Palestine Polytechnic University

Mechanical Engineering Department

Rest Concrete Recycling System

Submitted by:

Ashraf Al-Shreef Ibrahim Salhab

Supervisor:

Dr. Ra’ed Amro

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Abstract

Rest concrete recycling is an important issue in our mean time whereas it can be used daily in all over the world. Because factories get rid of rest concrete by pouring it in the road sides or in the agricultural lands, this leads to environment pollution and it drains resources.

As a result, we have found an idea that will contribute in solving the problem of rest concrete. The idea is all about designing a system that will recycle rest concrete and turn it into a useful product.

By doing so we will be saving our environment and saving rest concrete. This system may be a part of the factory or in a certain area whereas it can be a central station for several factories.

The system is made of several stages. At the beginning the concrete will be added then it will be mixed for another time. After that it will be poured in templates. There will be three templates to be chosen: tile paver, manhole cover and pavement.

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1.1 Overview and Motivation

With the fearsome attrition for the natural resources on earth, the need for many techniques that reduces the use of these resources or reuses them into other materials was emerged massively.

Concrete recycling is a use industry in many countries and most concrete can be crushed and reused. Existing technology for recycling is readily available and relatively inexpensive. It can be done in both developed and developing countries.

The motivation of our project is that the ways used to get rid of rest concrete are pollutes the environment and wasteful of resources at the same time, Hebron has a large number of concrete factories, it is about thirteen once, excess amount of concrete in one day about three cups, but there are no recycling system to take advantage of this excess quantities.

The materials can be recycled as three different forms:

1. Returned concrete which is fresh (wet) from ready mix.
2. Trucks production waste at a pre-cast production facility.
3. Waste from construction and demolition.

1.2 Short Description of the System (Project Idea)

An electrical mechanical system, controlled by a PLC, where the rest concrete is filled inside the tank, this tank serves to provide a suitable environment for the concrete to be able to reuse it again and then the rest concrete will be transferred to be processing through the electric conveyor to the processing template, processing template takes many forms, depends on the product such as manhole cover, pavement, and tile paver, as shown in figures (1.1, 1.2, 1.3) respectively.

Figure 1.1 : Manhole Cover

Figure 0.1: Tile Paver

Figure 0.2: Pavement

1.3 Objectives

1. Design a system that works to recycle the rest concrete in the mixer truck in order to preserve the environment and reduce pollution as a result of the wrong ways to get rid of the remnants of concrete.
2. Decreasing the environmental risks caused by concrete.
3. Eliminate the problem of waste of resources.

1.4 Problem Statement

1.4.1 Analyze

We have a quantity of the rest-concrete; these quantities are not used properly and are disposed from it in harmful ways environmentally and economically.

1.4.2 Environmentally Dangers

As shown in figure 1.4.

1. Visual pollution: This can refer to the solid waste of the rest- concrete that is lying on the side of the road.
2. Soil pollution: Occurs when chemicals from the rest-concrete are released by spill or underground leakage.
3. By the discharge of waste water from the rest- concrete that could be mixed with rain water seeping into underground.

A

B

Figure 1.4 : Environmentally Dangers

1.4.3 Economically Dangers

1. Waste of resources: Instead of using full amount of concrete, the quantity of excess concrete has been wasted and not used.
2. Material losses: This means that the economic value of the excess quantity of a concrete is not used.

1.5 Recognition of the Need

The research team made a questionnaire took (13) purposeful sample of concrete companies who have concrete, to decide if there is an important of the project, and if there is really a need to recycle the rest concrete, and here some of the results. As shown in figure (1.5), 0.67 of the participants who have between quarter and half of the cup of rest concrete, this is a large percentage, so we decide to work with them, and solve their problem.

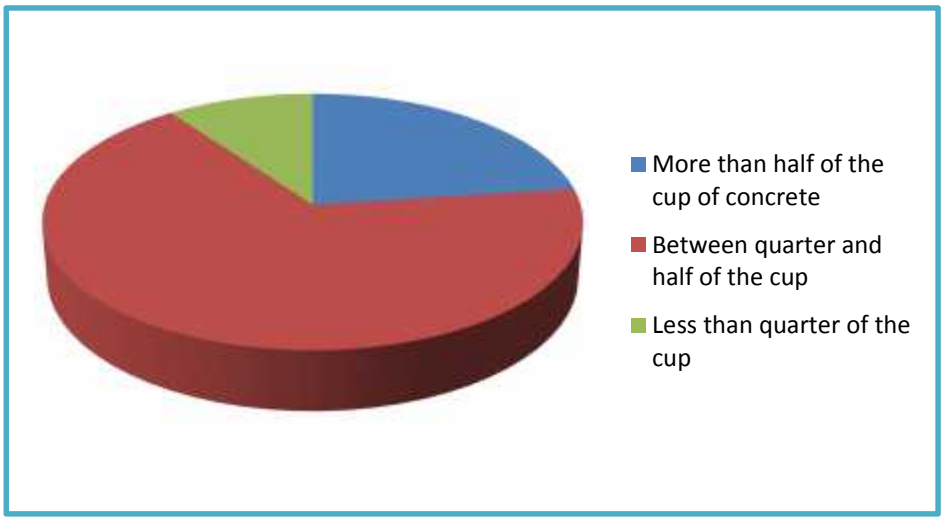


Figure 0.5: The remaining concrete in the pump basket after each concrete.

Also according to the questioner results about 0.61 of the companies said that we get rid of the remaining amounts of the concrete by putting it in the land or agricultural road as shown in

figure (1.6), this leads to an environmental pollution so which the project come with the solution of it.

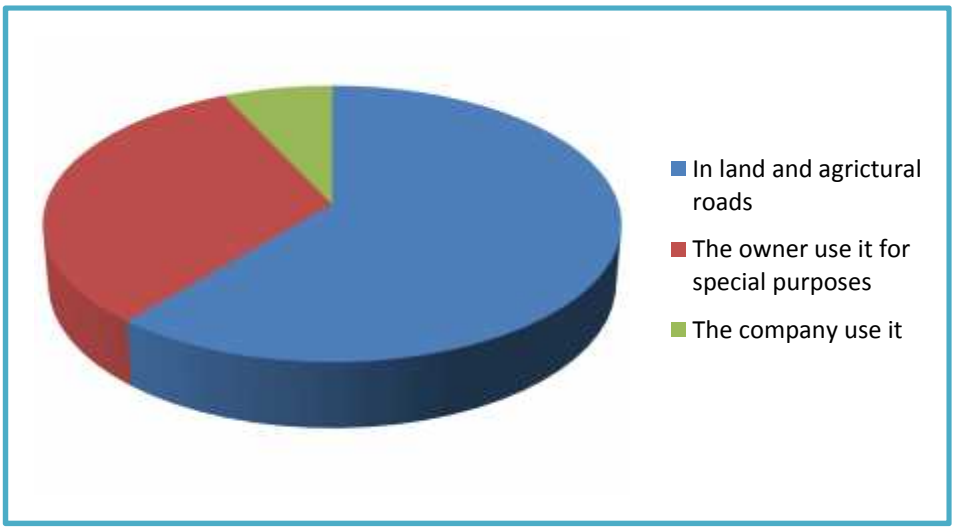


Figure 1.6 : Disposal of rest concrete that residual inside the pump.

As shown in Figure (1.7), 0.92 says they are ready to use our machine and the other says no.

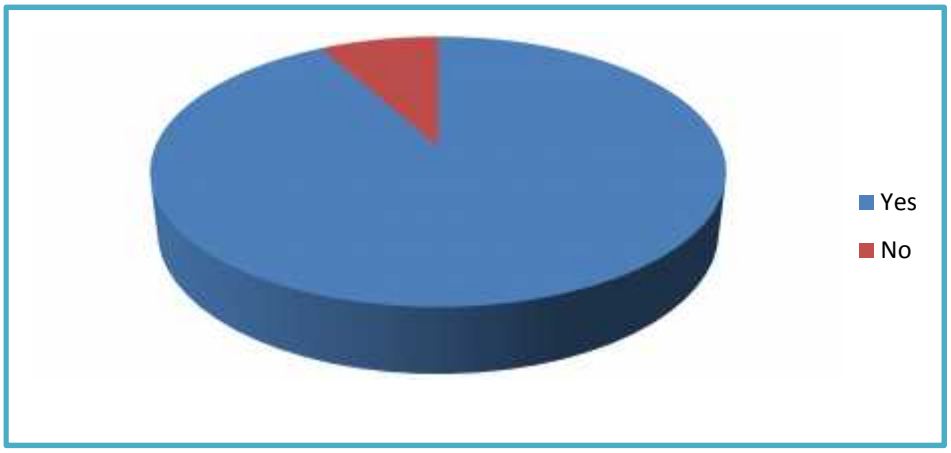


Figure 0.7 : if the system is available, will you use it?

1.6 The Budget of the Project

Component	Price(NIS)	Quantity	Total(NIS)
PLC	650	1	650
Motor's And Gears	750	2	1500
Micro Switches	50	3	150
level sensors	100	2	200
Raw Materials	1000	1	1000
Gears	100	1	100
fan	300	1	300
hydraulic Cylinder	100	1	100
wheels	50	4	200
railway	200	1	200
Manufacture (welding &Lathing)	1600	1	1600
Total			6000

Table 1.1: The Budget of the Project

1.7 Time Schedule for the Project

1.7.1 Schedule Time _First Semester

Task/week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Selecting project title																
Data collection																
Identify function and task																
Design and Analysis																
Documentation																

Table 1.2: Schedule Time _First Semester

1.7.2 Schedule Time _Second Semester

Task/week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Modify the design of project																
Data collection																
Analysis the system																
Documentation																

Table 1.3: Schedule Time _Second Semester

2

Chapter two

2.1 Introduction.

2.2 Loading Stage.

2.3 Mixing Stage.

2.4 Casting and Transporting Stage.

2.1 Introduction

This machine is the first of its kind in Palestine. It works on recycling rest concrete in the pump machine and transfers it into a useful product, and this can help in decreasing environmental pollution caused by the rest concrete and the problem of draining resources, so in this chapter we will show the stages of the system.

In our project we will show the new technology in recycling concrete in a full automated system programmed with a PLC, which will allow the user to control the operation of the system, The proposed machine is shown in the figure (2.1).

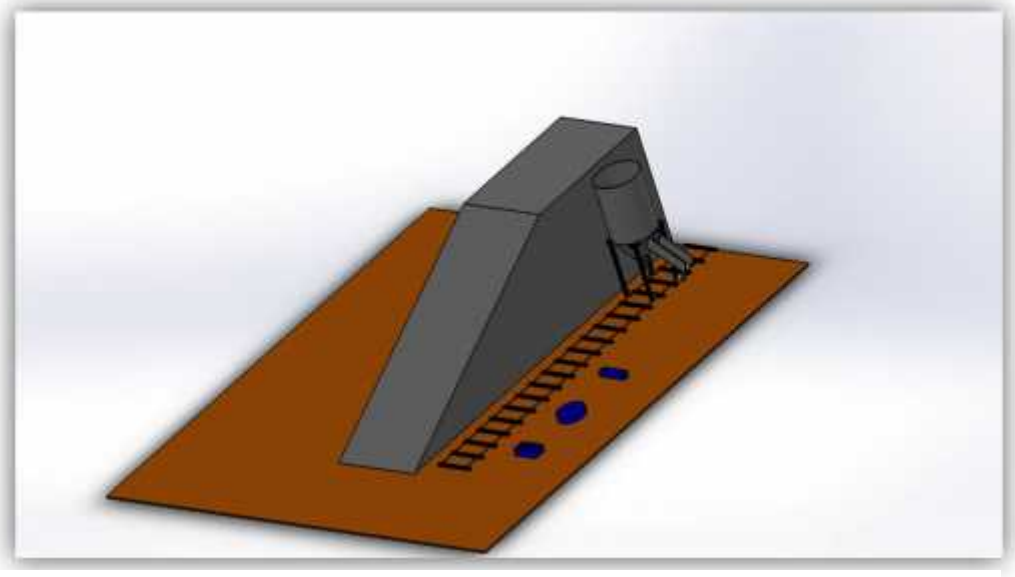


Figure 2.1 : The Proposed Machine

In order to draw an image in our minds about how the machine works and how the manufacturing stages pass through it to get the final product, we divided the stages of production into three stages, these stages are:

1. Loading stage.
2. Mixing stage.
3. Casting and transporting stage.

These three stages are integrated with each other in order to get the final product, in the coming sections each stage will be explained in full details.

2.2 Loading Stage

The loading stage starts when the operation of transferring the concrete from the pumping machine basket "Mchava" to the container. In this stage we will describe the stand and container that carries the concrete.

2.2.1 Stand

As shown in figure (2.2), the stand is used to hold all components of the system, so we design it from a stainless steel that can accommodate high weights.

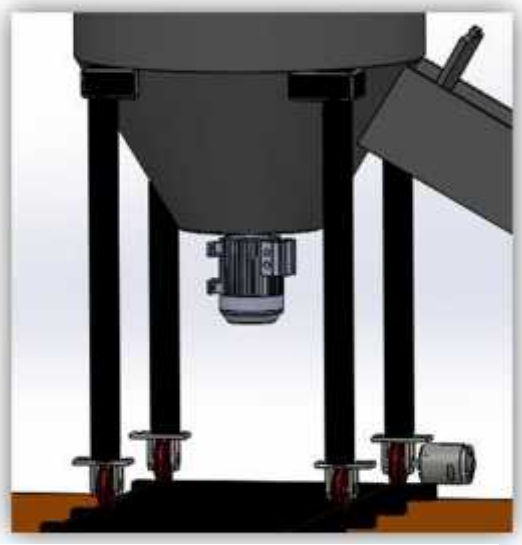


Figure 2.2 : The stand

2.2.2 Container

It is a stainless steel container, it has a cylindrical design to facilitate the mixing process, we chose stainless steel to resist high weights of concrete (chapter three has more details), this steel should be smooth to avoid the concrete from cohesion with the container sides, figure (2.3) represent the container design.

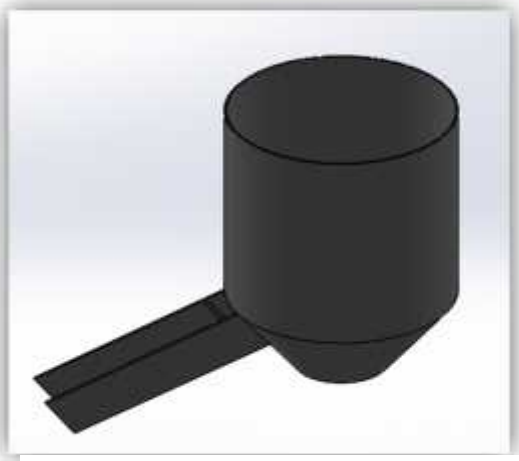


Figure 2.3 : The Container

2.3 Mixing Stage

During this stage, the system mix concrete which is already in the tank and this happens through a fan. This fan (as figure 2.4 shown) is controlled by a motor under the tank. If concrete need water, the worker will add it automatically as needed. A tank of water will be present near the system and it will be connected to the mixing tank through a pipe.

2.3.1 Fan

The fan is used for mixing or blending the rest of concrete in the container. The mixing process will be according specific amount for all material and according to some laws (chapter three has more details) in order to get a good percentage of materials without the use of estimates in the mixing process, it is suitable for wide areas, team of project design the mixer as in the figure (2.5), it has a special blades also shown in the same figure, there are special blades were designed at this shape for concrete mixing well, these blades often will remain rotate inside the container, then by adding water with the rotating blades, the concrete will not dry with passing time.

Figure 2.4 : The Fan

2.4 Casting and Transporting Stage

When the concrete is prepared, the system moves onto the railway through a mo-tor and when it reaches one of the molds Where there are three types of molds (As shown in figure 2.6), the system stops through a sensor which is put on the railway. Then the valve opens automatically for a known time by hydraulic cylinder then it cast the concrete. After it finishes casting the valve is closed automatically and the system starts to move again in order to reach another model. This operation is repeated until the tank is out of concrete.

2.4.1 Molds

We have three molds as shown in figure (2.5); these molds are made of stainless steel to facilitate the products extraction process after the concrete dry.

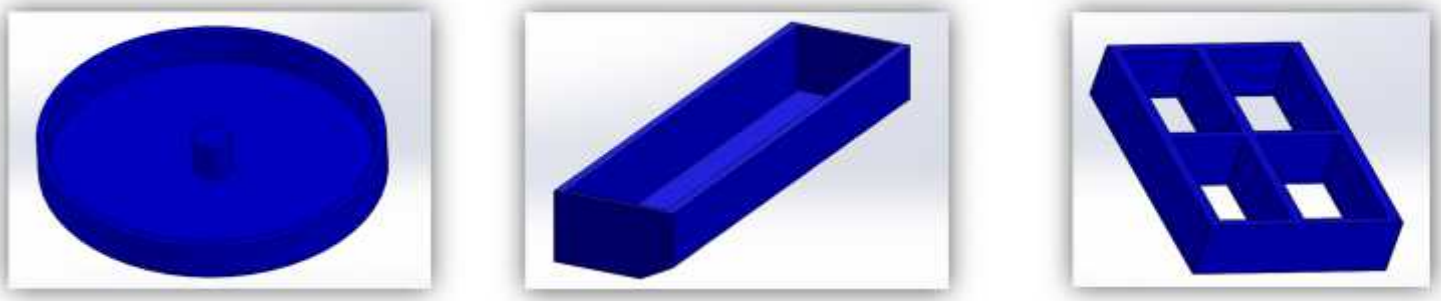


Figure 2.5 : The Molds

2.4.2 Railway

The container move on it until reaches the molds as shown in figure (2.6).

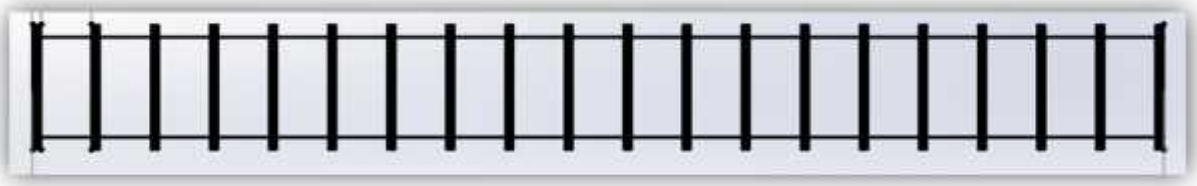


Figure 2.6 : The Railway

3

Chapter Three

Mechanical Design

3.1 Introduction.

3.2 Proposal System Description and Specifications.

3.3 Mechanical Design.

3.1 Introduction

As explained before, the recycling of rest concrete passes through five stages (load concrete to container, concrete mixing, push the concrete into molds, load the formed concrete from molds, expulsion the concrete from molds). We put the rest of concrete in a large bowl and then transfer it to the container through the pump. After that we mix the concrete inside the container through the fan and if the viscous mixture is supplied with water through the water tank. Then transfer them through the hole to molds, this process ends by pressing the concrete into the molds. In this design, to cover all stages needed, we divide the machine into seven parts, which are connected to each other, these parts are:

1. Container.

2. Fan.

3. Stand.

4. Molds.

5. Rail.

6. Pneumatic Cylinder.

Since the machine is used for preservation of the environment and in order to maintain the product, most of the machine parts are made of steel. and in order to obtain a good and simple design a set of parameters must be considered, these parameters are related to the machine itself such as: safety, portability, cost, design simplicity, availability, work space, on the other hand, the design must be able to produce efficient suitable for user related into the international standard.

3.2 Proposal System Description and Specifications

The first step in mechanical design is to know the whole operation of the system and to know how the machine is bind as shown in figure (3.1).

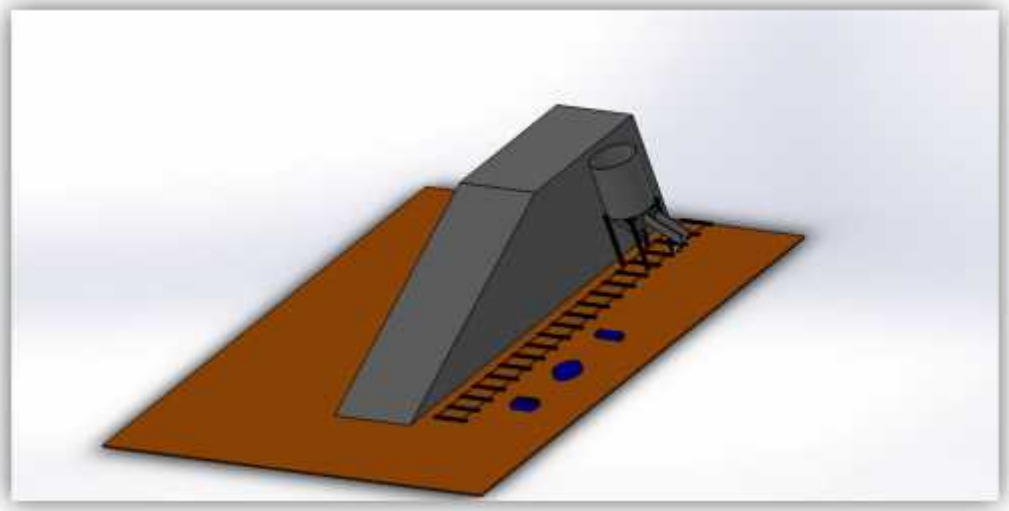


Figure 3.1 : The Proposed Machine

3.3 Mechanical Design

In this section each block will be explained in details, the used material for most parts in this machine is stainless steel (1020) because it resistant the high weights.

3.3.1 The Container

The first step in the whole operation start in the container as shown in figure (3.2) which designed to hold (70kg) of rest concrete.

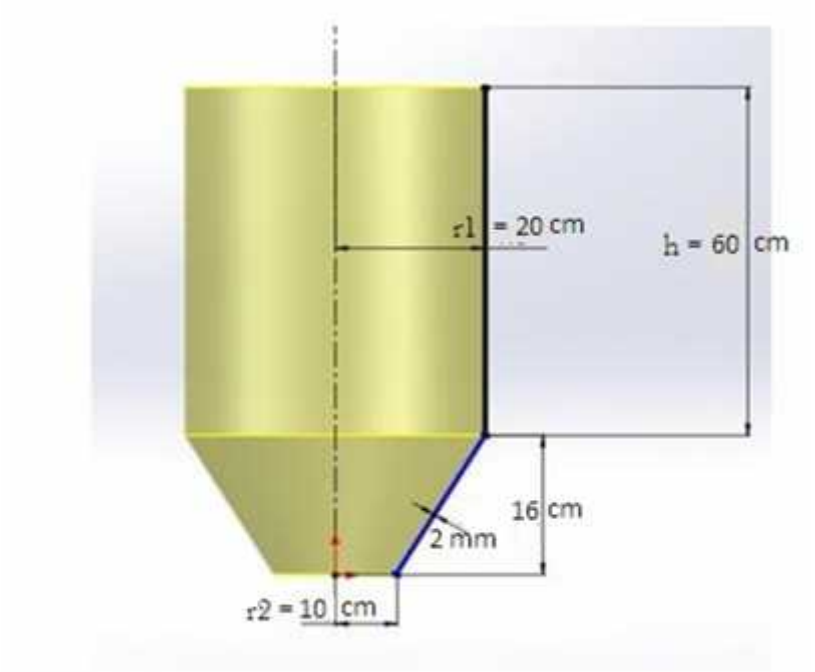


Figure3.2: The Container

Area Calculations:

First: the cylinder area (A1)

$$A_1 = 2\pi rh + 2\pi r^2 = 2\pi(rh + \pi r^2) \quad \ldots (3.1)$$

$= 1.54\ m^2$.

(h = 0.6 m, r = 0.2 m)

Where:

h: height of cylinder (m).

r: radius of cylinder (m).

A_1: area (m^2).

Second: circular truncated cone area (A2)

$$A_2 = \pi(g\ r_1 + r_2 + r_1^2 + r_2^2 \quad \ldots (3.2)$$

$$g^2 = h^2 + (r_1 - r_2)^2 \quad \ldots (3.3)$$

Where:

h: height of circular truncated cone.

R: radius of the big circle (cm).

r: radius of the small circle (cm).

A_2: area (m^2).

(h = 0.6 m, r1 = 0.2 m, r2 = 0.1 m)

Depends on equation (3.3)

g = 0.608 m^2

Depends on equation (3.2)

A_2 = 0.668 m^2

To find the area of stainless steel that need to make the container, should found the total area of the upper parts:

Total area = A_1+A_2 = 1.54 + 0.668 = 2.21 m^2

(It has been used down scaling prototype 1:3)

The dimension of the Container as shown in figure 3.2

Volume Calculations:

The total volume of container = volume of the cylinder + the volume of the cone

First: the volume of the cylinder (V_1)

$V_1 = \pi r1^2 * h = \pi\ (0.2)^2 * 0.6$ = 75.3 L = 0.0753 m^3 … (3.4)

($r_1 = 0.2\ m$, $h = 0.6\ m$)

Second: the volume of the cone (V2)

$$V_2 = \left(\frac{\pi r}{3}\right)\left(r_1^2 + r_2^2 + r_1 * r_2\right) = 0.0439\ m^3 = 43.9\ L \qquad \ldots (3.5)$$

The total volume of the container (V) = 75.3 + 43.9 = 119.2 L = 0.119 m^3

(It has been used down scaling prototype 1:3)

3.3.2 Mixture Fan

As shown in figure (3.3), it can be used to mix the material in container that comes from the bowl in order to keep the state of concrete to be able to use. Which covers diameter area estimated about 24 cm, and consumes a 220 voltage and a current of (2A) and it will turn in speed of (50 rev/min).[1]

Figure 3.3 : The Mixture Fan

3.3.3 Wheels

The machine has four flexible wheels, it seems like a cart wheels, using four wheels in this project is to make a balance to the system when the cart is moved, especially if the ground has some aggregates.

As shown in figure (3.4), a wheel is a circular component that is designed to rotate on an axial bearing. The wheel is one of the main components of this machine, it is used in conjunction with axles, allow heavy objects to be moved easily facilitating movement or transportation while supporting a load, or performing .lopper in. machine.

Figure 3.4 : The Wheels

3.3.4 Pneumatic Cylinder

3.3.4.1 Double acting cylinder

In a double acting cylinder, air pressure is applied alternately to the relative surface of the piston, producing a propelling force and retracing force. As the effective area of the piston is small, the thrust produced during retraction is relatively weak. The impeccable tubes of double acting cylinders are usually made of steel. The working surfaces are also polished and coated with chromium to reduce friction.

In this project we use one double acting cylinder as shown in figure 3.5

Used for the casting process in molds.

Figure 3.5 : The Double Acting Cylinder

By experiental we found the force we need to achieved this goal its about 196.2 N (F=M*a wher a=9.81 m/s^2 , and M=20 kg), and the geometry of the nail pipe clamp unit and mold concentrate the piston rod to be 8 (mm) and the piston diameter to be 20(mm) and from equation 3.6 we found the pressure it about 6[bar].

$F = p\ A = P(\frac{\pi d^2}{4})$ … (3.6)

where:

F: Force exerted [N].

P: gauge pressure [$\frac{N}{m^2}$, pa].

A: full bore area [m^2].

d: full bore position diameter [m].acting position area (A) = $P(\frac{\pi d^2}{4}) = 0.000314$ [m^2]

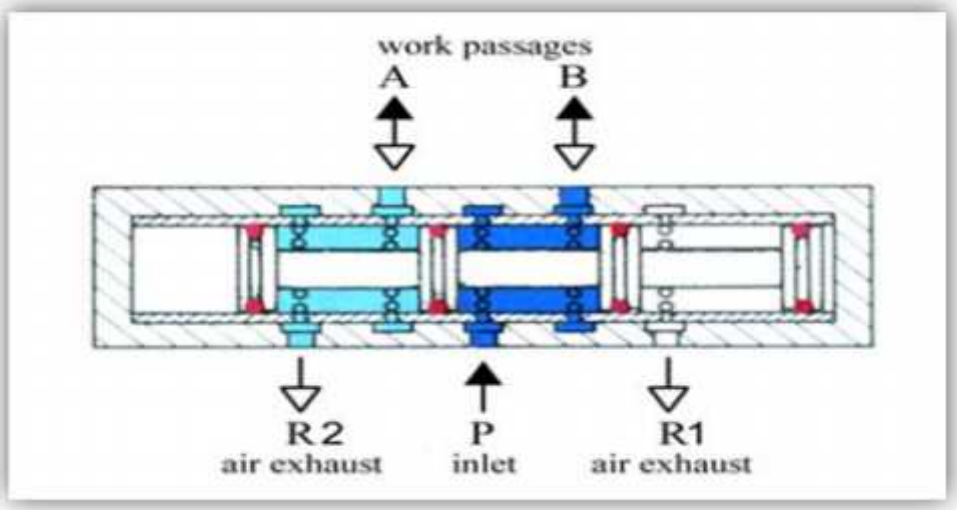
$p = \frac{F}{A} = \frac{169.2}{0.000314} = 624.84$ [KPa] = 6.2 [bar].

3.3.4.2 Control valve

(5/2 directional control valve):

When a pressure pulse is input into the pressure control port ‘P’ , the spool will move to the left, connecting inlet ‘P’ and work passage ‘B’. work passage ‘A’ will then make a release of air through ‘R1’ and ‘R2’. The directional valves will remain in this operational unit signals of the contrary are received. Therefore, this type of directional control valves is said to have the function of ‘mewmory’. As shown in figure 3.6

A. Cross section.
B. 5/2 directional control valve.
C. Pneumatic symbol.



A

B C

Figure 0.6 : Directional Valve

3.3.5 Actuator

3.3.5.1 Mixer Motor

(380 / 220) V AC motor. In this project we will use two motors of the type AC 380-220 V. The first one, it is used to run the mixer; the motor will be connected with gear ratio to control the speed of motor and make the speed of blades slow. The second one, it will be used to move the Container automatically move the rails.

In order to choose the suitable motor to rotate the internal blades must account several important points.

- Dynamic Viscosity of slurry.
- Reynolds number
- Power number
- Power consumption

1. Dynamic Viscosity of concrete (μ).

The dynamic viscosity of a fluid expresses its resistance to shearing flows, where adjacent layers move parallel to each other with different speeds.

Kinematic viscosity (dynamic viscosity) of the liquid is the amount of liquid's resistance to flow at his movement and the relationship of these highly liquid heat resistances. The more heat, less kinematic viscosity.

Viscosity affected by a time of mixing in the beginning, but with over time it stabilizes at the same concentration of the solution, also if the percentage of water increases the viscosity will decrease.

At unit weight W/C (Water/Cement) = 0.6, and at Temperature = 20◦, (Through an experiment).

The Dynamic Viscosity of Concrete (μ) = 4.7Pa.

2. Reynolds number (Re).

It is a dimensionless quantity that is used to help predict similar flow patterns in different fluid flow situations.

The Reynolds number is defined as the ratio of momentum forces to viscous forces , also used to characterize different flow regimes within a similar fluid, such as laminar or turbulent flow:

a) Laminar flow occurs at low Reynolds numbers, where viscous forces are dominant, and is characterized by smooth, constant fluid motion(Re < 10).

b) Turbulent flow occurs at high Reynolds numbers and is dominated by inertial forces, which tend to produce chaotic eddies, vortices and other flow instabilities (103<Re<105).

The Reynolds number (Re) defined as in equation[2] (3.7):

$$R_e = \frac{d^2 N \rho}{\mu} \ldots (3.7)$$

Where:

d: Impeller diameter in m (1.20 m).

N: Rotational speed in revaluation / sec (1rps).

ρ: Density of the fluid in (kg/m3) (2195kg/m3).

μ: Dynamic viscosity of slurry in (Pa.s) (4.7Pa.s).

So, Re = 168.12 not laminar either turbulent flow.

Note: We calculated the Reynolds number (Re) to determine the status of concrete laminar or turbulent flow.

3. Power number (Po).

The power number also known as (Newton number) is a commonly used dimensionless number relating the resistance force to the inertia force.

The power-number has different specifications according to the field of application.

The power number is defined as in equation[3] (3.8):

$$Po = \frac{P}{\rho N^3 d^5} \quad \dots (3.8)$$

Where:

d: Impeller diameter in m (0.6 m).

N: Rotational speed in revaluation / sec (1rps).

ρ: Density of the fluid in kg/m3 (2195kg/m3).

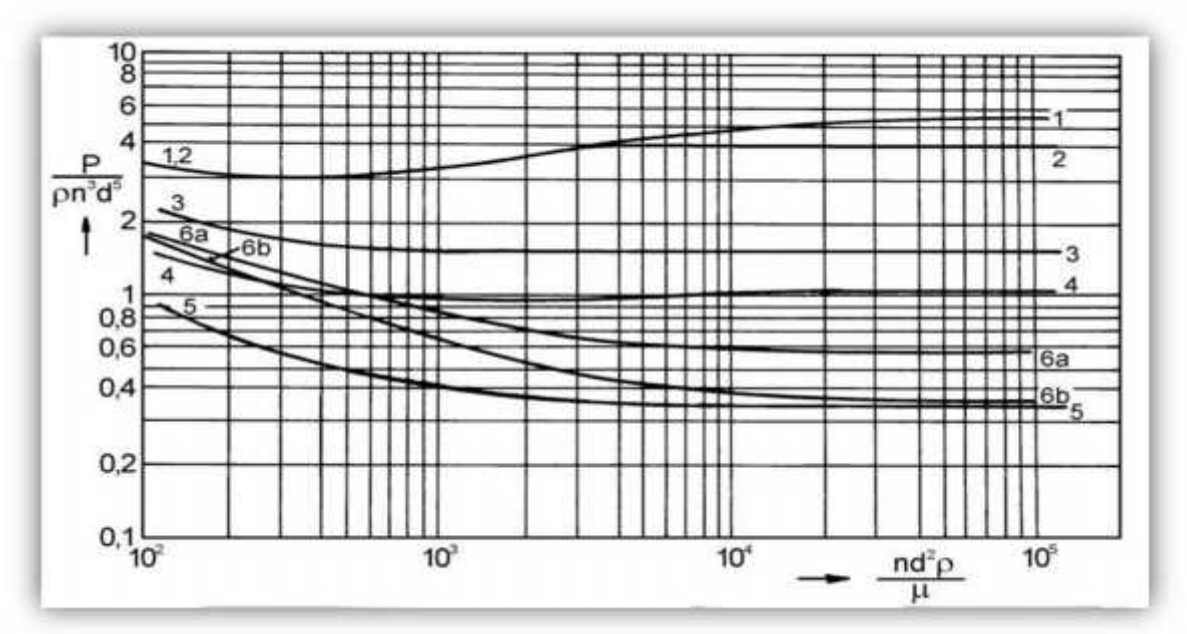


Figure 3.6 : Power Characteristic of Close Clearance Agitator

Through the curve describe in figure (3.7) for this type of blades, they depend mainly on the Reynolds number.

Po= 1.43.

4. Power consumption[4] (P):

$$P = \rho d^5 N^3 P_0 \quad \ldots (3.8)$$

= 2195*0.65∗13 *1.43.

= 244.07 W.

The connected motor power should be higher since to account for electrical and mechanical losses of the agitator drive system.

The gear box must reduce the speed of motor and increasing the torque of the motor.

Use gear box 1:50 to reducing the speed of the motor from 1400 rpm to 28 rpm, and increasing the torque:

Select the motor which has hp and power larger than the power on the shaft the motor selected has 0.37 KW.

The same motor will be selected in rail motor.

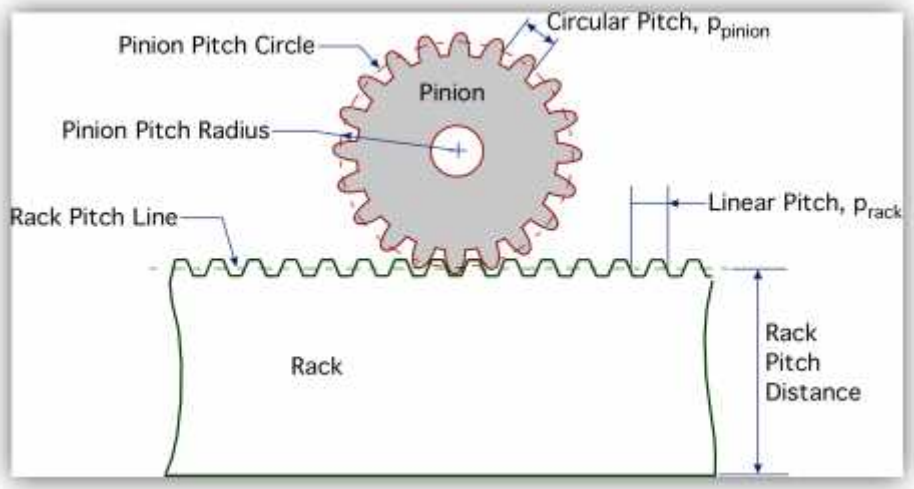
3.3.5.2 Mobile Motor

This motor is used to transfer The Container across the railway through rack and pinion (fig 3.8), and it is controlled speed this motor through the inverter.

Rack and Pinion

It is a type of linear actuator that comprises a pair of gears which convert rotational motion into linear motion. A circular gear called "the pinion" engages teeth on a linear "gear" bar called "the rack"

A



B

Figure 3.8 : Rack and Pinion

Pinion pitch radius = 2.5cm.

Circular pitch = 1.5mm.

Linear pitch = 1.5mm.

Gear box

Use gear box 1:20 to reducing the speed of the motor from 1400 rpm to 70 rpm.

Figure 3.9 : Gear Box

3.3.6 Sensors

In this project we will use four sensors, one ultrasonic sensor and three limit switch sensors (chapter five has more details).

4

Chapter Four

PLC Programming

4.1 Introduction.

4.2 PLC Characteristic.

4.3 PLC Connection.

4.4 PLC Graph.

4.1 Introduction

As it has been mentioned before the Rest concrete recycling system is fully automated and the process is performed sequentially, this can be perform by using PLC (programmable logic controller). This made adding automation capability and safety precautions possible, which is explained through this chapter.

The PLC is chosen to be used on the machine rather than the microcontroller because of its ability to operate with the voltage used at workshop (220V) without the need of other component, where the microcontroller can operate only with 5v and needs other component which has a high cost, A comparison between PLC and microcontroller is made in the table 4.1.

	PLC	Microcontroller (PIC or arduino)
Less Initial Cost		✓
Ease In Programming	✓	
Work At 220V	✓	
Build In Modules	✓	
Faster Response		✓
Less Total Cost	✓	

Table 4.1: Comparison between PLC and microcontroller

4.2 PLC Characteristic

Programmable Logic Controller (PLC) is a digital computer used for automation of electromechanical process, such as control of machinery on factory assembly lines, PLCs are used in many industries and machine. Unlike general-purpose computers, the PLC is designed for multiple inputs and output arrangements, extended temperature ranges, immunity to electrical noise, and resistance to vibration and impact. Programs to control machine operation are typically stored in battery backed up or non- volatile memory.

A PLC is an example of a hard real time system since output results must be produced in response to input conditions within a limited time otherwise unintended operation will result. In our controlling design it is desirable to use a PLC with 11 input and 6 outputs mention in the table 4.2, It must be compatible to use with 220 volt.

Input	Symbol	Logic allocation	address
Start(NO)	START	START=1, Operation is run	X1
Stop(NC)	STOP	STOP = 0, Operation is stop	X1
Emergency switch(NC)	EMG	Turn off all process	X2
Limit switch1	LM1	LM1=1, the Container in position1 (homing case)	X3
Limit switch2	LM2	LM2=1, the Container in position2 (first mold)	X4
Limit switch3	LM3	LM3=1, the Container in position 3 (second mold)	X5
Limit switch4	LM4	LM4=1, the Container in position 4 (third mold)	X6
proximity sensor	LV	LV=0, there is concrete	X13
Push bottom 1	P1	P1=1, casting in first mold	X7
Push bottom 2	P2	P2=1, casting in second mold	X10
Push bottom 3	P3	P3=1, casting in third mold	X11

Table 4.2: Input Parameters

Output	Symbol	Logic allocation	address
Mixer motor	M1	M1=1, Mixer Motor run	Y3
Mobile motor CW	M2_CW	M2_CW=1, Mobile Motor rotate CW	Y2
Mobile motor CCW	M2_CCW	M2_CCW=1, Mobile Motor rotate CCW	Y1
Pneumatic Cylinder	PC	PC=1, Pneumatic Cylinder is open	Y4
Red Led	LV_LED	LV_LED=1, The red led is light	Y6
Green Led	START_LED	START_LED=1, The green led is light	Y5

Table 4.3: Output parameters

The used PLC is DELTA DVP-ES2 as shown in figure 4.1, with 11 inputs and 6 outputs its data sheet is shown in the appendix.

Figure 1.1 : DELTA DVP-ES2

4.3 PLC Connection

As shown in figure 4.2

Figure 4.2 : PLC Connection

4.4 PLC Graph

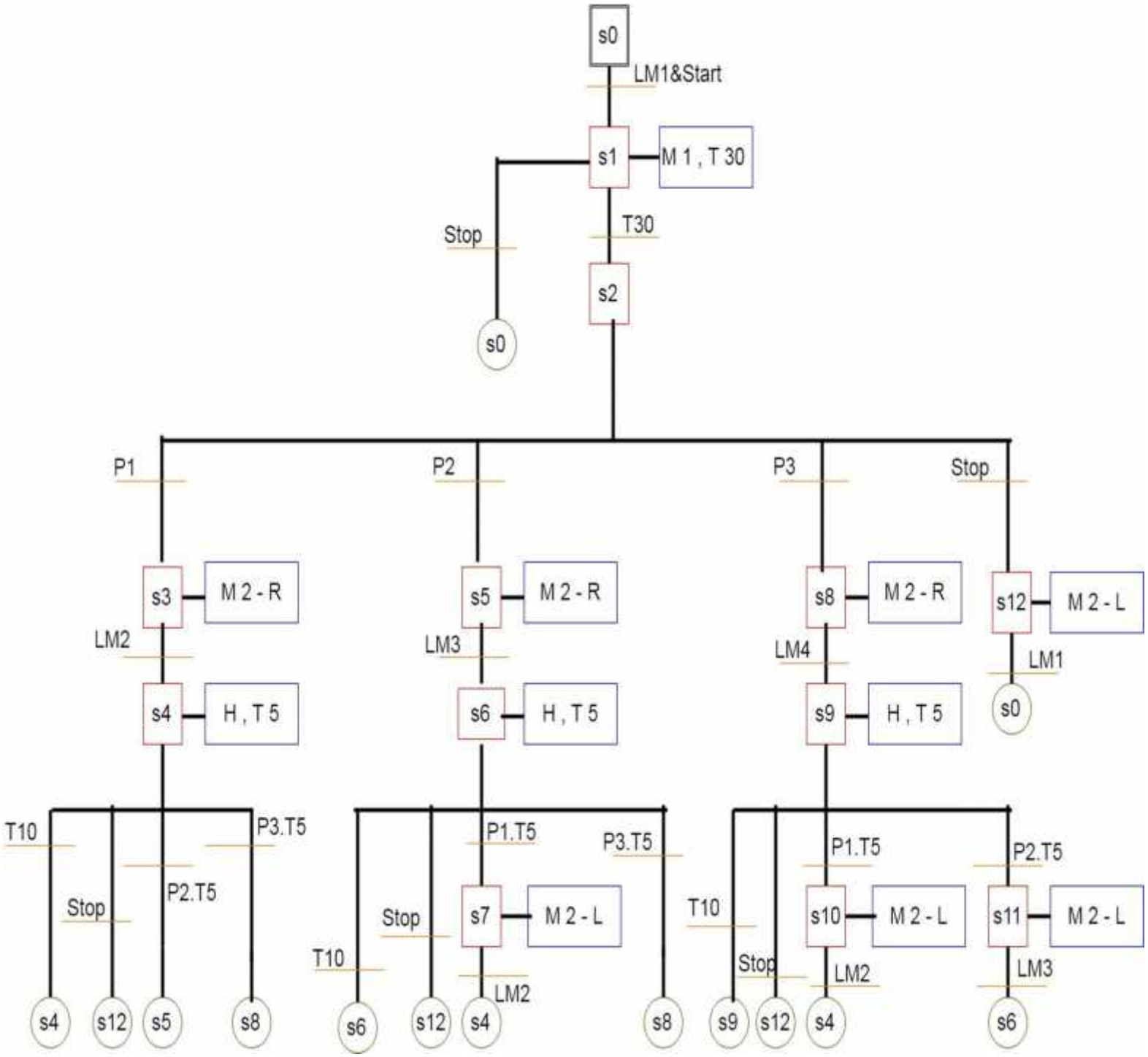


Figure 1.3 : PLC Graph

Software:

The software for DELTA DVP-ES2 is the program WPLSoft 2.37 as shown in the figure 4.4:

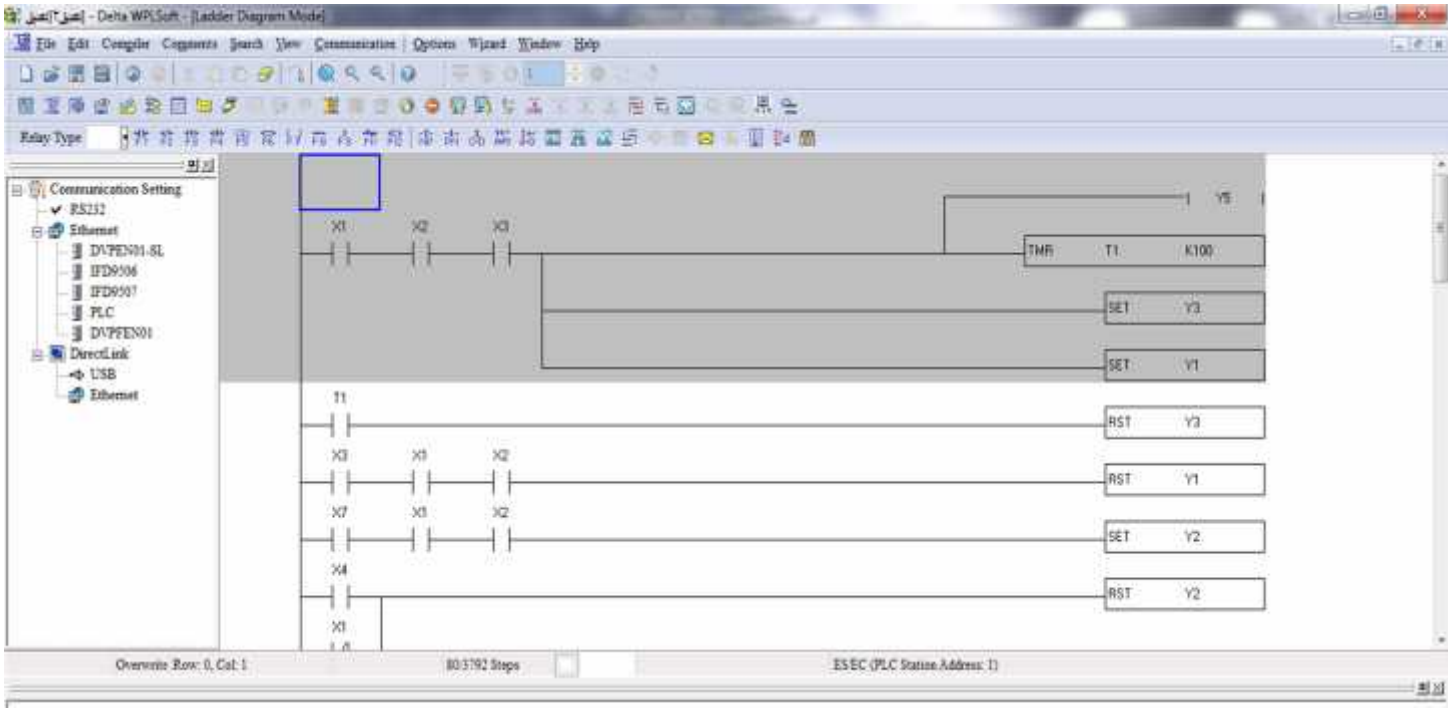


figure 4.4 WPLSoft 2.37 program

5

Chapter Five

Electrical Design & Protection

5.1 Introduction.

5.2 Motors.

5.3 Sensors.

5.4 Power and Control Circuit.

5.5 Electrical Panel & Protection.

5.1 Introduction

This chapter contains the electrical component specifications (motor, inverters, sensor, overload, etc), power & control circuit, and protection.

5.2 Motors

In this project there are two AC motors (MIXER Motor, MOBILE Motor).

5.2.1 Mixer Motors

Three phase AC motor with gear box (0.5 HP: 0.44KW)[5]

Motor Table	
Max current	2 A
Input power	0.37 KW
Voltage	380-220 V
Cos(Θ)	0.77
Phase	3 phase pole 50 Hz.
Speed	1400 -1600 rpm
IP	55

Table5.1: Mixer Motor Table

Figure 1.4 : Mixer Motor

5.2.2 Mobile Motors

Three phase AC motor (to control it using inverter):

Motor Table	
Max current	2 A
Input power	0.11 KW
Voltage	380-220 V
Cos(Θ)	0.61
Phase	3 phase pole 50-60 Hz.
Speed	1400 -1600 rpm
IP	55

Table5.2: Mobile Motor Table

Figure 1.5 : Mobile

5.2.3 Mobile Motor Voltage Frequency Driver

The purpose of using the voltage frequency driver is to control the speed of mobile motor by using multifunction speed; the type of conveyer Motor driver is Delta model
VFD007L21A shown in figure 5.3

Specifications:

Input: 1PH/9.7A 3PH/5.1A 200-240A 50-60HZ.
Output: 3PH 0-240V 4.2A 1.6kVA 1HP.
Input Phase: 1.
HP (CT): 1 Horsepower.
Max. Frequency: 600 Hertz.

Figure

5.3: Mobile Motor Inverter

5.3 Sensors

There are two types of sensors (Limit Switch Sensor & Optical Sensor).

5.3.1 Limit Switch Sensors

Limit switch is a switch operated by the motion of a machine part or presence of an object. They are used for control of a machine, as safety interlocks, or to count objects passing a point.

In this project there is 3 limit switches, all of switches are established on the railway in Casting and Transporting Stage figure 5.4.[6]

Figure 1.4 : Limit Switch Sensor

5.3.2 Proximity Sensor

Used to detect if there is concrete in the container or not, the displacement between the range for the sensor equals 50 cm.

As shown in figure5.5.

Figure 1.5 : Proximity Sensor

5.4 Power and Control Circuit

As shown in figure 5.6

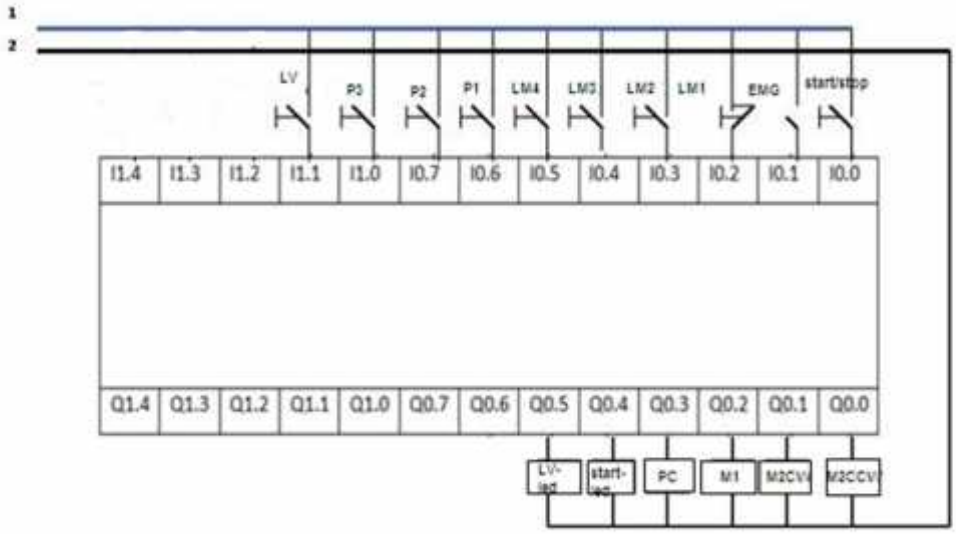


Figure 1.6 : Power and Control Circuit

5.5 Electrical Panel and Protection

5.5.1 Motor Overload

Overload relays are intended to protect motors against excessive heating due to prolonged motor over currents up to and including locked motor currents. Protection of the motor due to short circuits or grounds is a function of circuit breakers, or motor short-circuit protectors.

As shown in figure 5.7.

Figure 1.7 : Motor Overload

5.5.2 Contactors

A contactor is an eclectically controlled switch used for switching a power circuit, similar to a relay except with higher current ratings.

A contactor is controlled by a circuit which has a much lower power level than the switched circuit.

Contactors come in many forms with varying capacities and features. Unlike a circuit breaker, a contractor is not intended to interrupt a short circuit current. Contactors range from those having a breaking current of several amperes to thousands of amperes and 24 V DC to many kilovolts. The physical size of contactors ranges from a device small enough to pick up with one hand to large devices approximately a meter (yard) on a side. Contactors are used to control electric motors, lighting, heating, capacitor banks, thermal evaporators, and other electrical loads.

In this project we used three contactors, one contactor for a mixer motor and two contactors for mobile motor.

As shown in figure 5.8.

Figure 1.8 : Contactors

5.5.3 Switches

The emergence switch are used to stop the machine immediately when something wrong happened with the machine as shown in the figure 5.8.a. The pushbutton are used to select the mold number as shown in the figure 5.8.b .The selector switch used to select the system is on or off as shown in the figure 5.9.c .

A **B** **C**

Figure 1.9 : Switches

5.5.4 Klemens

Used to connect wires and a range the connections as shown in figure 5.10.

Figure 5.10: klemens

5.5.5 LED

The led as shown in figure 5.11 are singed the machine operation mode

Figure 5.11 : LED

6

Chapter Six

Experimental Result & Recommendations

6.1 Introduction.

6.2 Experimental Result.

6.3 Recommendations.

6.4 Future Work.

6.1 Introduction

This chapter provides experimental result and, some recommendations from the work team for this project. In this chapter we are listing some goals hope to be accomplished or_ at least_ under attention .

6.2 Experimental Result

We made some experiments on parts of our project and these are some of results**:**

Loading Stage: we put a quantity of concrete (10 L) on this part inside container.

Mixing Stage: after we put the concrete in container, the concrete mixer for 30 seconds, using a fan mixing.

Casting and Transporting Stage: after we mixing the concrete, the container is moving to molds and Concrete is casting into molds using Double acting cylinder.

6.3 Recommendations

1. Such projects should be handled among different departments according to the project nature (we had lots of electrical problems that might solve without having enough previous knowledge).

2. The metal workshops must have highly trained technician to read the plans, and to perform the design.

3. Once the university administration financially supported graduation projects, this support must be provided at the beginning of the project work, to enable students to do their projects according to the time plan, and to test them at the proper time.

4. The university should provide the proper toolsets, which enable the student to assemble his project and to test it the university campus, so he could get benefit of experiences in the university.

6.4 Conclusion:

The following tasks are suggested as future works:

1. Testing and evaluating the machine with different form of molds.

2. Compare the improvement of our product with other product.

The final system form:

Appendix A

Questionnaire Analysis

A.1 Environmental Samples.

A.2 The purpose of questionnaire.

A.3 Hypotheses of the questionnaire.

A.4 The results of questionnaire.

A.5 Discussion of results.

A.6 Questionnaire form.

A.1 Environmental Samples

This questioner took (20) purposeful sample of concrete Factories around the West Bank, The top three factories (ZALOOM, JRASHI, AL AMEER).

A.2 The Purpose of Questionnaire

This questionnaire aims to:

1. Know the percentage quantity of the rest Concrete.
2. Knowing where to dispose of the rest concrete.
3. Determine the importance of the idea “Rest Concrete Recycling System".
4. Know the percentage of those interested in buying the aforementioned press.
5. Determine which of these characteristics (quality, cost, easy to use) come first according to the concrete factories.

A.3 Hypotheses of the Questionnaire

- **The first hypothesis:**

  Wrong dispose of rest concrete resulting large environmental dangers.

- **The Second hypothesis:**

  The cost of the project may be high, but in the long run, remove residual excess of concrete will be need a stiff price.

- **Third hypothesis:**

  The product quality and quantity is determined by the user.

A.4 The results of questionnaire

This questionnaire took (20) worker in concrete company, **the results of questionnaire** is:

Q1: how much of the remaining concrete in the pump basket after each concrete casting process? The result in figure A.4.1 show that about 80% of the worker said that the remaining is about 0.25 m^3 and 20% said that the remaining is about 0.3m^3.

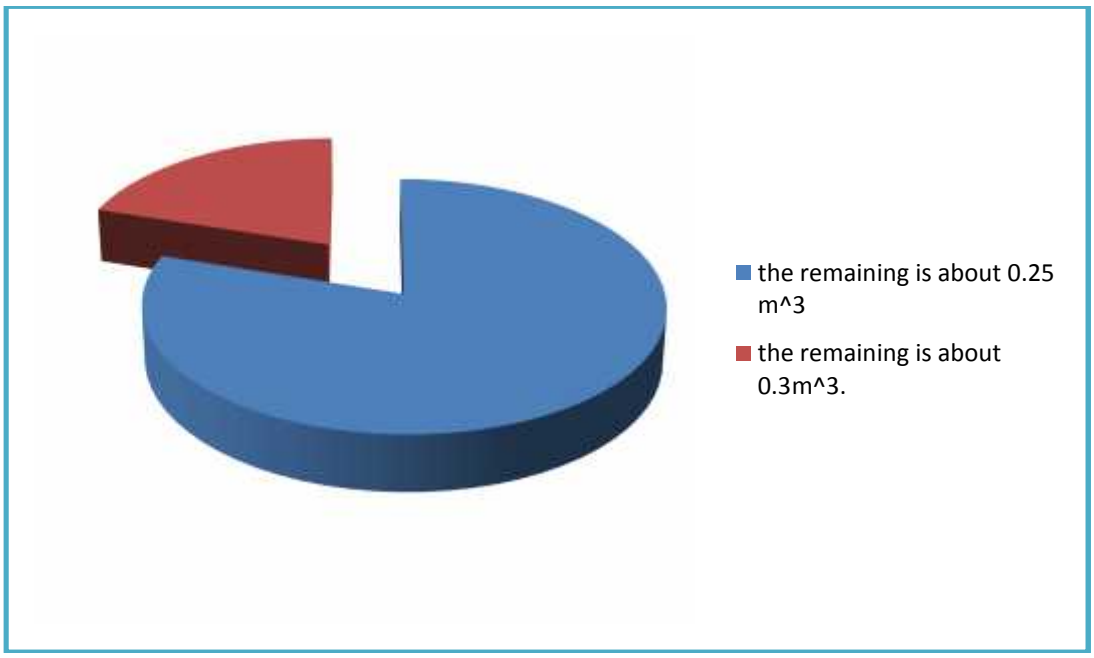


Figure A.4.1: how much of the remaining concrete in the pump basket after each concrete casting process?

Q2: what is the concrete type do you use?

The result in figure A.4.2 show that 20% of the worker use concrete that have power of (150), 40% use concrete that have power of (200), and 40% use the concrete that have power of (250).

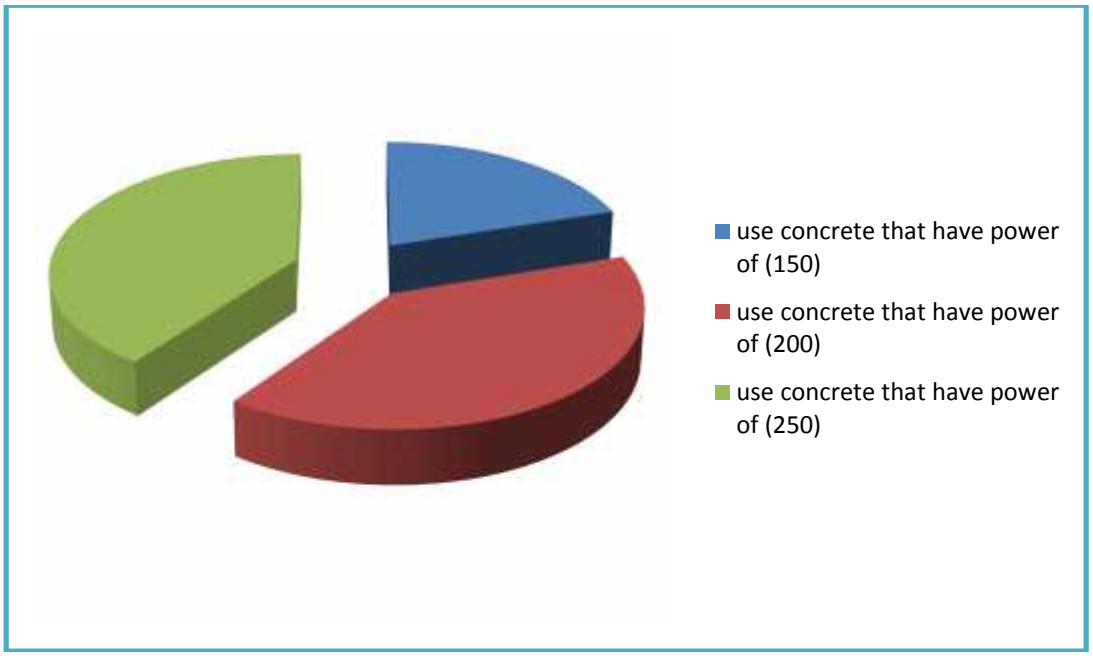


Figure A.4.2: what is the concrete type do you use?

Q3: how you disposal of rest concrete that residual inside the pump?
The result in figure A.4.3 show that about 61% of worker said that: in the land, and agricultural road, 32% said that the owner uses it in special purposes, and 7% said that the company uses it.

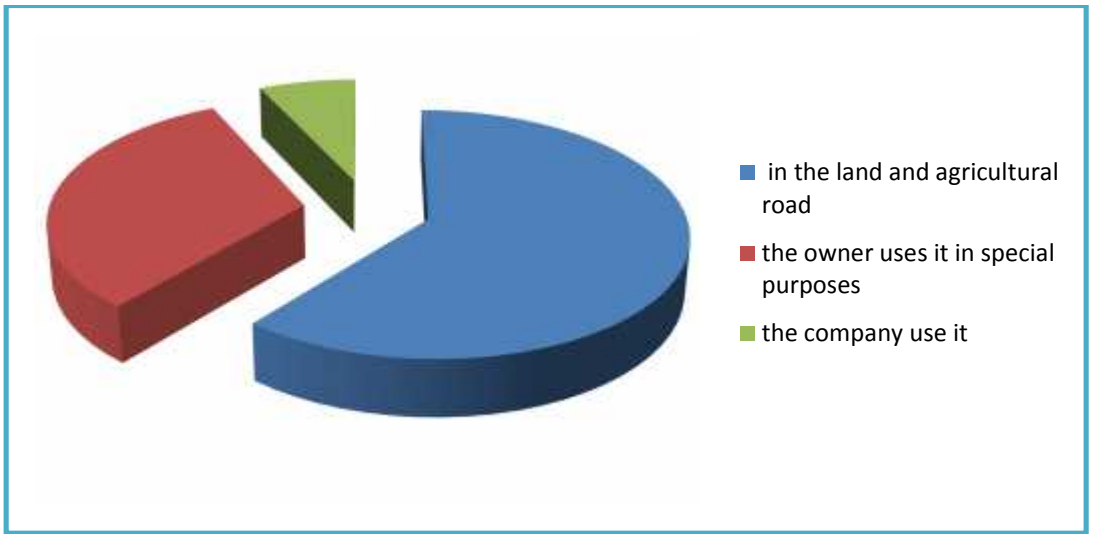


Figure A.4.3: how you disposal of rest concrete that residual inside the pump?

Q4: what is the maximum period of time that the concrete can remain in the basket without the condition change?
Most of workers said that the period time is between 1.5 – 1.75 hours.

Q5: what is the cost of residual concrete into the basket?
Most workers said the cost in just one basket is about 150 NIS.

Q6: what is the importance of the system for you?
Some of them are excited to this machine and expect that will be economically.

Q7: are you willing to buy this system?
Some of workers said that maybe I will buy it in the future.

Q8: if the system is available, will you use it?
The result in figure A.4.4 show that about 92% of workers said yes, the other said no.

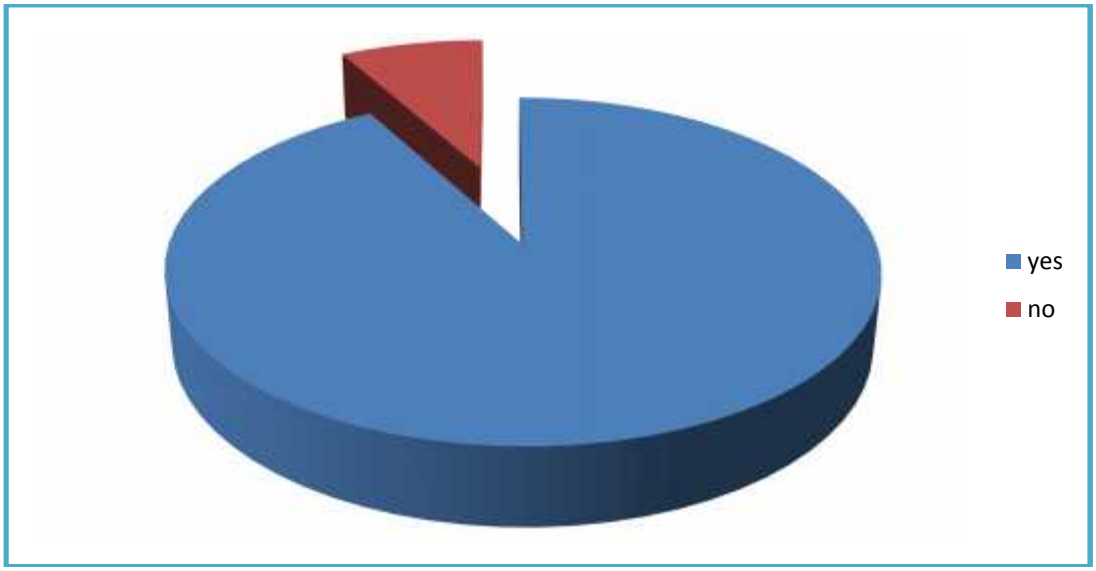


Figure A.4.4: if the system is available, will you use it?

Q9: what do you prefer to be the product benefit from the recycling?

a- Manhole cover.
b- Pavement.
c- Bricks have low efficiency.
d- Tile paver.

Most workers choose a, b and d.

Q10: if the recycling system was fixed in a certain place, you will go to it to unload residual quantity of concrete?

The result in figure A.4.5 show that about 75% of workers said yes, the other said no.

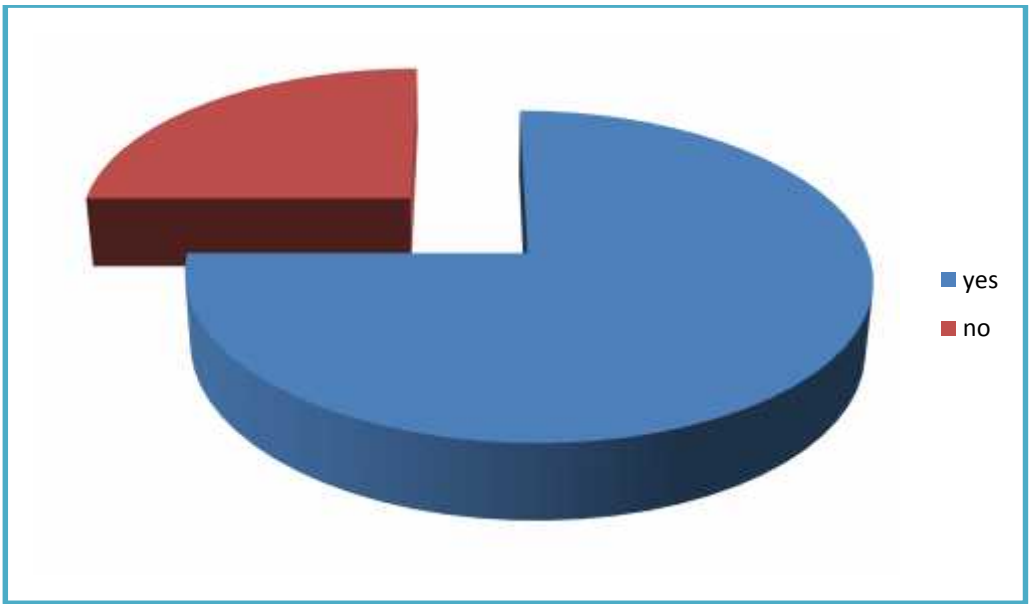


Figure A.4.5: if the recycling system was fixed in a certain place, you will go to it to unload residual quantity of concrete?

A.5 Questionnaire form

بسم الله الرحمن الرحيم

كلية الهندسة والتكنولوجيا التاريخ: / /

دائرة الهندسة الميكانيكية اسم

الشركة:.....

مشروع إعادة تدوير الخرسانة الجاهزة **العنوان:**

.....

كم تبلغ كمية الباطون المتبقية في الخلاطة بعد عملية صب الباطون ؟

.....

ما هو نوع الباطون المستخدم ؟

.....

كيف يتم التخلص من كميات الباطون المتبقية في الخلاطة ؟

.....

ما هي اقصى مده زمنيه يمكن ان تبقى الخرسانة داخل الخلاطة دون أن تتغير حالتها ؟

.....

ما هي تكلفة الخرسانة المتبقية بداخل الخلاطة ؟

.....

ما مدى أهمية وجود نظام لاعادة تدوير الخرسانة بالنسبة لكم ؟

.....

هل انتم على استعداد لشراء هذا النظام ؟

.....

في حال توفر نظام لإعادة تدوير الخرسانة هل ستقومون باستخدامه ؟

أ. نعم ب. لا

ماذا تفضلون أن يكون المنتج المستفاد منه بعد إعادة التدوير :

أ. مناهل اسمنت ب. مكعبات اسمنت لرصيف الشارع

ج. طوب كفائته قليلة د. احواض اسمنت للزراعة

منتجات اخرى تقترحونها : .....

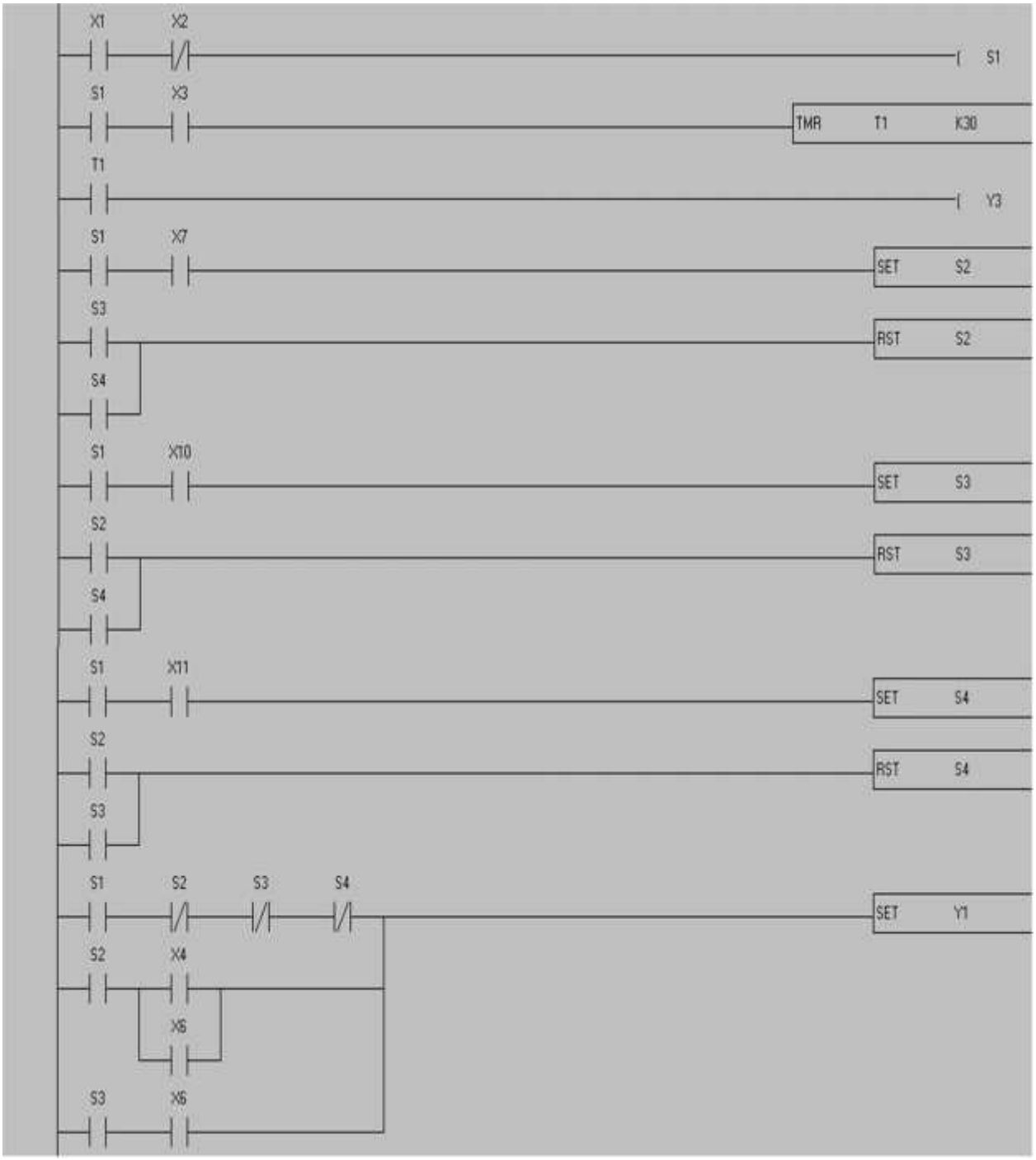
في حال كان نظام التدوير ثابتا في مكان معين هل ستقومون بالتوجه إليه لتفريغ كمية الاسمنت المتبقية ؟

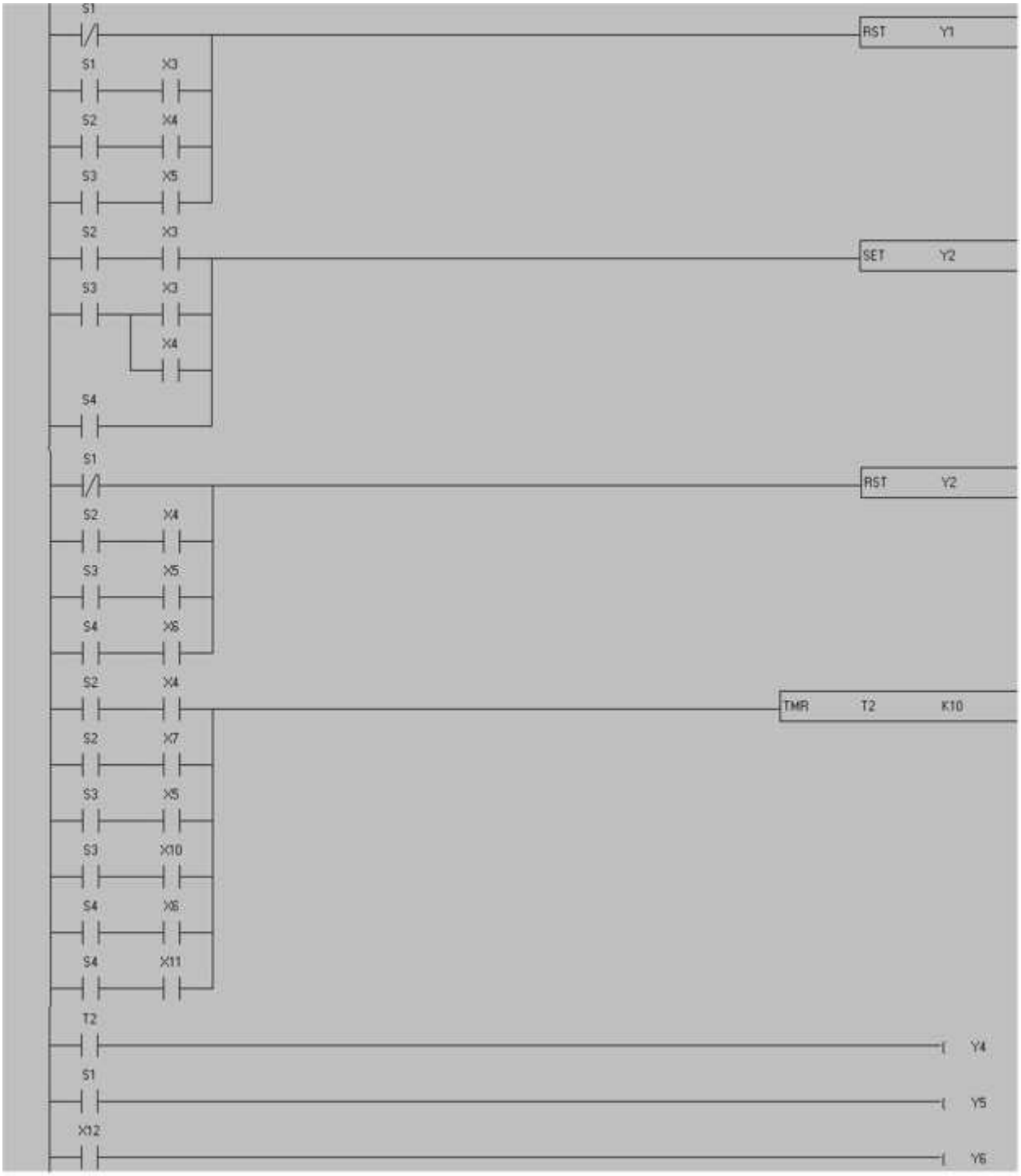
أ. نعم ب. لا

إقتراحات اخرى: .....
.....
.....

Appendix B

PLC Programming code


X1
X2
S1
S1
X3
TMR T1 K30
T1
Y3
S1
X7
SET S2
S3
RST S2
S4
S1
X10
SET S3
S2
RST S3
S4
S1
X11
SET S4
S2
RST S4
S3
S1
S2
S3
S4
SET Y1
S2
X4
X6
S3
X6


S1
RST Y1
S1 X3
S2 X4
S3 X5
S2 X3
SET Y2
S3 X3
X4
S4
S1
RST Y2
S2 X4
S3 X5
S4 X6
S2 X4
TMR T2 K10
S2 X7
S3 X5
S3 X10
S4 X6
S4 X11
T2
Y4
S1
Y5
X12
Y6

Appendix C

C.1 Mechanical Properties of Stainless Steel.

C.2 Mechanical Properties of Steel 1020.

C.1 Mechanical Properties of Stainless Steel

Table A–5

Physical Constants of Materials

Material	Modulus of Elasticity E		Modulus of Rigidity G		Poisson's Ratio ν	Unit Weight w		
	Mpsi	GPa	Mpsi	GPa		lbf/in^3	lbf/ft^3	kN/m^3
Aluminum (all alloys)	10.4	71.7	3.9	26.9	0.333	0.098	169	26.6
Beryllium copper	18.0	124.0	7.0	48.3	0.285	0.297	513	80.6
Brass	15.4	106.0	5.82	40.1	0.324	0.309	534	83.8
Carbon steel	30.0	207.0	11.5	79.3	0.292	0.282	487	76.5
Cast iron (gray)	14.5	100.0	6.0	41.4	0.211	0.260	450	70.6
Copper	17.2	119.0	6.49	44.7	0.326	0.322	556	87.3
Douglas fir	1.6	11.0	0.6	4.1	0.33	0.016	28	4.3
Glass	6.7	46.2	2.7	18.6	0.245	0.094	162	25.4
Inconel	31.0	214.0	11.0	75.8	0.290	0.307	530	83.3
Lead	5.3	36.5	1.9	13.1	0.425	0.411	710	111.5
Magnesium	6.5	44.8	2.4	16.5	0.350	0.065	112	17.6
Molybdenum	48.0	331.0	17.0	117.0	0.307	0.368	636	100.0
Monel metal	26.0	179.0	9.5	65.5	0.320	0.319	551	86.6
Nickel silver	18.5	127.0	7.0	48.3	0.322	0.316	546	85.8
Nickel steel	30.0	207.0	11.5	79.3	0.291	0.280	484	76.0
Phosphor bronze	16.1	111.0	6.0	41.4	0.349	0.295	510	80.1
Stainless steel (18-8)	27.6	190.0	10.6	73.1	0.305	0.280	484	76.0
Titanium alloys	16.5	114.0	6.2	42.4	0.340	0.160	276	43.4

C.2 Mechanical Properties of Steel 1020

Table A–20

Deterministic ASTM Minimum Tensile and Yield Strengths for Some Hot-Rolled (HR) and Cold-Drawn (CD) Steels [The strengths listed are estimated ASTM minimum values in the size range 18 to 32 mm ($\frac{3}{4}$ to $1\frac{1}{4}$ in). These strengths are suitable for use with the design factor defined in Sec. 1–10, provided the materials conform to ASTM A6 or A568 requirements or are required in the purchase specifications. Remember that a numbering system is not a specification.] *Source:* 1986 SAE Handbook, p. 2.15.

1 UNS No.	2 SAE and/or AISI No.	3 Processing	4 Tensile Strength, MPa (kpsi)	5 Yield Strength, MPa (kpsi)	6 Elongation in 2 in, %	7 Reduction in Area, %	8 Brinell Hardness
G10060	1006	HR	300 (43)	170 (24)	30	55	86
		CD	330 (48)	280 (41)	20	45	95
G10100	1010	HR	320 (47)	180 (26)	28	50	95
		CD	370 (53)	300 (44)	20	40	105
G10150	1015	HR	340 (50)	190 (27.5)	28	50	101
		CD	390 (56)	320 (47)	18	40	111
G10180	1018	HR	400 (58)	220 (32)	25	50	116
		CD	440 (64)	370 (54)	15	40	126
G10200	1020	HR	380 (55)	210 (30)	25	50	111
		CD	470 (68)	390 (57)	15	40	131
G10300	1030	HR	470 (68)	260 (37.5)	20	42	137
		CD	520 (76)	440 (64)	12	35	149
G10350	1035	HR	500 (72)	270 (39.5)	18	40	143
		CD	550 (80)	460 (67)	12	35	163
G10400	1040	HR	520 (76)	290 (42)	18	40	149
		CD	590 (85)	490 (71)	12	35	170
G10450	1045	HR	570 (82)	310 (45)	16	40	163
		CD	630 (91)	530 (77)	12	35	179
G10500	1050	HR	620 (90)	340 (49.5)	15	35	179
		CD	690 (100)	580 (84)	10	30	197
G10600	1060	HR	680 (98)	370 (54)	12	30	201
G10800	1080	HR	770 (112)	420 (61.5)	10	25	229
G10950	1095	HR	830 (120)	460 (66)	10	25	248

References:

[1]http://www.oumiagitator.com/Low_Viscosity_with_Impellers/Low_Viscosity_with_Impellers_4.html

[2]http://formulas.tutorvista.com/physics/reynolds-number-formula.html

[3]https://www.rpi.edu/dept/chem-eng/Biotech-Environ/AERATION/dimnum.htm

[4]http://energyzarr.typepad.com/energyzarrnationalcom/2008/10/performance-and-energy-consumption-are-they-exclusive.html

[5] http://www.oyoun-alarab.ps/a/images/catalog.pdf

[6] http://www.tradekorea.com/product/detail/P2347/Limit-Switch-for-Elevator.html

[7]http://www.thomasnet.com/productsearch/item/469960-1550-3001319-28236/trirotor-inc/rotary-piston-pump-up-to-120-gpm-series-120/