



An-Najah National University

Faculty of Engineering

Mechanical Engineering Department

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Graduation Project Report II

PLASTERING WALL MACHINE

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إهداء

إلى المعلم الاول ... الحبيب المصطفى صلى الله عليه وسلم ...
إلى القلب الحنون التي كانت بجانبى بكل المراحل التي مضت ...
من تلذذت بالمعاناه وكانت شمعة تحترق لتتير دربي ... إلى أمهاتنا الحبيبات .. إلى من
علمني أن اقف وكيف ابدأ الالف ميل بخطوة ..
إلى يدي اليمنى ..

إلى من علمني الصعود وعيناه ترقباني ... إلى آبائنا الأجلاء ..
إلى من رووني من ينابيع الفضيلة ..
إلى الذين أخذو بيدي إلى منهل المعرفة وأظلوني بشجرة الإيمان ... إلى أهلنا الأعزاء..
إلى من أمسك بيدي وعلمني حرفا ..
إلى من كانوا سنداً لي ..

إلى من لهم الفضل بإرشادي إلى طريق العلم والمعرفة ..

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إلى كل محبي المعرفة .

إلى من ضاقت السطور عن ذكرهم فوسعهم قلبي ... إلى أصدقائنا الأوفياء .

إلى من ضحوا بحرياتهم من أجل حرية غيرهم ... إلى أسرانا البواسل .

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DISCLAIMER:

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Abstract:

The aim of this project is to design plastering machine .This machine is used for transferring blucher by conveyor belt to the board that make the surface finish good and same thickness. This system for plastering the wall .The advantages of using this machine are for saving in man power, raw material and cycle time .Additionally. Plastering is widely used as a finishing technology for both interior and exterior walls made from bricks. The plastering wall machine will help to save labor cost up to 85%, increase productivity by 10–15 times, get professional quality finishing in less time, reduce project cost, manufacture plastering wall machine in low cost .

It was done by hard work and contentiously effort, by helping the supervisor of project and trying in the workshop.

Introduction:

The aim of this project was to design cement plastering machine. This machine is used for transferring liquid cement using pumping system for plastering the wall and ceiling, the advantages of using this machine are for saving in man power and cycle time. Additionally, the machine can be used under any weather condition, the cement is protected from the element during transport to the placement area. Plastering is widely used as a finishing technology for both interior and exterior walls made from bricks, cement or timber.

Description :

Cement pump apply pressure to a column for forcing the cement through pipe to plaster the required area such as wall or ceiling. A construction machine for the forced pumping of cement mix through a conduit to the location where it's to be placed.

The pumping operation starts with the discharge of the cement usually from a ready mix truck into a hopper large enough to hold a small supply of fresh cement. In the hopper an agitator keeps the fresh cement flowing smoothly into the pumping cylinder. Cement piston pumps operate in the same principle as a twin cylinder reciprocating engine, in which one cylinder draws cement from the hopper on the return stroke and another pushes it on the forward stroke into the line. Pistons in both cylinders operate in opposite directions so there is a constant pressure on the cement in the line. The pistons are driven by hydraulic cylinders powered by a hydraulic pump. A synchronized valve enables cement from the two cylinders to go into one pump discharge line. This valve is often used to distinguish one type of pump from another.

History of plastering:

Although plastering is one of the most physically strenuous jobs in building construction it was not before the early fifties that machines were developed which supported this strenuous task. The first machines to be developed were automated mixers which made the task of manual plaster mixing obsolete [1, 2]. The introduction of plastering machines such as RUMA 1, Putzmeister KS 1 [3] and Putzmeister Gipsomat [4] in the sixties was considered revolutionary and marked the beginning of a new plastering technology.

The development of the AMPA machine [5] was the first attempt to significantly increase the level of automation but this kind of equipment has never been accepted in practice. Automated spraying of mortar and paint has recently been demonstrated by means of the mobile articulated prototype robot TAMIR which had been developed in Israel [6] and a prototype of an artesian robot which had been constructed in a Swedish joint venture between Swedish construction companies and universities [7]. Unfortunately these developments have been unable to provide a breakthrough in the plastering industry. Thus, even today, the plastering machines developed in the sixties such as [3, 4] are still considered to be State-of-the-Art.

Following surface preparation the plastering process is performed in three steps:

Step 1: Application of plaster to the wall.

Step 2: Formation of a (roughly) plane surface by leveling the plaster which had been applied to the wall.

Step 3: Finishing the surface in order to meet the given tolerances (e.g. maximum horizontal and vertical deviation of 8 mm at measuring distance of 2.5 m according to DIN [8]).

While mixing and pumping of the plaster material is supported by a machine, each of the described steps involves manual labor. Movement of the heavy spraying nozzle (step 1) and distribution of the plastering material on the wall (step 2) is especially strenuous tasks for the operator (1).

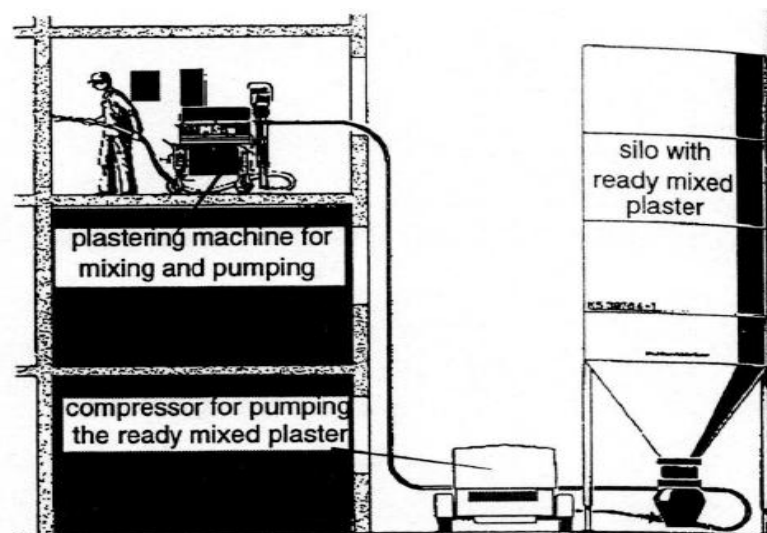


Figure 1

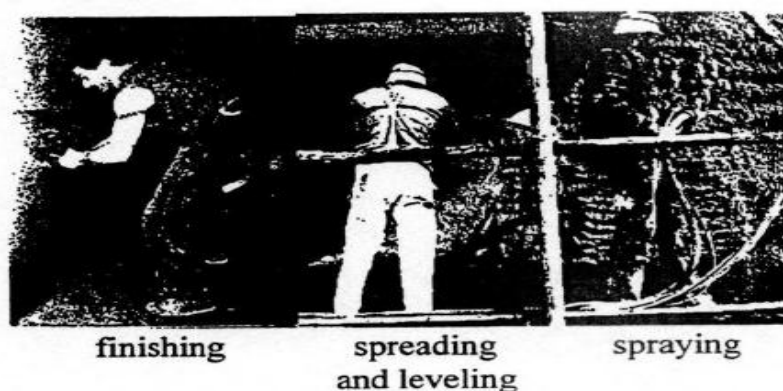


Figure 2

It is the new machine used to reduce human work especially work of plasterers.
Very easy and simple to operate.
Simple structure, light weight, small cubage, easy to operate.
Saving more than 20% raw material (cement & sand).

Scope of the Work:

Pumping placement is faster than placement by other method , cement can be placed in areas that are difficult or impossible to reach by other method , it's often result in a saving in man power and cycle time , it can take place under any weather condition since the cement is protected from the element during transport to the placement area , pump cement can be easier to handle because the flow of cement is directed to the exact spot of the placement whereas cranes and conveyors deposit large piles of cement that must be moved manually .

Concepts and specification:

There are several machines and concepts that related to cement pump machine and depends on and on its working process as the following machines:

Plastering wall machine:

Machines has been developed to automate the plastering work is very much demand for construction field. it is proposed to automate the plastering work . The completed model was validated by testing the machine using the brick wall and the statistical details of the manual work are also observed at the different conditions (2).



Mobile plastering robot :

The main task of the plastering robot is the application and initial smoothing of plaster on the wall or ceiling and the removal of excess plaster material.



Figure 4

The tasks of the human operator include:

The positioning of the robot at the wall,
Determination of the required plaster thickness,
Initialization and monitoring of the automated plastering process and correction of any operating errors and
Repositioning of the robot to other walls, rooms and floors.

After commencement of the plastering process the robot will carry out the following tasks

Measurement of the distance to the wall,
Tool positioning and motion control necessary for the defined plaster thickness,
Quantity control of the plaster mixing machine for a defined plaster flow,
Regular meandering motion generation and control for plaster application within the working envelope of the robot and
Automated motion of the robots working position along the wall (1).

Some calculations in mobile plastering machine:

Pressure head:

The pressure indicates the normal force per unit area at a given point acting on a given plane. Since there is no shearing stresses present in a fluid at rest - the pressure in a fluid is independent of direction.

***Note that this calculations for water and we need for cement the viscosity it will be deferent*

For fluids - liquids or gases - at rest the pressure gradient in the vertical direction depends only on the specific weight of the fluid.

How pressure changes with elevation can be expressed as

$$dp = - \gamma dz \quad (1) \text{ where;}$$

dp = change in pressure

dz = change in height

γ = specific weight

The pressure gradient in vertical direction is negative - the pressure decrease upwards.

Specific Weight

Specific Weight can be expressed as:

$$\gamma = \rho g \quad (2) \text{ where;}$$

γ = specific weight

g = acceleration of gravity

In general the specific weight - γ - is constant for fluids. For gases the specific weight - γ - varies with the elevation.

The pressure exerted by a static fluid depends only upon

the depth of the fluid

the density of the fluid

the acceleration of gravity

Static Pressure in a Fluid

For an incompressible fluid - as a liquid - the pressure difference between two elevations can be expressed as:

$$p_2 - p_1 = - \gamma (z_2 - z_1) \quad (3) \text{ where;}$$

p_2 = pressure at level 2

p_1 = pressure at level 1

z_2 = level 2

z1 = level 1

With the development of technology and the development of a lot of pump that pumps cement become necessary to develop this pumps.

In this project have designed a pump that pumps the cement to a certain height and distance using compressor and fluid analysis and conveyor system. Not expensive there are additives which directly improve pump ability: this increase the viscosity of the mixture, but they are expensive. And can take this project anywhere.

The project has been changed and decided to work on automatically plastering machine

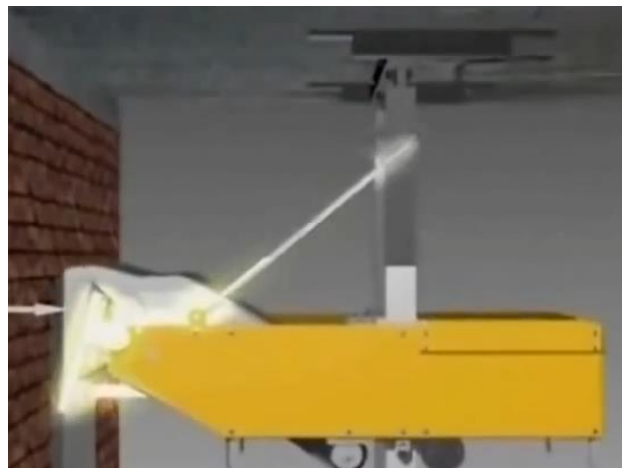


Figure 5

Because it seen that this machine is abbreviated all mechanism were needed in the previous machine and achieve all wanted objectives and more

It's less expensive compared with the previous one

It's less weight

Easier in moving

Gives a good , soft surface finished, without needed a worker to settlement the surface

gives the same thickness for the whole wall that has been plastered

faster in ends the work , need less time to finish

more efficiency , and effectively

Plastering is the plasterwork which is known as ornamentation done by plasterers on walls by manually in most parts of the world. The plasterwork needs more effort of humans and also consumes more time in manual process. This is an intention to implement an innovative process with a development of “Automatic Plastering Machine”. Automation is one of the

significant and evolving disciplines among all technologies. Our aim of this innovative idea is to render the plasters on walls automatically. This idea aims in reducing the work of plasterer. It is feasible, light weight, inexpensive and simple structure comparing to the existing machine. This innovative process keeps up with the ever changing world of building automation.

GENERAL VIEW:

- This innovative machine is unique and perhaps one kind of automated plastering machinery ideally suitable for the construction/building industry.
- It works with conventional cement mortar which brings it to a smooth, flat finish with variable and adjustable thickness to suit each application.
- It can plaster the wall automatically by moving up and down in vertical direction.



Figure 6

- It can be plastered by one-time in vertical direction. The thickness of the ash/gypsum salleri can be adjusted.
- It has special design for adjusting the thickness of plastering/salleri/cement mix.



Figure 7

- It has two rails for rising and moving automatically, therefore it can be used for different height and width of the wall.
- It has large capacity hopper and you can put the ash/lime/gypsum in it one-time.
- It has microcontrollers for controlling the motor to automatic extend of cement flow and to automatic movement of hopper for cement discharge/plastering.
- It is easy to operate. One or two person can operate.
- Easy to move, without removing any parts of the machine and there are wheels under the machine for easy movement
- The quality is subject to handmade wall plastering standard and it is suitable for construction site safety and reliability.

Description

- General description of the project is given as, “Quick plastering of walls automatically by pumping the cement mix from funnel and plaster it on wall in vertical and horizontal movement using microcontrollers by controlling the stepper motor. It is cost effective and reduces human effort”.
- Inside the hopper, there will be a gear pump which pumps the cement mix as an output to wall through the cylinder slit
- The cement mix which came out will be captured by the metal plate and it forcibly sticks to the wall.
- The cement mix will be punched by metal plate using rollers.
- The stuck cement mix will also be smudged using metal plate and rollers.
- To make this as automation, a sensors to detect cement flow has been interfaced, the stepper motor for the movement of the header unit in rail guides and the AC motor to control the flow with microcontrollers.
- Here the vertical and horizontal distance as the input for the movement of header unit. Will be given



Figure 8

Constrains, standards/ code and Earlier course work

There are many challenges and limitation that rise up while working on this project, from these challenges

There is no enough source and information about the machine

Expensive parts and components

Moreover it does not a valuable

The most challenges thing was the statues of the transportation because of occupation in specially in recent days, so the difficult was in ability of bring some of the machine parts.

Other thing have been faced was how to not make the conveyor slipping, caused the appropriate conveyor belt could not be found .

Cods / Standards

For design calculation of bearing the [SKF] catalogue was used

The [ASTM] code was used for calculation of tubes.

The Amine cam bearing Manufactures Association [ABMA]

Earlier course work

The mechanical engineering design course was very useful and the most concepts and information were taken from it,

Especially the project that was done for that course was very helpful, and learned a lot from it

With other courses like: strength of material, control and fluid.

Literature review:

Possible adoption of many scenarios because not all the pieces are available in the market, so it can be used alternative parts .

1) Ceiling bean: used to fix the steel tube to the roof of the room need plastering.

2) Steel Tube: there is three members, two legs fixed at the base and its hollow and the other will slides inside from above, they fixed by using arc welding .and put two bearings between the steel tube and the container to slide easily with the lowest friction when the machine is on.



Figure 9

3) Upper adjustable touch: this part is connected with the tube by welding and it have a two small channels in order to the wheel that fixed on the level part walk on it and then the limit switch will be on to make the container slide down, more over the main purpose of this part to fixed the machine with the ceiling by using the hydraulic system.



Figure 10

4) Steel wire: is the wire help the machine to move up and down on the steel tubes by pulling it, while it connected to electricity motor , the two cable steel will rotate on the two pulley's that fixed inside the container and join its to cover by the shaft and in the end of the shaft we will putt a small gears to make the rotation of the conveyer belt , Polly's , also the small rotation mixer going together , the mixer use to prevent the material going to solid phase.



Figure 11

5) Conveyor belt: which use to move the bleacher to be used on the wall from the ash pit , this peace will be a simple by using a rolling parts from side and in the other side will connected with gear and the shaft .

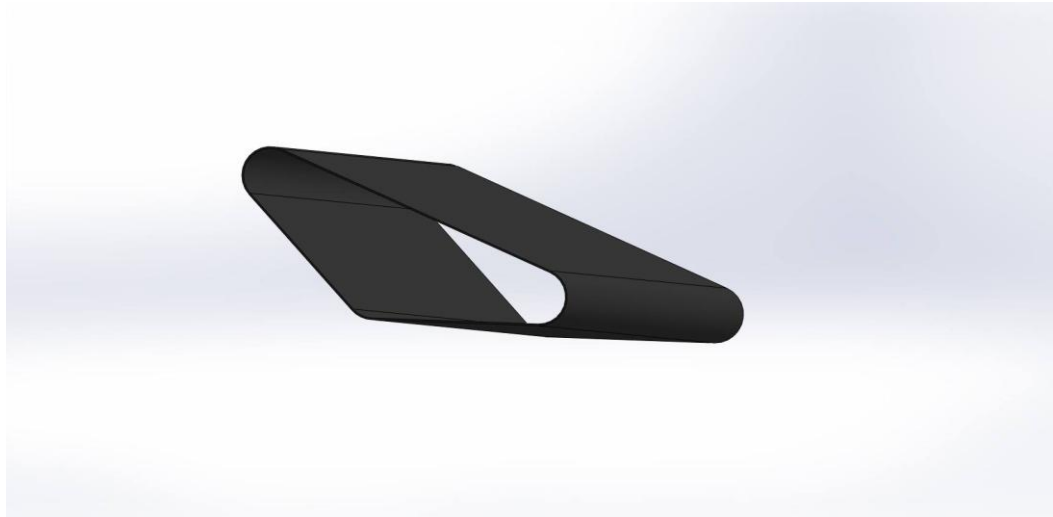


Figure 12

6) Plastering board: a board use to distribute plastering material on the wall tidily, by moving up and down to make it smooth layer, can use an air springs or helical springs to control the angle that the board will take it, in different time during the plastering operation.



Figure 13

7) Resist board: prevent bleacher from volatility for the rest of the machine parts.

8) Supporting bar: it's located in the base and others (when we use the rollers to make a good level).

9) Lower adjustable touch: specific the lowest point that the plasterboard can reach

10) Hydraulic base: used to lift the machine from the ground a certain distance, so that the workers can adjust the vertical, it connected the machine by using of screws and nuts to make the maintenance easily.



Figure 14

11) Hydraulic handle: it's a part which connected with the hydraulic system to take the fluid (oil) to the storage of the oil to make the machine free then make it off.



Figure 15

12) Hydraulic pedal: this part is connected with the hydraulic system and the base, and used to fixed the machine from the above and down by applying the wait of the worker (using the worker leg impulse)



Figure 16

13) Conveyor handle switch



Figure 17

14) Power plug: Plug the power cord into the AC power connector on the back of the switch, as shown

Generally the plug is the movable connector attached to an electrically operated device's mains cable, and the socket is fixed on equipment or a building structure and connected to an energized electrical circuit. The plug has blades, or pins (referred to as male) that fit into matching slots or holes (called female).

And it will be connected to the motor indirectly, to provide the electric current needed to run

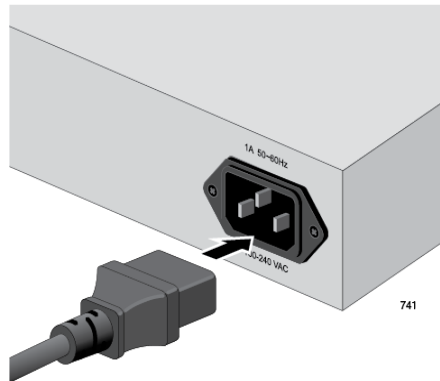


Figure 18

15) Power lights: it's as a Sensor is illuminated when the motor running

16) Power

17) Limit switch touch bar: move from an angle of elevation to a slight depression
Rods, stabilized at the machine columns with two small calves at the end... So they slip when touching the ceiling, thus changing the direction of the plastering plate.

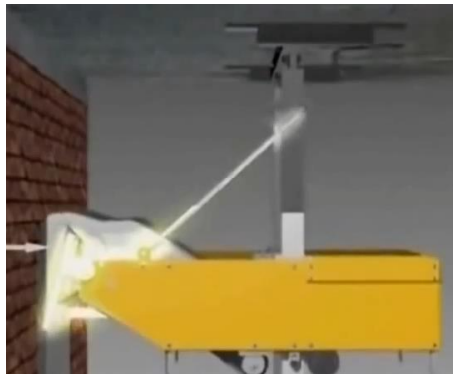


Figure 19



Figure 20

18) Supporting bar.

19) Location ruler: tow ruler are used, to make the plaster in same thickness, there is a hollow for each tube and using the same length for two supporting parts to take the same thickness of plaster, when the machine fixed they will be removed .

20) Oil window: is the window where we can add the oil to the machine.

21) Driving shaft: to transfer the power from the motor and convert it to vertical movement. It's located horizontally at the ash pit.

And it connect with a bearing, the other end connected with a roller to have a free rotates.

23) Ash pit: Ash pits in which the necessary to put Bleacher, its containing the auger conveyor which is used to mix cement.



Figure 21

Internal parts: that's include the following terms :

Two rollers which rolls to move the conveyer belt



Figure 22

Motor: the motor is the main component in the machine which move all items in the system and a drive shaft fixed with it .



Figure 23

The driveshaft : it rotate by the motor and with its rotating ,rotate the gears.

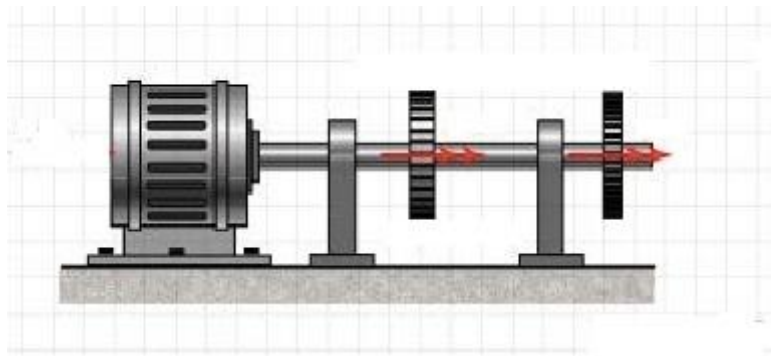


Figure 24

Gears: some gears for transfer the movement to rollers and other for the vertical movement on the steel tube.

Spur gear used to a rotating machine part , which mesh with another toothed part to transmit torque, in most cases with teeth on the one gear being of identical shape, and often also with that shape on the other gear. Two or more gears working in a sequence (train) are called a gear train or, in many cases, a transmission; such gear arrangements can produce a mechanical advantage through a gear ratio and thus may be considered a simple machine. Geared devices can change the speed, torque, and direction of a power source. The most common situation is for a gear to mesh with another gear; however, a gear can also mesh with a non-rotating toothed part, called a rack, thereby producing translation instead of rotation.

The gears in a transmission are analogous to the wheels in a crossed belt pulley system. An advantage of gears is that the teeth of a gear prevent slippage.

TYPES OF GEARS



Figure 25

Tow pulleys In order to warp the wire.

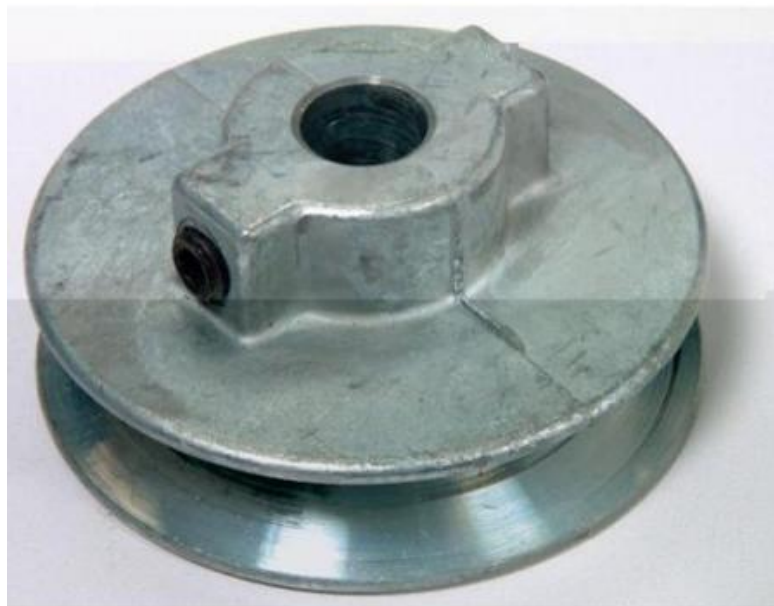


Figure 26

It's work principle

Fill the plaster into the ash pit first .

The plasters continually sent into the plastering mouth by the conveyer belt .

Using two up rights with a steel wire cable and a beam, the winch inside the machine will rotate rolling up, the cable raising the machine which raises the plaster if there is any without stopping until reaching the top.

Plastering trowel will switch, once begin pressed .the angle changed when it's pressed to its base and the plaster will come down (its angle of depression).

The automatic rendering machine , it's mainly composed of a machine body , plastering trowel and two up rights going through the machine body , fixed two up rights between the ground and the roof before using them , then fill in the ash pit full with plaster .

Turn on the machine, the plaster is sent to the plastering trowel by the conveyer belt .

At the same time the machine inclines upward to plaster walls.

When the machine come close to the roof the plastering trowel will be moved from an angle of elevation to a slight depression , it changes into a plastering trowel modestly , then the machine start to decline to float the plaster being wiped just now that the wall is completed .



Figure 27

Some of specifications:

Model	Sunrise-1000	Sunrise-2000	Sunrise-3000
Size	700X600X700mm	1150X850X250mm	1300X850X540mm
Power	1.5KW	2.2KW	2.2KW
Voltage	220/380V	220/380v	220/380v
Rendering height	3.5m	Below5m(standard 3.5m)	Below5m(standard 3.5m)
Rendering Thickness	2--25mm	2--25mm	2--25mm
Length of Plastering trowel	80CM	80CM	80CM
Rendering Speed	450--500 m ² /8hour	500--600 m ² /8hour	600-700 m ² /8hour
Weight	80KG	130KG	196KG

Figure 28

Previous work:

ABSTRACT

A plastering machine is formed to apply and compact cement-sand mortar plaster onto a vertical wall surface. A container (30) for holding and applying mortar is attached to a frame assembly moveable along both a vertical axis and horizontal axis. The container is supported by a frame-assembly (16) which includes vertical moveable frame members (18, 20) energized by hydraulic means, mounted onto a base frame (2). The base-frame (2) is fitted with swivel caster wheels (4) and angled roller wheels (6). A vibration rod (44) is provided within the container (38). A cutter and smoothening device (42) is provided to smoothen the plaster applied to the wall surface.

IMAGES (4)

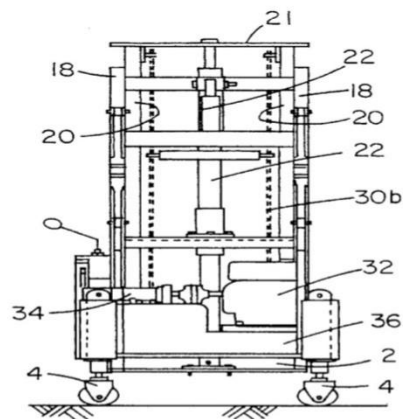


Figure 1

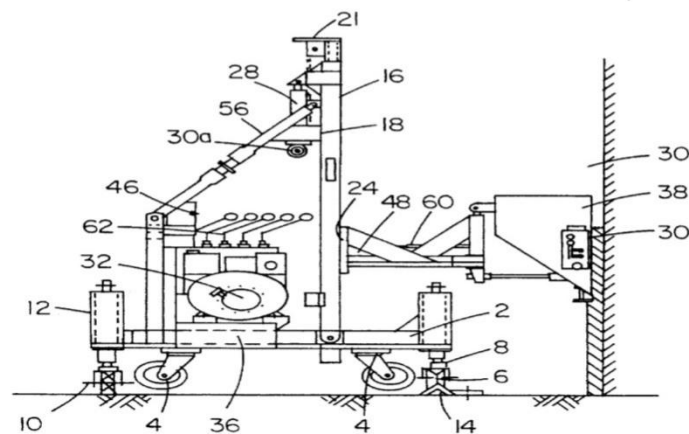


Figure 2

Figure 29

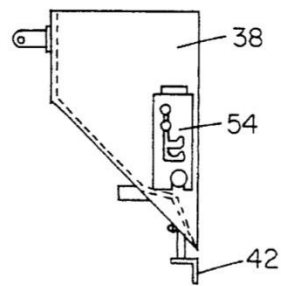


Figure 3(a)

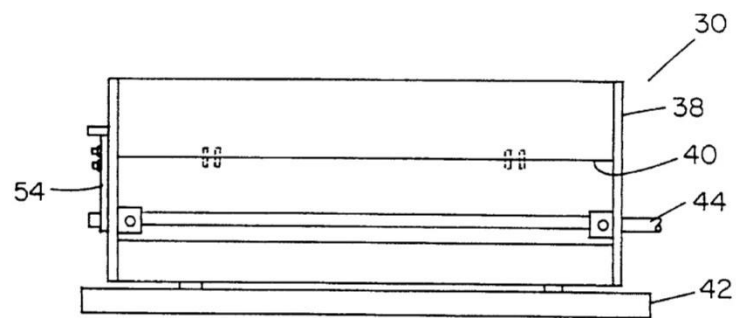


Figure 3(b)

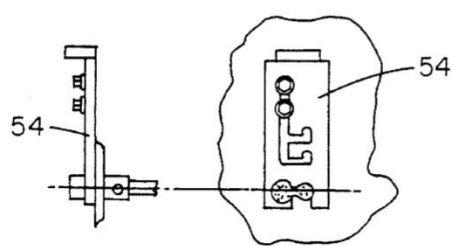


Figure 3(c)

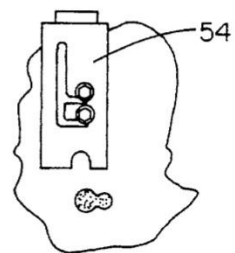


Figure 3(d)

Figure 30

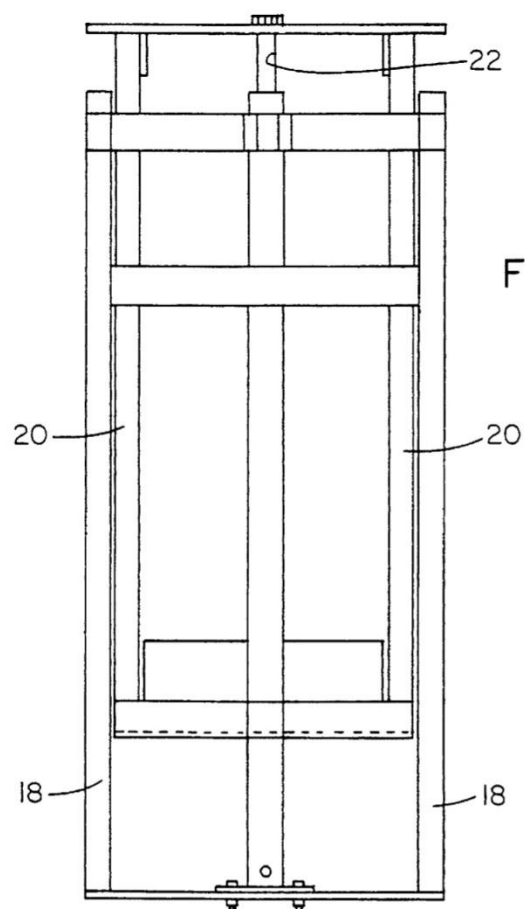


Figure 6(a)

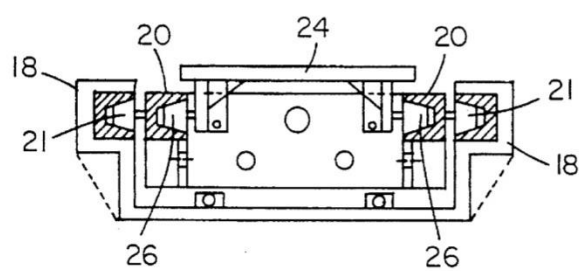


Figure 6(b)

Figure 31

CLAIMS(12)

I claim

1. A plastering machine to apply cement-sand mortar plaster onto a planar vertical surface, comprising:

i) a container secured to a frame assembly means capable of vertical movement to hold and to apply cement-sand mortar plaster onto the planar surface; and

ii) a vibration means to compact the cement-sand mortar plaster onto the planar vertical surface.

2. A plastering machine as claimed in claim 1, wherein:

the frame assembly means includes an outer pair of frame members which are non-movably fixed onto a base frame and an inner pair of frame members longitudinally movable along the outer pair of frame members.

3. A plastering machine as claimed in claim 2, further comprising:

a travelling frame member, movable along the inner pair of frame members and to which the container is secured.

4. A plastering machine as claimed in claim 3, wherein:

the travelling frame member is secured to rollers which are slideable along a pair of grooves formed in the inner pair of frame members.

5. A plastering machine as claimed in claim 1, wherein:

the container is supported to means for enabling movement of the container toward and away from the planar vertical surface along a horizontal direction.

6. A plastering machine as claimed in claim 1, wherein:

the vibration means includes a longitudinal vibration rod disposed horizontally along a length of the container.

7. A plastering machine as claimed in claim 1, further comprising:

means for smoothening the plaster on the vertical planar surface.

8. A plastering machine as claimed in claim 7, wherein:

the means to smoothen the plaster on the vertical planar surface comprises an elongate member and is positioned below a base of the container.

9. A plastering machine as claimed in claim 6, wherein:

the vibration rod is detachably attached to the container.

10. A plastering machine as claimed in claim 1, wherein:

the machine is mounted on plurality of wheels comprising at least two front wheels which are angled roller wheels and are moveable along a grounded angle rail.

11. A plastering machine as claimed in claim 10, further comprising:

means for aligning the machine at a desired inclination to a vertical direction by independently adjusting respective corners of the base frame of the machine relative to ground level.

12. A plastering machine as claimed in claim 4, further including:

a hydraulic pump, motors and hydraulic controls for actuating the vibration means, the travelling frame member, and the container, mounted so as to be isolated from the outer pair of frame members, the inner pair of frame members, and the container.

DESCRIPTION

FIELD OF THE INVENTION

This invention relates to a plastering and in particular to a machine to apply cement-sand mortar plaster onto brick wall, or concrete wall surfaces to provide a substantially smooth surface.

BACKGROUND OF THE RELATED ART

In the construction of buildings, the exposed brick wall surfaces or concrete wall surfaces, which are often rough or uneven, are generally plastered with cement-sand mortar to provide a substantially smooth surface. This application of cement-sand mortar plaster is typically done manually. The manual plastering method is labor intensive and generally does not always result in uniform plastered surfaces, if the task is undertaken by persons lacking the necessary skills. Further, the manual rate of application of plaster is also slow.

Various attempts have been made to introduce mechanical contrivances to apply plaster onto walls. In one such example, cement plaster is sprayed onto the wall, resulting in a rough surface. The inventor is not aware of any other machines or contrivances used to apply plaster onto walls.

SUMMARY OF THE INVENTION

A principal object of this invention is to provide a plastering machine to apply cement-sand mortar plaster onto a substantially planar vertical surface.

The plastering machine in the preferred embodiment includes a container secured to a frame assembly means capable of vertical movement to hold and to apply cement sand mortar plaster onto the planar structure. The frame assembly includes an outer pair of frame

members which are non-moveably fixed onto a base frame and an inner pair of frame members longitudinal moveable along the outer pair of frame members. The travelling frame member is secured to rollers which are sliceable along a pair of grooves in the inner pair of frame members. A vibration means is provided and includes a vibration rod disposed horizontally along the length of the container. The plastering machine is mounted onto a fixed set of wheels and a set of hydraulically mounted roller wheels and the base frame can be raised above ground level.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the invention may be more clearly understood reference will now be made to the accompanying drawings which show a preferred embodiment thereof by way of example and in which:

FIG. 1 is a rear elevation view of a preferred embodiment of the invention.

FIG. 2 is a side elevation view of the preferred embodiment.

FIG. 3(a), (b), (c) and (d) shows details of a container and vibrator locking device.

FIG. 4 is an enlarged side view of a container and frame of the preferred embodiment.

FIG. 5(a) and (b) are detailed views of the container and frame.

FIG. 6 is a detailed view of the frame assembly.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIGS. 1 to 6, there is shown a preferred embodiment of the plastering machine. The plastering machine includes a base frame (2) which is of rectangular configuration. The base frame is mounted onto four caster swivel wheels (4) each rotatable 360 degrees about its respective mounting. At least one pair of angled roller wheels (6) are installed at the front end of the base frame (2). These angled roller wheels are mounted onto a pair of hydraulic piston rods (8). Another pair of wheels (10) is mounted onto a second pair of hydraulic piston rods (12). By activating the hydraulic pistons (8, 12), the base frame can be lifted above the ground, so that the caster swivel wheels (4) are free, i.e. no longer in contact with the ground. The pair of angled rollers are mountable onto an angled rail (14). Each of the two pairs of hydraulic pistons (8, 12) can be independently operated so that the base frame and the fixtures thereon can be aligned vertically to any desired angle.

The plastering machine further includes an upright mast assembly (16). The upright mast assembly (16) consists of three frames. The outer frame (18) includes a pair of frame members, and is stationary with one end anchored to the base frame (2). The inner frame (20) is slidable along the outer frame (18) preferably by means of eight to twelve guide rollers

(21). The inner frame (20) is secured to a hydraulic piston (22) at appropriate position, preferably at the connecting bar (21) of the inner frame (see FIG. 6). Thus the inner frame (20) can be moved up and down along the outer frame (18) by operating the hydraulic piston (22). A travelling frame (24) is slidable along the inner frame (20) by means of guide rollers (26). The movement of the travelling frame (24) along the inner frame (20) is by means of a hydraulic piston (28) and a chain and sprocket assembly. Thus two independent sliding movements are enabled by the provision of the outer frame, the inner frame and the travelling frame assembly.

To raise the container assembly, the inner frame is first raised, by energizing the hydraulic piston (22). To raise the container assembly further, the second hydraulic piston (28) is energized whereby the travelling frame is raised by sliding along the inner frame (20). The second set of guide rollers (26) facilitates this sliding movement. The frame are lowered by the operation of the hydraulic pistons. A motor (32), a hydraulic pump apparatus (34), and a hydraulic fluid tank (36) are suitably accommodated and mounted onto the base frame so as to be isolated from the outer frame, the inner frame and the container.

The container assembly will now be described by referring to FIGS. 2, 3, 4 and 5. The container (38) is a generally rectangular box with a inclined base. The front panel (40) extends from the top of the container to about 10 cm from the edge of the inclined base to leave a rectangular void. A cutter or smoothening device number (42) is attached to the base of the container (30) and lies along the same plane as the front panel (40). A vibrator means preferably including a vibrator rod (44) is introducible onto the container. The vibration generator means (46) is powered by the hydraulic pump (34) or the motor (32).

The vibration generator means (46) and the vibration rod (44) are connected by a flexible rubber hose of appropriate design and strength (not shown in illustration).

The container (38) is mounted onto the travelling frame (24) by appropriate structural frame-members as shown in FIGS. 4 and 5. To move the container (38) forward, a hydraulic ram is provided. By energizing this hydraulic ram (48), the container can be moved forward towards the wall or withdrawn backwards. The angle of the container or the front panel and the cutter (42) can be adjusted by rod and bolt means (52). The cutter (42) can be independently adjusted by bolts. Alternatively hydraulic means (not shown) can be employed to adjust the position of the cutter (42).

To lock the removable vibrator rod (44) suitable vibrator locking devices (54) are provided on both sides of the container side walls. In the preferred embodiment, the locking device (54) consists of a plate with slots sliceable over bolts.

The frames (18, 20) are secured in position by the provision of appropriate frame structures including a turn buckle rod assembly (56). The turn buckle (56) is used to adjust the arm position during the setting up of the machine for plastering. Liquid levels (58) are provided on either side of the outer frames (18) to facilitate level positioning of the machine before

commencing the plastering operation. To facilitate the registration of the container distance from the wall, a wall space indicator (60) is provided. The indicator measures the distance of the container from the wall surface. Whenever the machine is moved from one place to another the wall indicator readings are taken at the location. Thereafter the position of the container is adjusted to the corresponding level.

The workings of the machine and other features of the invention will be described now. The machine is moved towards the wall or structure to be plastered and positioned in a manner such that the container is adjusted and parallel to the plane of the wall or the structure. The angled rail (14) is positioned parallel to the plane of the wall or structure and is preferably fixed in the selected position by driving of nails or screws into apertures provided along the length of the rail. The machine is then positioned in registration with the angled rail. The pair of angled roller wheels (6) is then mounted over the angled rail. It will be observed that with the angled roller wheels (6, 10) in a first rest position, they are above the ground level, while the castor swivel wheels are on the ground and are bearing the weight of the machine. Thus it is relatively convenient to move the machine to adjacent the wall or the angled rail, before positioning the angled roller wheels (6) over the rail. The four hydraulic rods (12, 8) are energized so that the wheels are extended downwards thus "lifting" the machine above the ground level, whereby the castor swivel wheels (4) are lifted above the ground. The hydraulic rods are independently adjusted in such a manner that the machine is vertical. The positioning of the machine vertically is facilitated by the liquid level indicators (58).

The container (38) is lowered to the ground wherein the cutter (42) is at ground level. The desired thickness of the plaster to be applied onto the wall is determined. The desired distance of the container (38) from the wall is correspondingly determined and fixed in position. If necessary the hydraulic ram (48) is energized to ensure that the container is at the desired position. The angle of inclination of the container to the wall can be further adjusted if necessary by adjusting the rod and adjusting bolts (52). The vibrator rod (44) is inserted into the container (38) at the front edge of the container and at least one end of the vibrator rod is locked in position by the use of the vibrator locking device (54).

Although the present invention has been described and illustrated in detail, it should be clearly understood that the same is by way of illustration and example only and is not to be taken by way of limitation, the spirit and scope of the present invention being limited only by the terms of the appended claims.

Cement plaster is introduced into the container (38) by any known means, either by pumping plaster into the container or by manual means. The vibrator rod (44) is energized and the container is moved vertically upwards in a controlled manner. The cement mortar is compacted onto the wall, the vibration generated in the mortar in the container, ensuring that the mortar flows downwards by gravitational force. As the container is raised upwards, an even layer of plaster is compacted onto the wall structure by vibration action. The cutter (42) as it moves upwards with the movement of the container (38) ensures that the mortar is smoothened out to produce an even and smooth plastered wall.

At the first stage, the traveling frame and the container is moved vertically upwards by moving the inner frame (20) upwards, by activating the main hydraulic position (22). Once the inner frame reaches the maximum height, the second stage of vertical movement is activated. In the second stage, the second hydraulic piston (28) is activated, the traveling frame (24) moves upwards along the inner frame (20). The configuration of the outer pair of frame (18), the inner pair of frame (20) and the traveling frame (24) is similar to that found in fork-lift truck where the forks are mounted to a traveling frame, in corresponding relationship to the traveling frame and the container (38) in this invention. Once a rectangular patch of wall is plastered, the container is withdrawn backwards and is lowered to the ground level, the machine is moved laterally along the angular rail to the next position such that edge of the container is at the edge of the rectangular patch to be plastered. The process is repeated as described earlier.

The speed of the movement of the container upwards and the rate of vibration has to be coordinated so that the cement mortar is effectively plastered.

The hydraulic rams, are powered by a hydraulic pump (34), the hydraulic control levers (62) are conveniently located towards the side edge of the machine, so that it is convenient for the operator to stand adjacent to the machine and operate the control levers. The hydraulic fluid tank (36) is conveniently located beneath the hydraulic pump, on top of the base frame (2). For convenience, the vibration generating means is positioned at the back of the machine, adjacent to the hydraulic levers.

Vibration forces are transferred to the vibrator rod by means of a suitable detachable rubber hose (not shown).

The present embodiment is desired to be easily disassembled and assembled at site, thus enhancing the flexibility of the machine. The size, in particular the length of the container can be varied so that at each upward movement of the container a larger surface area of the wall can be plastered.

The entire machine can be conveniently motorized, so that an operator can move the machine from one point to another, just similar to the operation of fork-lift trucks. Alternatively the hydraulic pump, hydraulic tank and the hydraulic control levers can be isolated from the machine.

It has been found in practice that the use of the machine as described above, greatly increases the rate of plastering of wall. Further the finish of the surface area after plastering is much smoother and even as compared to the manual operations. The strength of the plaster compacted onto the wall surface is stronger as compared to that plastered surface produced in manual operation (3).

Methodology:

The experimental work was depending on a research to get more information about this plastering machine, so as seen this machine is unique and not available in Palestine.

In this project the important thing is the stability of the machine and prevent it to fall , if it fall then may be make injures and become dangerous machine .

So for safety the machine should be stable and to make this it required to fixe it properly by :

Fixing the base of tubes by using a well welding.



Figure 32

Adding two legs from right and left of the machine body, which prevent the falling during the work.

The hydraulic handle is very important component to complete the stability which must be sure that the hydraulic handle is impulse.



Figure 33

If the cable crashed the plastering car will not fall , because the motor and gear rotates at a specified speed .

Parts needed shown in the figures of solid works

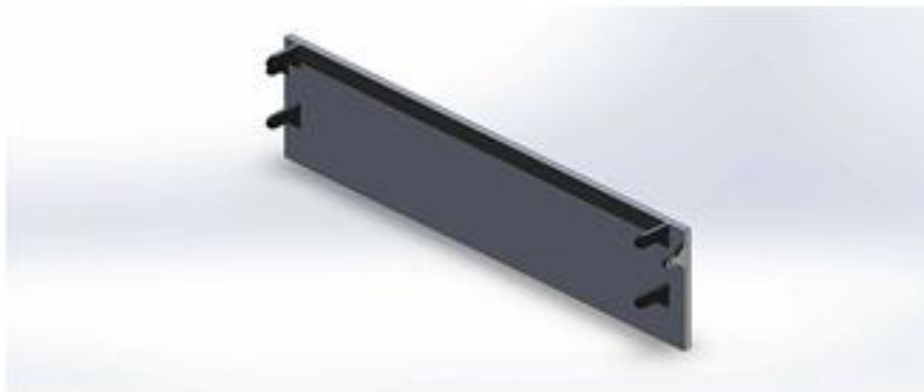


Figure 34

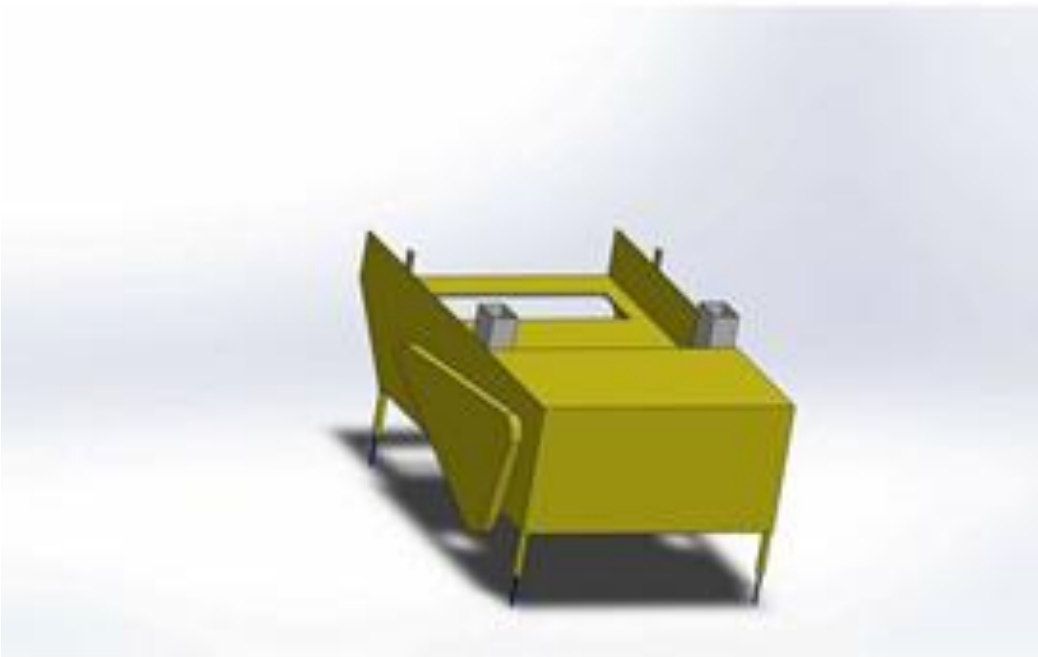
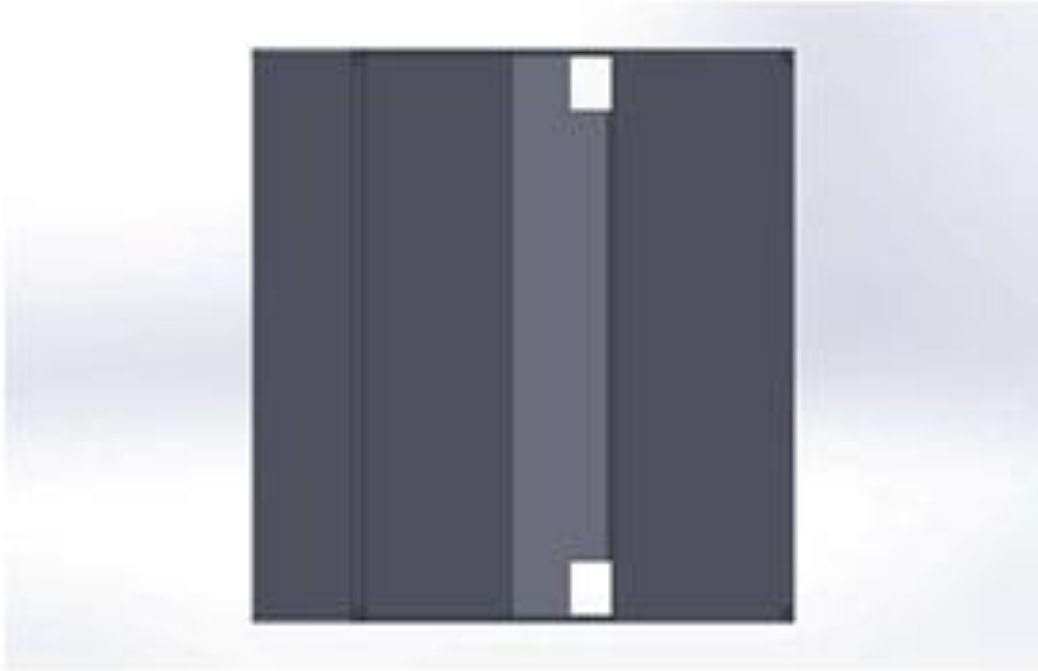


Figure 35

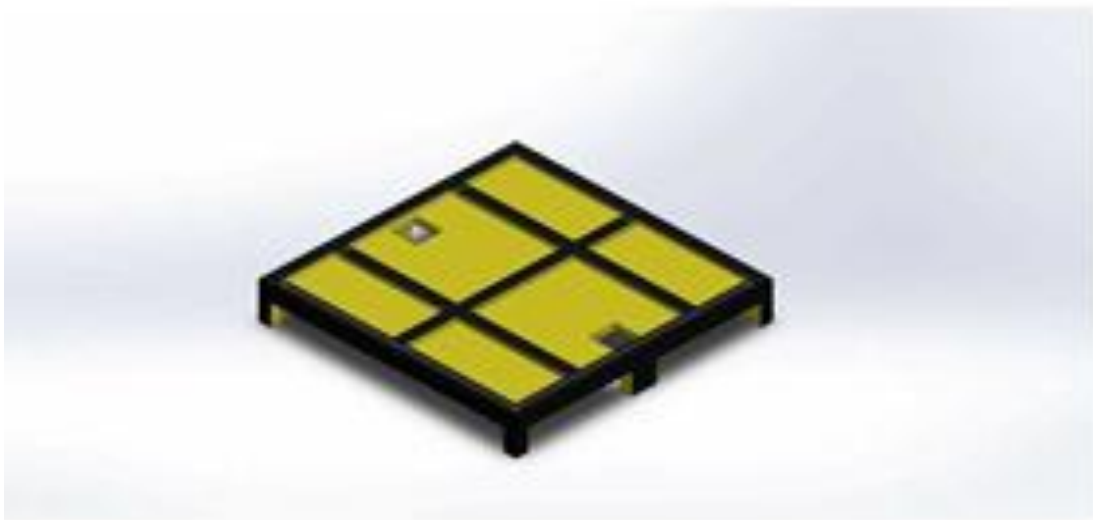
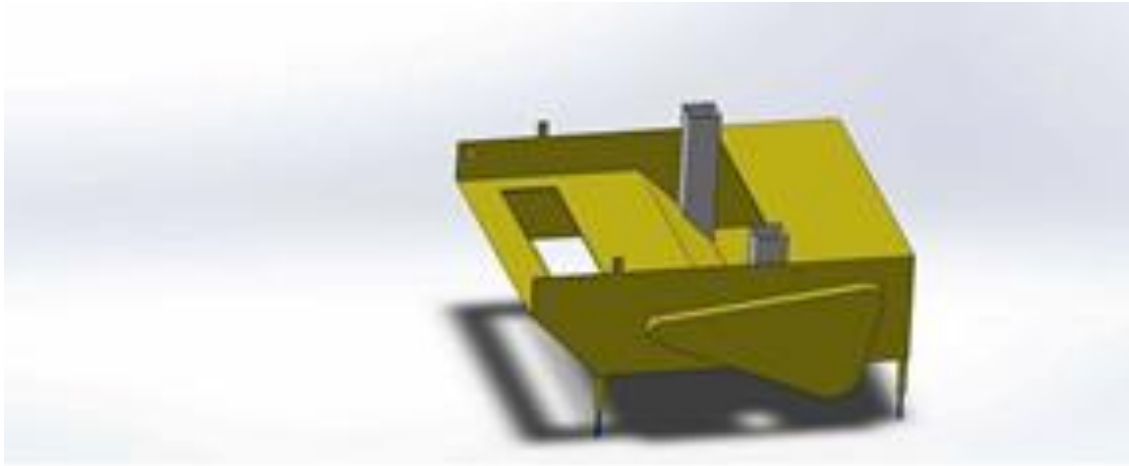


Figure 36



Figure 37

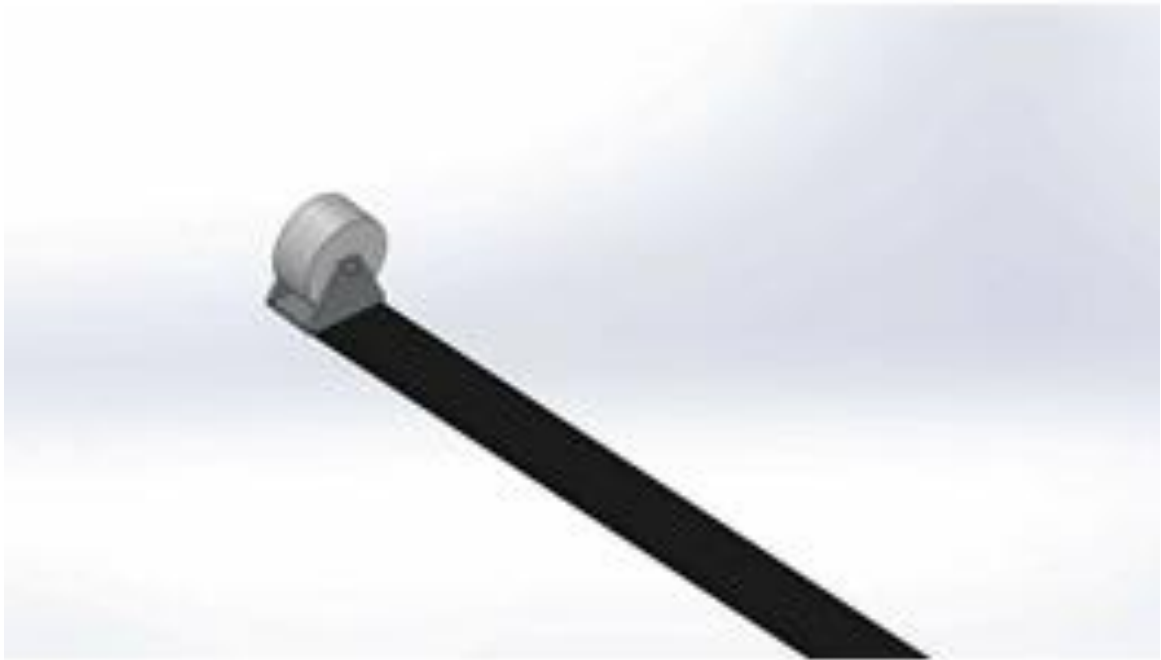


Figure 38

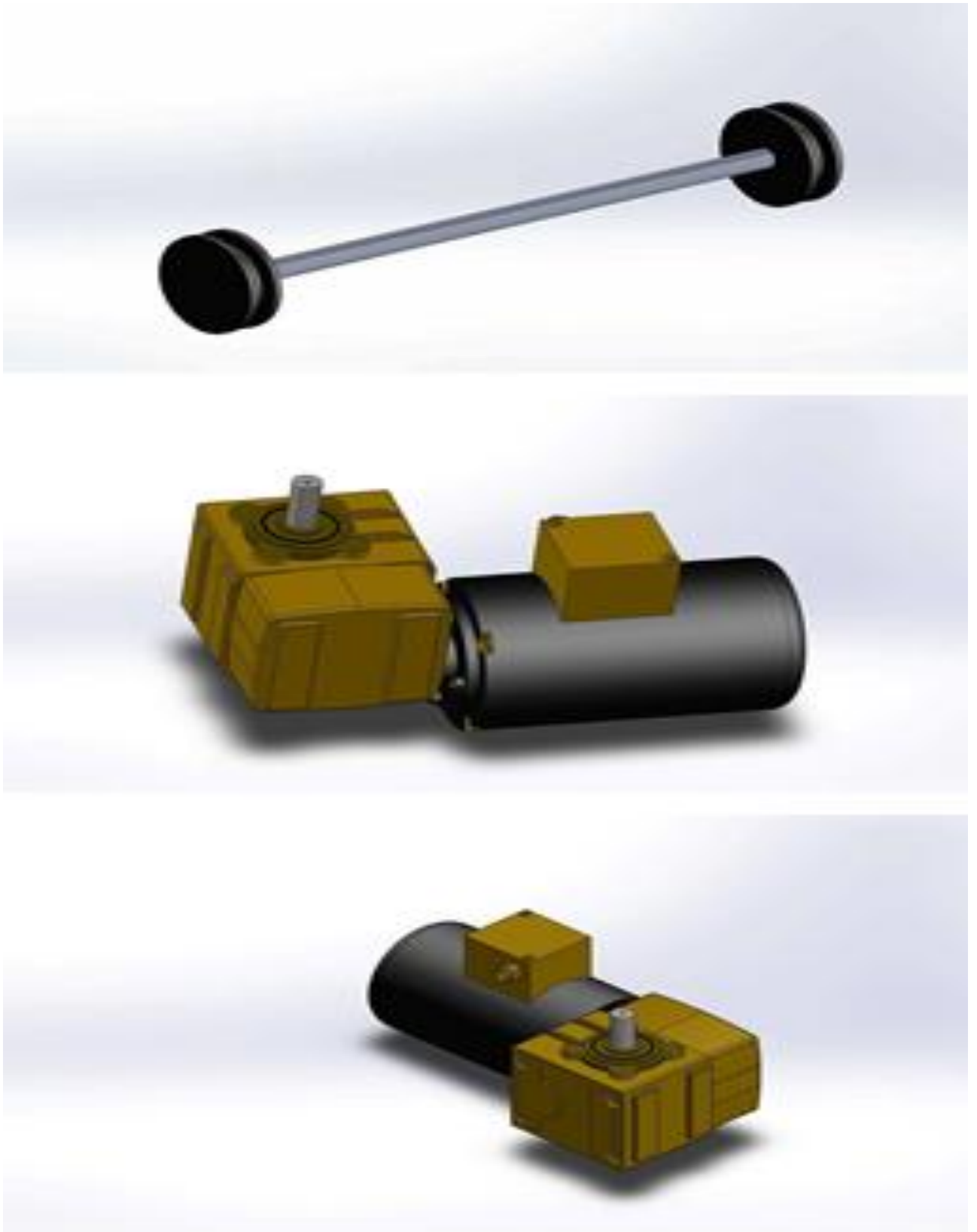


Figure 39

And the final shape will be as shown:

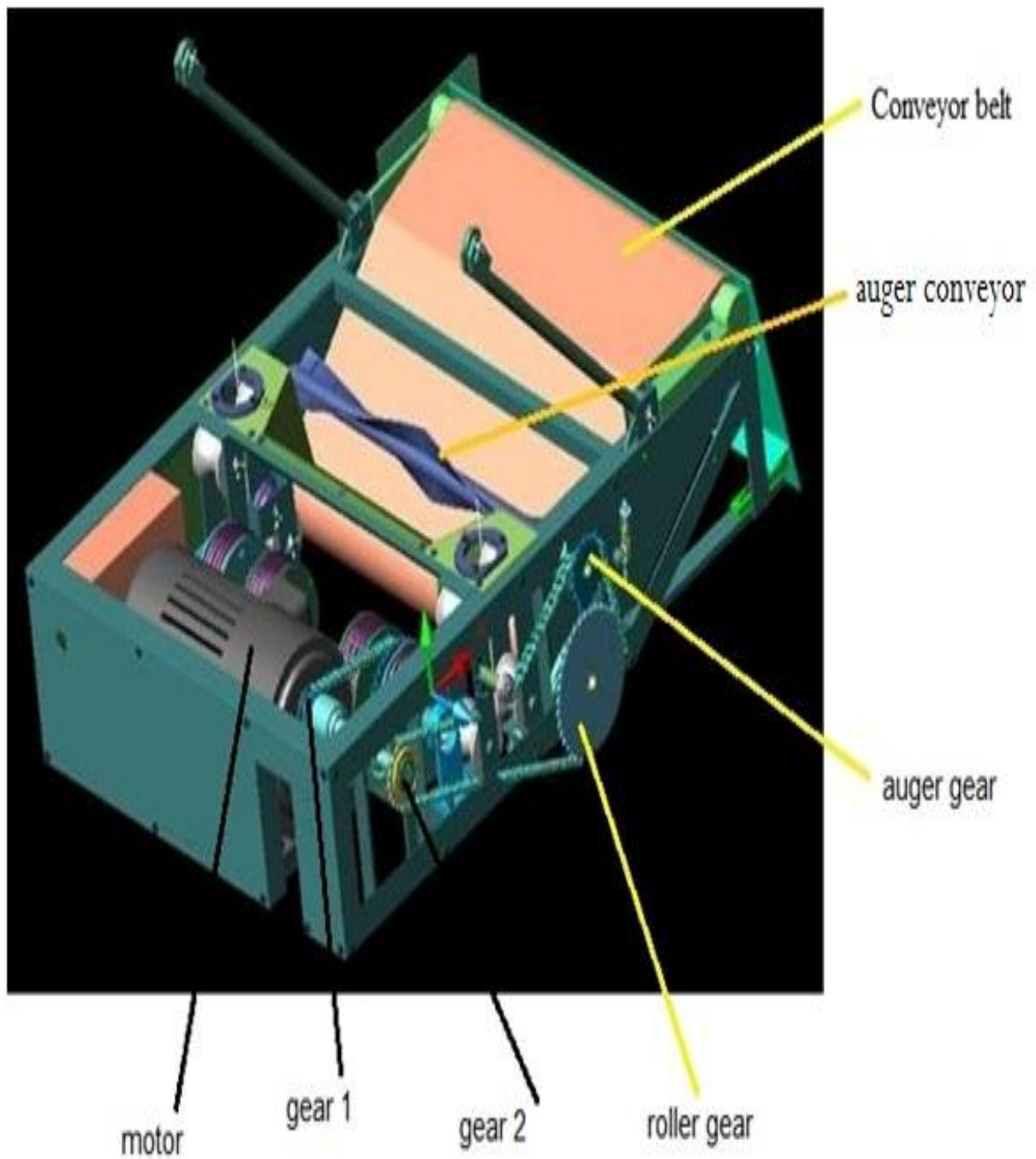


Figure 40

Results and analysis

Parts

Plastering core: which have the motor and the other components that make the system.

Motor : the motor have two gears one for pulleys and the other for moving other two gears as following:-

Gear to move the rollers which move the conveyer , and every rollers have two bearing .

Gears to move conveyor belt and mixer.

Two tubes: to carry two plastering can in vertical direction by two bearings.

Cable: the cable use to move the box (system)vertically ,up and down .

Other parts : will be shown in the figure(2) :-

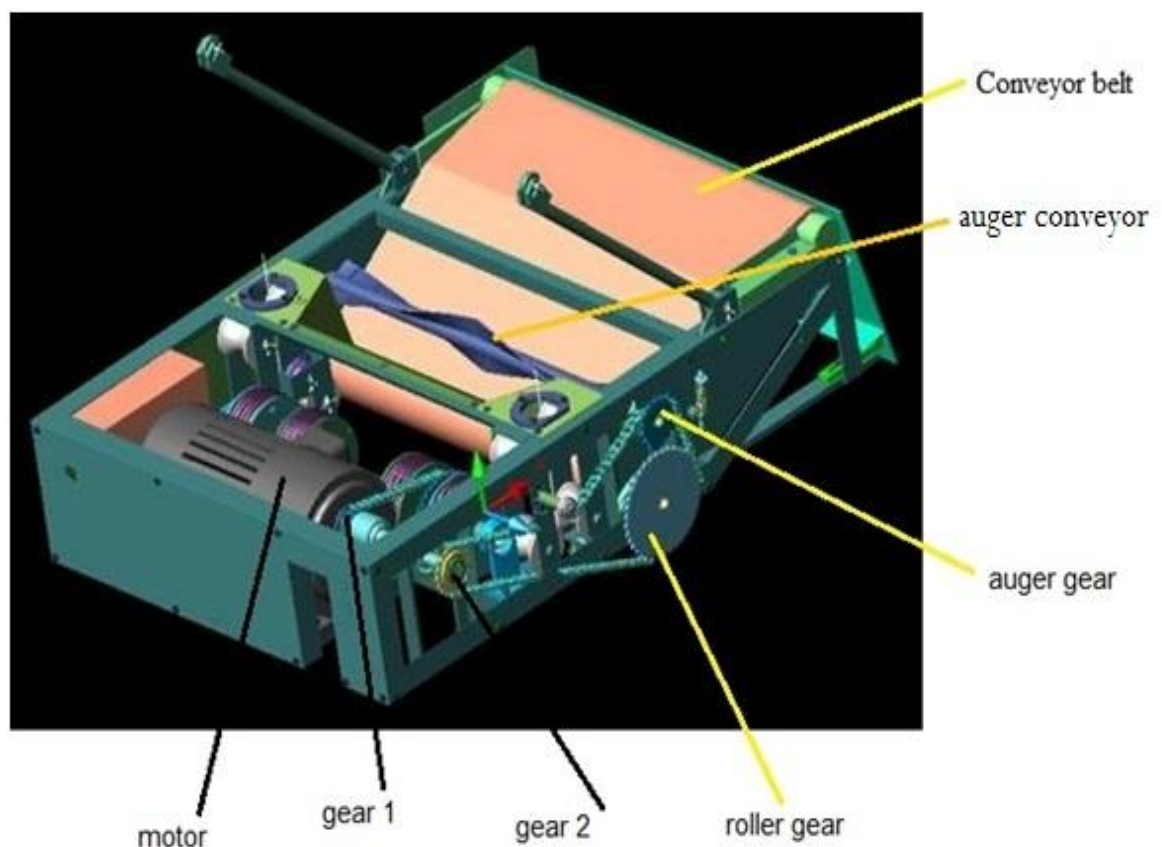


Figure 41

Calculation

The calculation of gears will be shown so that “The design will be at 100Kg mass of 1.5 Kwatt and 0, 14 m/s .

Power calculation

power calculation is necessary to determined the speed in (RPM) for the gear which is connected to Polly

$$power = \tau \times \omega$$

Where:-

τ : is the torque

ω : is the angular speed

And to find the gear radius and speed (RPM) that done by try and error.. And that can be explained as following:-

Motor power = 1.5 KW

Vertical speed = 0.14 m/s

Maximum weight = $100 \times 9.81 = 981$ N

The tension “ $T = Wt = m \times g = 100 \times 9.81 = 981$ N

Where:-

Wt : is the tangential force

The tangential force “ Wt ” of the Polly connected to the gear is the same for gear
 Wt (Polly) = Wt (gear)

The Polly has radius = 0.05 m

So to find ω for the Polly we use that equation at a vertical speed = 0.14 m/s

$$V = \omega \times r \quad , \quad “r: \text{radius (for Polly)}”$$

$$\omega = \frac{0.14}{0.05} = 2.8$$

$$n = \frac{\omega \ 60}{2\pi} = \frac{(2.8) \times 60}{2\pi} = 26.75$$

The gear diameter should be less than Polly diameter $d_1 < d_2 \rightarrow d_1 < 0.1$

And the gear speed should be more than Polly speed $n_1 > n_2 \rightarrow n_1 > 26.75$

So by try and error the value of (d_1 and n_1) were founded in which H for gear should equal 1.5kw , As table (1) shown :-

In using the equation $Wt = \frac{60000 H}{\pi d n} = 981N$

Table 1: measurement diameter

D(m)	n(r.p.m)	H(kw)
0.05	30	0.08
0.045	300	0.69
0.04	300	0.62
0.035	300	0.54
0.05	400	1.03
0.045	400	0.92
0.04	400	0.82
0.035	400	0.72
0.05	500	1.28
0.045	500	1.16
0.04	500	1.03
0.035	500	0.90
0.05	650	1.67
0.045	649	1.50
0.04	650	1.34
0.035	650	1.17

Then $d1 = 0.045\text{ m}$ and $n1=649\text{ RPM}$ then

Design calculation:

1-Gears :

All uses gears are spur gears and have properties shown in the table (2)

Table 2

Gear number		N	D	P	Wt(N)	m	ρ
1- (gear of motor have two gear same dimension)	Gear A	0.036	0.045	0.8	981	1.25	3.92
	Gear B	0.036	0.045	0.8	$60 \times 9.81 \times 2 = 1177.2$	1.25	3.92
2- (gear of polls)		0.0333	0.1	0.333	981	3	9.43
3- (gears of auger)		0.028	0.07	0.4	$9.81 \times 60 = 58.86$	2.5	7.85
4-(gear of roller)		0.0333	0.1	0.333	$9.81 \times 60 = 58.86$	3	9.43

Where

N: is the number of teeth

d: diameter

p :diametral pitch

m: module

The module taken from the (table 13-2) in the mechanical engineering design book

Sample calculation:-

$$p = \frac{1}{m}$$

$$\rho = \frac{\pi}{p}$$

$$N = P \times d$$

- GEAR of motor
The first gear $d = 0.045 \text{ m}$
The second gear $d = 0.045$
- Gear of pulley
The $d = 0.1 \text{ m}$
- Rotating of the auger $= 0.1 \text{ m/s}$
 $V = \omega \times r$
 $r = 0.035 \rightarrow d = 0.07 \text{ m}$
 $\omega = \frac{0.1}{0.035} = 2.86 \text{ Rad/s}$
 $Wt = m \times g = 60 \times 9.81 = 588.6 \text{ N}$

- Roller gear
Velocity of the roller $= 0.2 \text{ m/s}$
 $r = 0.05 \rightarrow d = 0.1 \text{ m}$
 $V = \omega \times r$

$$\omega = \frac{0.2}{0.05} = 4 \text{ rad/s}$$

2-Bearing :

All bearing is pull bearing type with a same dimension and same calculation

The reliability is = 90%

To select the bearing the catalog rating load(C10) ,have to be found by the equation:-

$$C10 = af \times FD \left[\frac{XD}{X0 + (\theta - X0) \times \ln\left(\frac{1}{R}\right)^{\frac{1}{b}}} \right]^{\left(\frac{1}{a}\right)}$$

Where :-

af : application factor

FD: design radial force

$$XD = \frac{LD \ nD \ 60}{lR \ nR \ 60}$$

$$X0 = 0.02$$

$$b = 1.483$$

$$\theta - X0 = 4.439$$

$$C10 = 1.2 \times 413 \left(\frac{540}{0.02 + 4.43 \left(\ln\left(\frac{1}{R}\right)^{\frac{1}{1.483}} \right)} \right)^{\frac{1}{3}}$$

$$C10 = 5812.5 \text{ lb} \rightarrow 25.8 \text{ KN}$$

Select C10 from table 11.3 = 31.7 KN

$$Y2 = 1.63$$

$$X2 = 0.56$$

$$\frac{fe}{V \times Fr} = x + y \frac{Fa}{V \times Fr} \rightarrow fe = 3.66 \text{ kN}$$

$$C10 = af \times Fe \left[\frac{XD}{X0 + (\theta - X0) \times \ln\left(\frac{1}{R}\right)^{\frac{1}{b}}} \right]^{\left(\frac{1}{a}\right)}$$

C10 = 53.4 KN $\rightarrow$ from table 11.2 find at C10 = 55 ,so $\rightarrow C0 = 35.5 \text{ KN}$

$$\frac{Fa}{C0} \text{ from table 11.1 } \rightarrow 0.0431 \text{ KN}$$

$$\text{from table 11.1 } \rightarrow e = 0.24$$

Keep doing interpolation till we get C10 before =C10 after

$$\rightarrow C10 = 57.9 \text{ KN}$$

(4)

.

3-Tube :

The machine have a carbon steel tubes with 3 meter high , so the buckling have to be founded to make sure about there stability and safety

And to fined if there's buckling or not according to the maximum weight that can be lifted , so in this process cheek in [Euler , Johnson curve] must be done ,

The slandered ratio $[\frac{l}{k}]$ obtained by blotting $\frac{P_{cr}}{A}$ vs . R

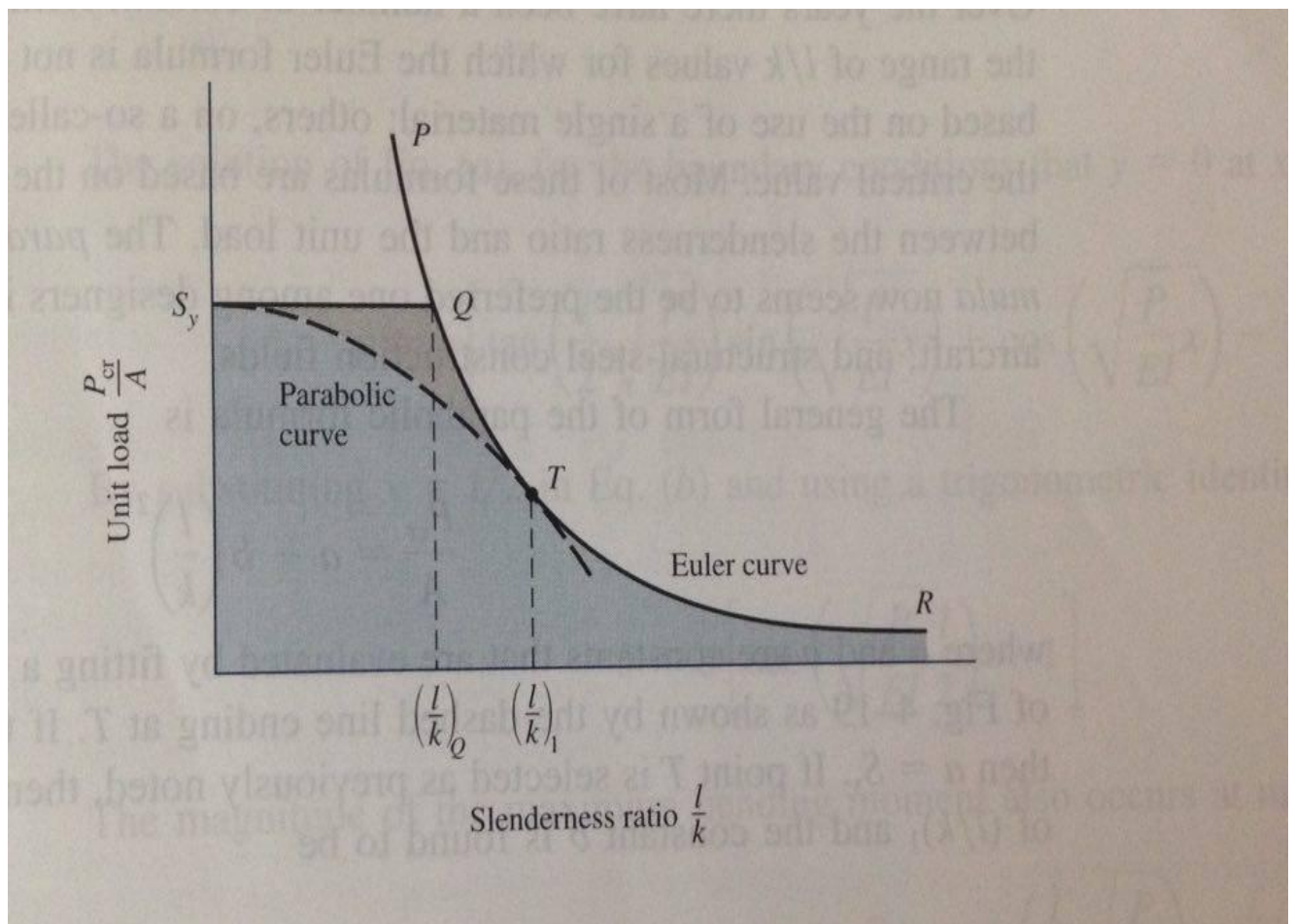


Figure 42

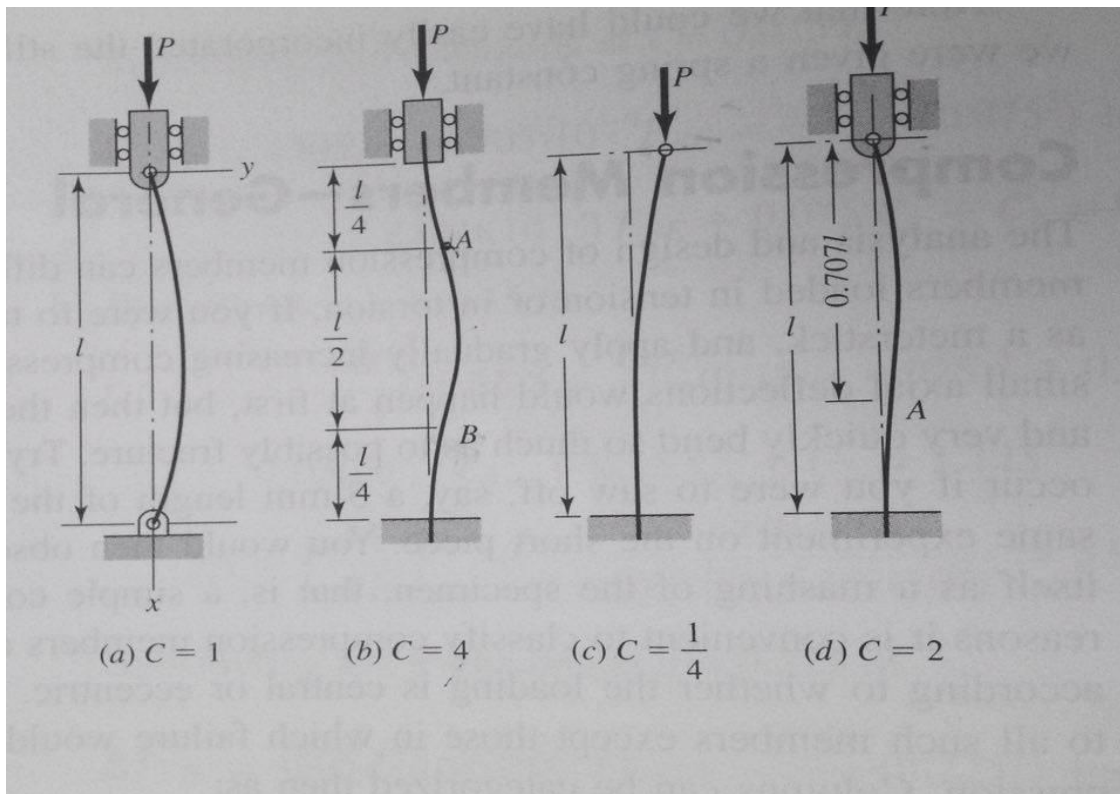


Figure 43

Column End Conditions	End-Condition Constant C		
	Theoretical Value	Conservative Value	Recommended Value*
Fixed-free	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$
Rounded-rounded	1	1	1
Fixed-rounded	2	1	1.2
Fixed-fixed	4	1	1.2

*To be used only with liberal factors of safety when the column load is accurately known.

Figure 44

Where :-

$\frac{P_{cr}}{A}$: is unit load r

$$R = \left(\frac{l}{k}\right)_i$$

- If $\left(\frac{l}{k}\right) > \left(\frac{l}{k}\right)_1$; Select Euler method
- If $\left(\frac{l}{k}\right) < \left(\frac{l}{k}\right)_1$; select Johnson method

To determine $(\frac{L}{K})_1$:-

$$(\frac{L}{K})_1 = [\frac{2\pi^2 CE}{S_y}]^{\frac{1}{2}}, \quad c = 1.2 \text{ fixed rounded} \rightarrow \text{Table 4 - 2}$$

$$E = 207\text{Gpa} \rightarrow \text{Table A - 5}$$

$$S_y = 270\text{Mpa} \rightarrow \text{Table A - 20}$$

$$(\frac{L}{K})_1 = [\frac{2\pi^2(1.2) \times (207 \times 10^3)}{270}]^{\frac{1}{2}} = 153.9$$

$$K = \sqrt{\frac{I}{A}},$$

$$I = \frac{1}{12}bh^3, \quad b=10 \text{ cm} \\ h=8 \text{ cm}$$

$$I = \frac{1}{12} \times 0.10 \times 0.08^3 = 4.27 \times 10^{(-6)} \text{ m}^4$$

$$A = 0.08 \times 0.10 = 8 \times 10^{(-3)} \text{ m}^2$$

$$\rightarrow K = \sqrt{\frac{4.27 \times 10^{(-6)}}{8 \times 10^{(-3)}}} = 0.0231$$

$$\rightarrow \frac{L}{K} = \frac{3}{0.023} = 129.9$$

$$153.9 > 129.9$$

$$(\frac{L}{K}) > (\frac{L}{K})_1 \rightarrow \text{BY Euler}$$

$$P_{cr} = \frac{C \times \pi^2 E I}{L^2} \rightarrow \frac{1.2 \times \pi^2 207 \times 10^3 \times 4.27 \times 10^{(-6)}}{3^2} = 1.16 \text{ kN}$$

And the load $P = 0.50 \text{ KN}$

$$P_{cr} > P$$

$$1.16 > 0.50 \text{ (safe)}$$

Desiccation

The project solves several problems:

First of all reduce the time which can plaster from (450-500 $m^2/8h$) .note that, the machine costs 1.5 NIS/hr that mean 12 NIS/8hr.

Make the surface finish more efficient with little effort.



Figure 45

In traditional way the raw material is wasted too much but the machine comes and solves this problem, which has a shield prevent the material go out so the wasting is reduced.



Figure 46

The machine needs at maximum two workers caused to reduce the cost and by a less time the cost also reduced.

Solve scaffolding problem which the machine go up to 3 meters high.



Figure 47

The suggested future study about supplier to this machine which pumps and mix the cement to different heights or any place where the machine located and pour the cement in the ash bit.

Conclusions and recommendation

From the project there is a lot of things have been learn , the most important thing is (nothing is impossible) , if you need to make a solution you must use your knowledge to find the solution or alternatives , other thing the appropriate method to make a good design .

The project contributes in reducing the effort of humanity and cost.

In coming time (future) the two workers can be reduced to one, by replace the two level rulers with two sensors. And by using control system make it full automatic ...

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