4

Chapter Four

Electrical Design

4.1 Electrical Design

We have two types of load:

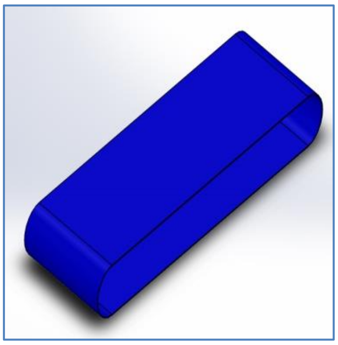
1- Dead load
2- Live load

4.1.1 Dead Load

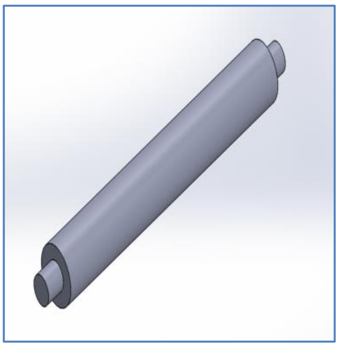
We have a many parts of conveyor that have different wieghts and this wieghts are the dead load in the load cell:

- ✓ **The Belt,** we weighing it and equal 0.5 kg.
- ✓ **The Roller,** we weighing it and equal 0.5 kg.
- ✓ **The Bearing,** we weighing it and equal 0.05 kg.
- ✓ **The Pulley,** we weighing it and equal 0.1 kg.
- ✓ **The Sidebar,** we weighing it and equal 0.5 kg.
- ✓ **The Conveyor Carrier,** we weighing it and equal 0.5 kg.
- ✓ **The Motor and Gear ratio,** we weighing it and equal 5 kg.

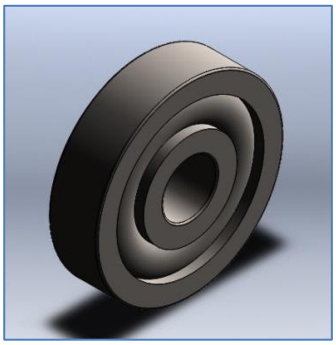
The following figure shows the dead load component of convyor:



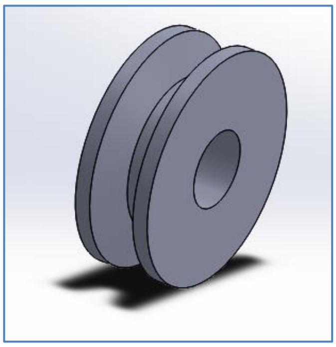
The Belt



The Roller

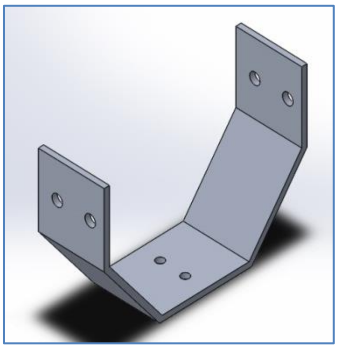


The Bearing



The Pulley

The Sidebar



The Conveyor carrier

Figure 4.1: Dead load Component of Convyor

According to this data we want calculate the total dead load weight of the conveyor:

$$\text{dead load} = \text{belt weight} + 2\text{roller weight} + 4\text{bearing weight} + 2\text{sidebar weight}$$
$$+\text{Conveyor carrier weight} + \text{motor and gear weight} \qquad \text{....... Equation (4.1)}$$

$$\text{dead load} = 0.4\text{kg} + (2 * 0.5)\text{kg} + (4 * 0.05)\text{kg} + (2 * 1)\text{kg} + 0.5\text{kg} + 5\text{kg}$$
$$= 9.1\text{kg}.$$

4.1.2 Live Load

It is the different wieghts that pass on the conveyor and the range of this wieghts from 0.0kg to 5.0 kg.

To choose the suitable load cell we will calculate the max wieght on the load cell.

$$\text{max weight} = \text{dead load} + \text{max live load} \qquad \text{............ Equation (4.2)}$$
$$\text{max weight} = 9.1\text{kg} + 5\text{kg} = 14.1\text{kg}$$

According to the max weight we will choose the ***Low Profile Aluminium load cell*** that have weight min 0.0 kg and the max weigh is 5kg due to the datasheet that attachment in (Appendix B).

4.1.3 Internal Design for the Load Cell

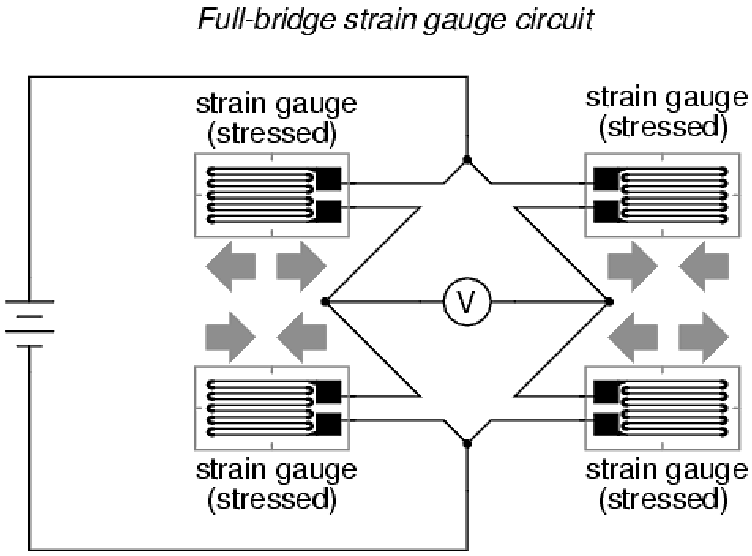


Figure 4.2: Internal Design for the Load Cell

Gauge Factor

The gauge factor GF is defined as:

$$GF = \frac{\Delta R / R_G}{\epsilon} \quad \text{............ Equation (4.3)}$$

Where ΔR: is the change in resistance caused by strain.

R_G: is the resistance of the under formed gauge.

ϵ: is strain.

For metallic foil gauges, the gauge factor is usually a little over 2. For single active gauge and three dummy resistors in a Wheatstone bridge configuration, the output V from the bridge is:

$$v = \frac{BV.\ GF\ .\epsilon}{4} \quad \text{............ Equation (4.4)}$$

Where BV: is the Bridge Excitation Voltage.

We can’t determine the change on gauge factor that effect on output signal that happen when we effect on the load cell by different weights; because the relationship between output signal and the weight is not defined in datasheet and we will find this difference by experiment.

4.2 Power Circuit

4.2.1 Symbol Address

Name	**Symbol**
Circuit Breaker	Q1
Earth Leakage	Q2
Contactor 1	KM1
Contactor 2	KM2
Over Load 1	RT1
Over Load 2	RT2
Motor 1	M1
Motor 2	M2

Table 4.1: Symbol Data for Power Circuit

4.2.2 Power Circuit Connection

4.3 Control Circuit

4.3.1 Inputs Symbol

Name	Symbol	Address	Description
Emergency	EM	X0	Digital input
NC Overload 1	SRT 1	X1	Digital input
NC Overload 2	SRT 2	X2	Digital input
Photo Sensor 1	S0	X3	Digital input
Photo Sensor 2	S1	X4	Digital input
Sensor Cylinder 1	S2	X5	Digital input
Sensor Cylinder 2	S3	X6	Digital input
Sensor Cylinder 3	S4	X7	Digital input

Table 4.2: Inputs Symbol Data for PLC Program Connections

4.3.2 Outputs Symbol

Name	Symbol	Address	Description
Contactor	KM1	Y0	Motors
Coil 1	Y1	Y1	Cylinder 1
Coil 2	Y2	Y2	Cylinder 2
Coil 3	Y3	Y3	Cylinder 3

Table 4.3: Outputs Symbol Data for PLC Program Connections

4.3.3 PLC Program Connections

4.3.4 Connection Module Load Cell

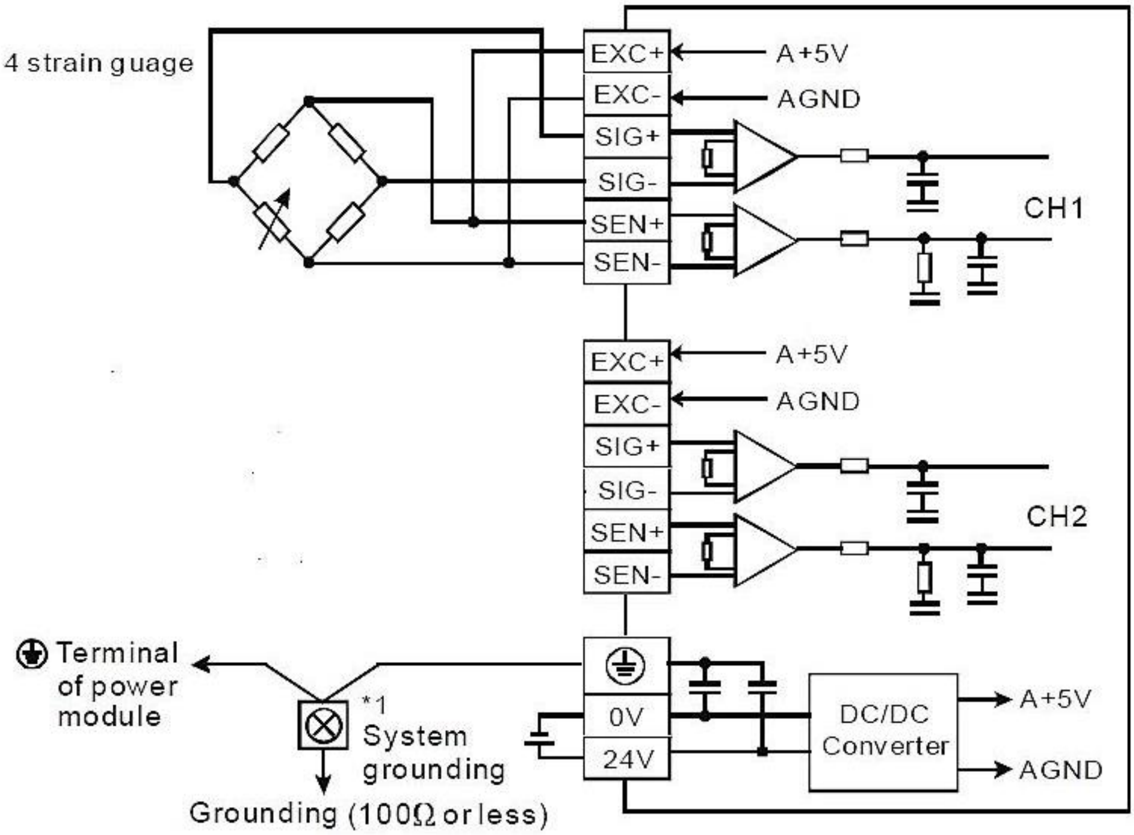


Figure 4.3: Connection Module Load Cell

4.4 Pneumatic Circuit

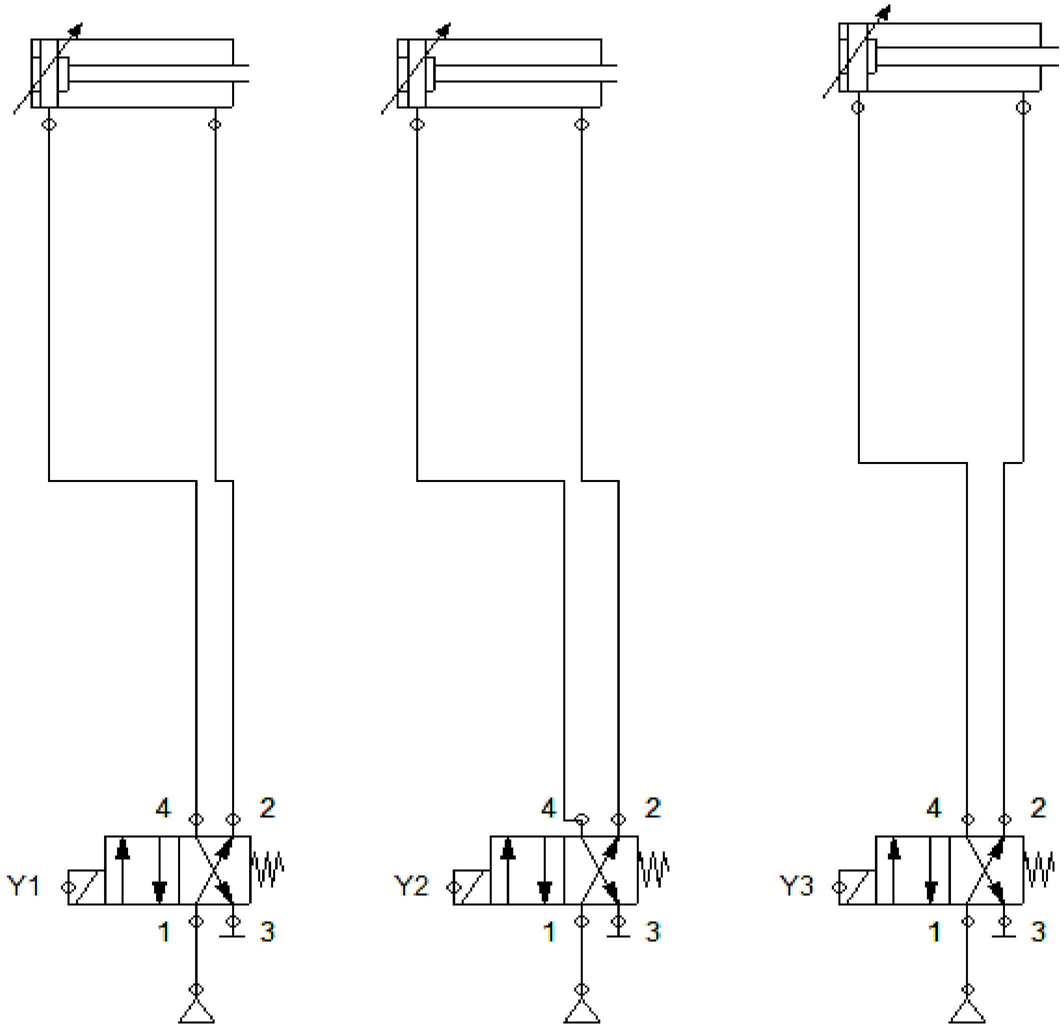


Figure 4.4: Connection Pneumatic Circuit