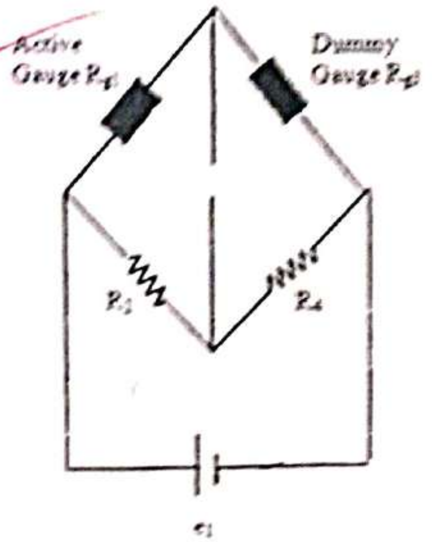
Supposing a change in temperature occurs, the resistance R_1 & R_3 changes by an amount ΔR_1 and ΔR_3 respectively.

Hence for balance, $\frac{R_1 + \Delta R_1}{R_3 + \Delta R_3} = \frac{R_2}{R_4}$

Or $\frac{R_4}{R_2}(R_1 + \Delta R_1) = (R_3 + \Delta R_3)$

or $\frac{R_4}{R_2} R_1 + \frac{R_4}{R_2} \Delta R_1 = R_3 + \Delta R_3$

But $\frac{R_4}{R_2} R_1 = R_3 \therefore \frac{R_4}{R_2} \Delta R_1 = \Delta R_3$



Suppose $R_4 = R_2$ this requires that $\Delta R_1 = \Delta R_3$

It means that for the bridge to remain insensitive to variations in temperature the gauges R_1 and R_2 should have their resistances change by equal amount when subjected to variation in temperature. Therefore the active gauge R_1 and the dummy gauge R_3 should be identical.

The use of dummy gauge for temperature compensation is simple and effective and should be employed whenever possible.

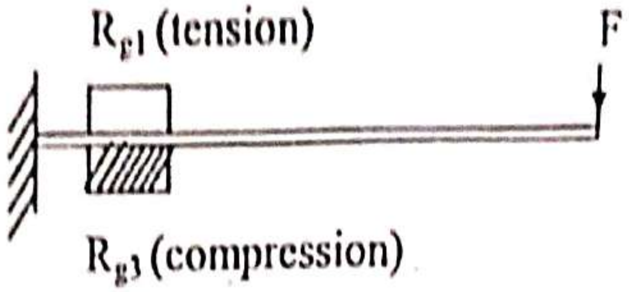
Use of two active gauges in adjacent arms

- Certain applications, where equal and opposite strains are known to exist, it is possible to attach two similar gauges in such a way that one gauge experience a positive strain and the other a negative strain. Thus instead of having an arrangement wherein the gauge acts as the active gauge and the other as the dummy gauge, we have now an arrangement wherein both the gauges are active gauges.

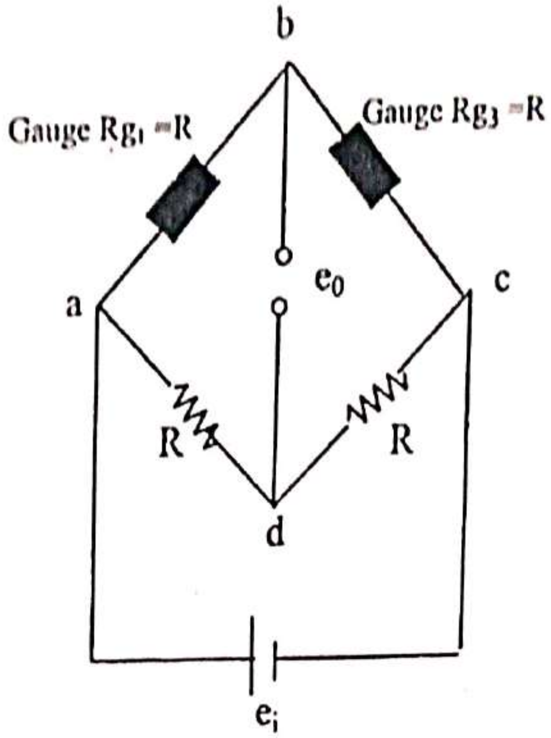
  Fig shows the two gauges mounted on a cantilever. The gauge R_a is on top of the cantilever and hence experiences tension or a positive strain. The R_3 is at the bottom surface of the cantilever and hence experiences a compression or a negative strain.

- The bridge arrangement for the two gauges is shown in Fig., There are two active gauges in the 4 arm bridge and hence it is called a Half Bridge.
- The temperature effects are cancelled out by having $R_2 = R_3$ and using two identical gauges in the opposite arms of the bridge.
- When no strain is applied both points b and d are at the same potential, $e_i/2$ and the value of output voltage $e_0 = 0$.

- When the arrangement shown in Fig is subjected to strain, the resistance of gauge 1 increases and gauges Rg_3 decreases. Resistance of gauge R_{g1} when strained is $R(1 + \Delta R/R)$



Two gauges used for measurement of strain



Adjacent arm compensation using two active gauges

Resistance of gauge Rg_3 when strained is R_{g3}

$R(1+ \Delta R /R)$

Now $R_2 = R_4 = R$ $\therefore$ Potential of point d is = $e_i/2$

$\therefore$ Potential of point

$$b = \frac{R(1 + \Delta R / R)}{R(1 + \Delta R / R) + R(1 - \Delta R / R)} \times e_i$$

$$= \frac{1 + \Delta R / R}{2} e_i$$

$\therefore$ Change in output voltage when strain applied is

$$\Delta e_0 = \frac{1+\Delta R/R}{2} e_i - \frac{e_i}{2} = \frac{\Delta R/R}{2} e_i = \frac{G_f \varepsilon}{2} e_i$$

Thus the output voltage from a half bridge is twice that from a quarter bridge and therefore the sensitivity is doubled. In addition, the temperature effects are cancelled. The gauge, sensitivity of a half bridge is

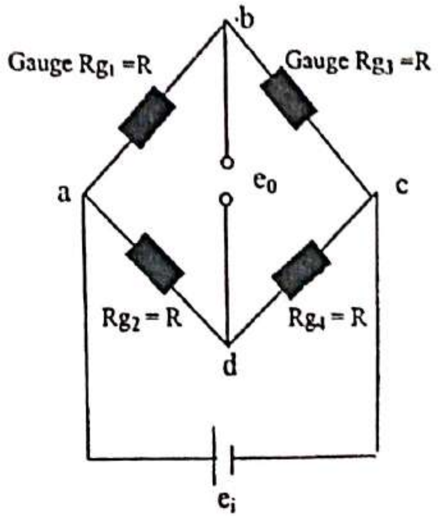
$$S_g = 2kR_g G_f$$

Use of four active gauges

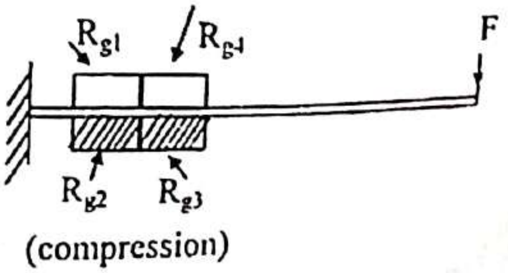
- Fig shows a cantilever using 4 strain gauges for the measurement of strain. All the four gauges are similar and have equal resistance when strained

  R_{g1} $R_{g2} = R_{g3} = R_{g4} = R.$

- These gauges are connected in the arms of a Wheatstone bridge as shown in fig., since the bridge has 4 active gauges with one gauge in each of the four arms, it is called a Full Bridge.



Bridge circuit for measurement of strain four using active gauges



- When no strain is applied the potential of points b and d are both equal to ei/2 and hence the output voltage $e_0 = 0$.

When strained, the resistance of various gauges are:

For R_{g1} and R_{g4}: $R(1+ \Delta R / R)$ and for R_{g2} and R_{g3} : $R(1 - \Delta R/R)$

Potential of b when strain is applied

the core. Show that the change in inductance is linearly proportional to the displacement. Neglect the reluctance of the iron parts.

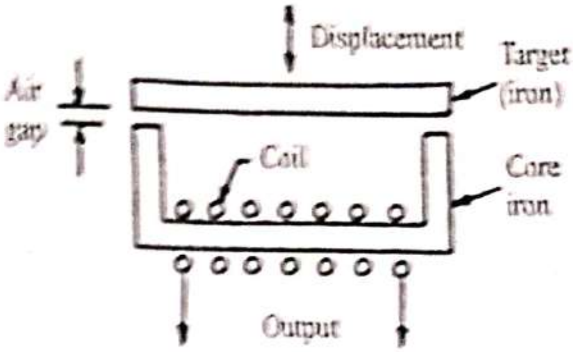


Fig. Variable reluctance inductive transducer

Solution:

Inductance with air gap length of 1.00 mm, L = 2 mH.

Length of air gap when a displacement of 0.5 mm is applied

$$= 1.00 - 0.02 = 0.98 \text{ mm.}$$

Now inductance is inversely proportional to the length air gap as the reluctance of flux paths through iron are neglected. Since the gap length decreases, the inductance increases by ΔL.

$$\therefore \quad L + \Delta L = \frac{2}{0.98} = 2.04\text{mH}$$

Change in inductance $\Delta L = 0.04$ mH.

Linear Variable Differential Transformer (LVDT)

The most widely used inductive transducer to translate the linear motion into electrical signals is the linear variable differential transformer (LVDT).