INDIAN INSTITUTE OF TECHNOLOGY, KANPUR

LAB-MANUAL

Experiment No:-6

Weight Measurement using Strain Gauge

TRANSDUCERS AND INSTRUMENTATION

VIRTUAL LAB

Experiment No:-5

Aim: - Study of Weight Measurement using Strain Gauge.

Apparatus Requirement: -

- Personal computer
- Lab view 2009 Runtime engine
- Internet facility (for online experiment and for offline experiment just download the executable file from the experiment download link given in website)

Theory:-

Strain Gauge:-

There are several methods of measuring strain; the most common is with a strain gauge, a device whose electrical resistance varies in proportion to the amount of strain in the device. For example, the piezoresistive strain gauge is a semiconductor device whose resistance varies nonlinearly with strain. The most widely used gauge, however, is the bonded metallic strain gauge.

The metallic strain gauge consists of a very fine wire or, more commonly, metallic foil arranged in a grid pattern. The grid pattern maximizes the amount of metallic wire or foil subject to strain in the parallel direction (Figure1). The cross sectional area of the grid is minimized to reduce the effect of shear strain and Poisson Strain. The grid is bonded to a thin backing, called the carrier, which is attached directly to the test specimen. Therefore, the strain experienced by the test specimen is transferred directly to the strain gauge, which responds with a linear change in electrical resistance. Strain gauges are available commercially with nominal resistance values from 30 to 3000 Ω, with 120, 350, and 1000 Ω being the most common values.

It is very important that the strain gauge be properly mounted onto the test specimen so that the strain is accurately transferred from the test specimen, though the adhesive and strain gauge backing, to the foil itself.

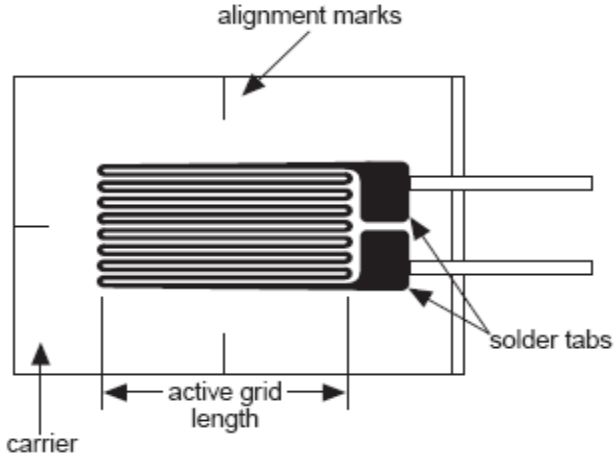


Figure:1 Bonded Metallic Strain Gauge

Formula Used: -

To measure such small changes in resistance, strain gauges are almost always used in a bridge configuration with a voltage or current excitation source. The general Wheatstone bridge, illustrated below, consists of four resistive arms with an excitation voltage, V_{EX}, that is applied across the bridge.

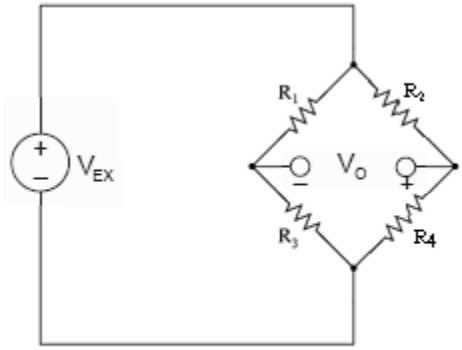


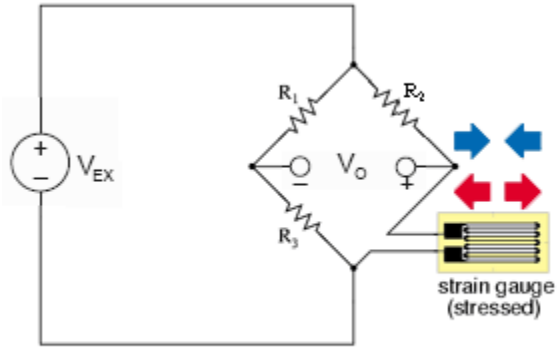
Figure:2 Wheatstone Bridge

The output voltage of the bridge; V_o will be equal to:

$$V_o = \left[\frac{R_4}{R_2 + R_4} - \frac{R_3}{R_3 + R_1} \right] \times V_{EX}$$

From this equation, it is apparent that when R1/R2 = RG1/RG2, the voltage output VO will be zero. Under these conditions, the bridge is said to be balanced. Any change in resistance in any arm of the bridge will result in a nonzero output voltage. Therefore, if we replace R4 in Figure with an active strain gauge, any changes in the strain gauge resistance will unbalance the bridge and produce a nonzero output voltage.

Quarter bridge circuit: -

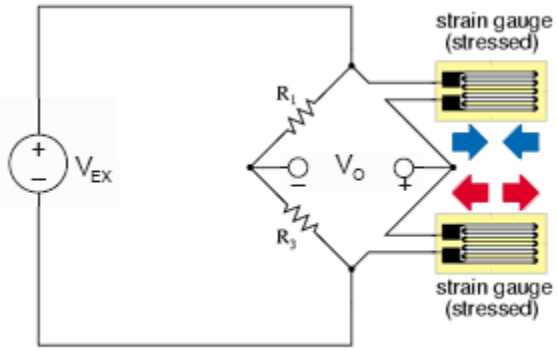


Quarter-Bridge Circuit

The output voltage of the bridge; V_o will be equal to:

$$V_o = \left[\frac{R_G + \Delta R}{2R_G + \Delta R} - \frac{1}{2} \right] \times V_{EX}$$

Half bridge circuit: -

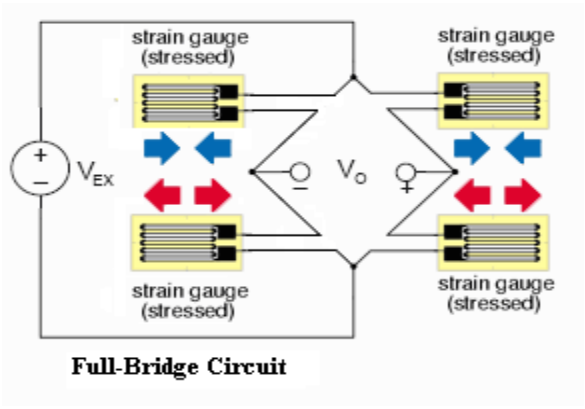


Half- Bridge Circuit

The output voltage of the bridge; V_o will be equal to:

$$V_o = \left[\frac{R_G + \Delta R}{2R_G} - \frac{1}{2} \right] \times V_{EX}$$

Full bridge circuit: -



Full-Bridge Circuit

The output voltage of the bridge; V_o will be equal to:

$$V_o = \left[\frac{\Delta R}{R_G} \right] \times V_{EX}$$

Procedure: -

Select the experiment, (Study Weight Measurement using Strain Gauge).

1. Click on Start Switch.
2. Now, to change the value of resistance with the help of slider.
3. As on changing the value of resistance you will get the corresponding voltages in different Wheatstone Bridge systems.

4. According to change in resistance, the indicator shows the different values of weight in different bridge system.
5. Finally Stop the Experiment.

Observational table: -

Sr. No.	ΔR(Change in Resistance in Ω)	Measured Weight(Quarter-Bridge Circuit)	Measured Weight(Half-Bridge Circuit)	Measured Weight(Full-Bridge Circuit)
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				

Result: -The experiment has been successfully implemented. The value of measured weight according to change in resistance shown in observation table.

Precaution: -

- Follow instructions carefully.
- For fetching correct value, wait until the process gets complete.
- Runtime engine should be properly installed.