cylinders of different diameters interconnected by same liquid. The larger cylinder has a ram and the smaller has a plunger. When force is applied by lever it gets multiplied to many times and that multiplied force acts on the spring through load cell. Due to this force the plunger compresses the liquid transmitting compressive force to the spring thereby compressing it. A load gauge is used to measure the force and the ruler scale to measure the deflection of spring. The ratio of this force to the corresponding deflection gives the spring constant (stiffness) of the spring under test. From this study we come to know the versatility of a spring testing machine.[1]

- **MUHAMMAD ABU RAHAT** presented a technology for measuring the stiffness of springs (tensile & compressive). The testing model consists of a frame, load cell & a vernier digital calliper scale; a spring is placed on the angled guide bar. When a mass hanger is directly attached to the bottom of the spring, the position of the bottom of the mass relative to a meter stick is recorded. Masses are added to the spring and the position of the bottom of the mass hanger is then noted. A load cell shows the vertical force applied to the spring. By moving freely with the load cell, scale behind spring directly measures the spring compression. The results are obtained in the form of time graph for force and displacement of the spring. And thus by getting the load and displacement, spring constant of the compression spring can be measured. The procedure is repeated for various masses thus getting different samples of

readings. These samples are then compared with the theoretical formula based calculations of spring constant.[2]

➢ **WANG JIAN** studied the design of spring load testing & separating system ensuring the quality of the spring. The overall system structure consists of a rectangular table having workstations; one of them is the load cell testing station. In this station, the spring is pressed from the rated position to the maximum position to measure the rated and the maximum pressures. The order of works carried out is the circle table rotating, the spring blanking, the load testing, the value calculating and the spring sorting. One master controller and four slave controllers take the responsibility for all the system functions and the synchronization among each controller is dominated by the master processor through the network communication. The complete debugging function consisting of servomotor control, display of spring parameter, valve switch control, & setting A/D parameter and the convenient operation ensure that the Spring Load Testing and Classification System will run steadily.[3]

III. *FABRICATION*

Project Design:

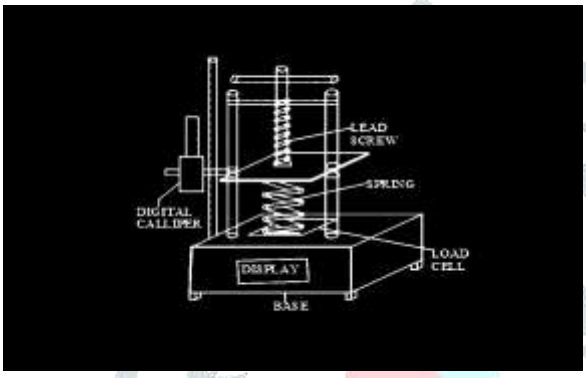
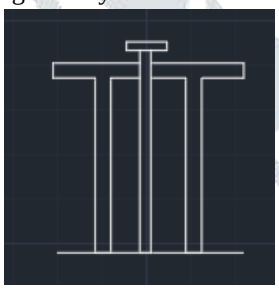


Fig: CAD Model of Digital Stiffness Testing M/C.

Frame High-quality, custom-made frames that serve as a study platform for conducting experiments. There are two frames in this picture. The bigger upright frame has clamps and feet. The frame can stand on a workbench or table thanks to the feet. Iron, copper, tin, aluminum, stainless steel, and brass are common metals used in spring rolling.

Lead Screw Guide Bar:

For solid support, guide bars are generally made of stainless-steel alloys, brass, and copper. With a height of 262mm and a gap of



around 150mm between them. The guides are joined at the top by a metal band. The guides are evenly spaced, much like the machine's spring.

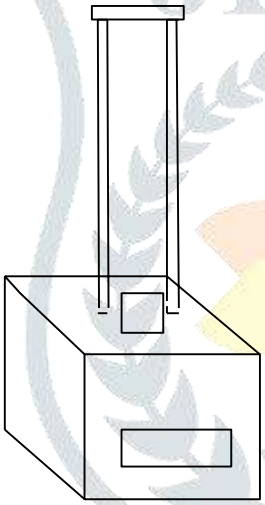
Load Cell Base:

Length:86mm
Height:70mm
Width:8mm

Base for load cells with capacities greater than 50kN and up to 300kN. The stainless steel base gives our Size 2 Low Profile Load Cells the finest possible mounting. The M36x2 central thread detail on the base matches the M36x2 central thread detail on the mating Load Cell, allowing for in-line mounting.

Main Frame:

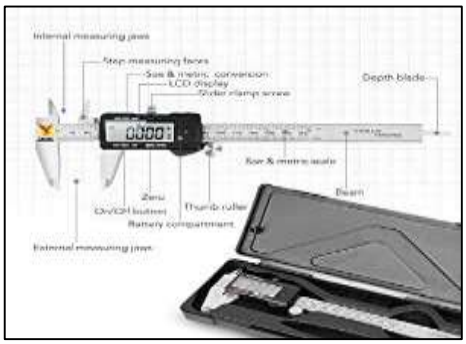
Different types of pressure are applied to the frames in particular. Because the weld joints must be long-lasting, the welding process utilised should be carefully chosen. The frame serves as a foundation for all of the components. In general, stainless steel is utilised to avoid degradation and corrosion as required for long-term sustainability. The length is around 160mm, the height is 100mm, and the width is 8mm.



Frame height:100mm
Frame length:160mm
Frame width:8mm

Fig..Base model of digital spring stiffness testing machine

Zhart Digital Vernier Caliper:



Vernier electronic digital calliper:

• Made of hardened stainless steel, this digital Vernier calliper is a suitable instrument for a wide range of industrial and automotive applications.

• With a linear capacitive measuring system, internal, external, and height dimensions may be easily and correctly determined.

• A tiny locking thumb screw locks the jaws in place in any position, allowing for zero setting.

• At the rear, there's an useful conversion chart with an easy-to-read big LCD display.

Technical Specifications Of Zhart Digital Vernier Caliper

Measuring range: 0.00-150 mm / 0.00-6 in, 0.00-200 mm / 0.00-8 in

Lead Screw with copper nut:

Legth:500mm
Diameter:8mm

Fig. lead screw with coper nut

The screw has a single thread that runs the entire length of it. Because the nut only moves when the screw turns, your system will not move suddenly when the lead screw is at rest:

• 8mm lead screw diameter

• Height of guide bar: 500 mm

• Thread pitch: 2 mm

• Stainless steel for the lead screw

• Copper nut; 2 3d printer trapezoidal screws are included in the package.

Fig. Digital spring stiffness testing machine

Above parts are fabricated and the result of digital spring stiffness testing machine is fully fabricated by assembly joined.

IV. *CONCLUSION*

- Low-cost machine manufacturing
- At the same time, the machine measures weight and length.

- The data will be shown in a digital format on an LCD panel.
- Many different forms of spring force can be simply tested.

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