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Design and Fabrication of Low Cost Semi-Automatic Plastering Machine

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Abstract - *India is one of the fastest growing developing countries in the world. One of the many traits of any developing countries is the continuous construction of buildings in smart cities. Hence, a need of automation is needed in civil engineering industry. Most important part of construction of building is the plastering process. The plastering process in India is still being done manually. This has to change by introducing Automatic Wall Plastering machine in the industry. There is already a Plastering Machine available in market. But, it is more costly for the small project when compared to their budget. So, our aim is to make an attempt to make an automatic plastering machine which is of low cost with efficiency almost equal to existing costlier machine.*

***Key Words*: Interior Wall Plastering, Semi-Automatic Plastering Machine, Design and Fabrication, Low Cost, Electric Hoist.**

1. INTRODUCTION

In India, concrete is very popular the manual process of wall plastering on construction site, there is a vast scale requirement of labor and hence the labor cost is responsible for increasing the price of construction or project work. The quality of work is mostly depending on the skill of the labor work in manual plastering process. The construction turn has made the contractors to equip their construction so as to perform the highest output with minimum construction cost. In order to have highest output, parameters like accuracy, precision, quality, and cycle time have to be optimized. This is possible either by having skilled manpower or by automating the system. The solution of this problem is just to automate the process, so that there will be saving of period and cost and getting good plaster finishing to the walls. The plastering machine can plaster the walls automatically and smoothly.

The project success from the project management's viewpoint is achieved when the project is completed with the lowest possible cost, the highest quality, no accidents, etc. In other words, success means bringing each of the project performance indicators (PPI) - such as cost, schedule, quality, safety, labor productivity, materials consumption or waste, etc. to an optimum value. Applying automation and robotics in construction is addressed from the perspective of raising building projects performance to serve the client and the environment. Robotics and automation systems in construction industry can achieve the following advantages:

- Higher safety for both workers and the public through developing and deploying machines for dangerous jobs.
- Uniform quality with higher accuracy than that provided by skilled worker.
- Improving work environment as conventional manual work is reduced to a minimum, so the workers are relieved from uncomfortable work positions
- Eliminating complains about noise and dust concerning works such as removal, cleaning or preparation of surfaces
- Increasing productivity and work efficiency with reduced costs

1.1 Motivation

The main problems in the current scenario like labor shortage, Risk in the work of plastering, high cost of existing automated machines and also reduced quality and efficiency in work motivated for a semi-automated low cost plastering machine.

1.2 Aim

The aim of this innovative plan is to render the plasters on walls mechanically. This concept aims in reducing the work of labors and also reduces the cost as well as time. It's light-weight weight, cheap and easy structure. This innovative method keeps up with the ever ever-changing world of building automation.

1.3 Objectives

1) To study on manual working technique of Plastering Machine
2) Identification of materials for the model
3) Design and Fabrication of plastering Machine
4) Working of plastering Machine

2. METOHODOLOGY

2.1 To study on manual working technique of Plastering

Figure 1 shows the trowel operation technic in traditional plastering method. The correct plastering technique is essential with only the trowel being used to apply and finish the skim coat. Achieving a good finish is the combination of firm pressure combined with the correct angle of trowel.

Plastering Technique for applying plaster is initiated by trowel loaded with plaster, and then leading edge of the trowel will be a long way from the wall. The leading edge need to be flattened gradually into the wall. With the next stroke the trowel will be used for flattening out the plaster as just applied. There will be no plaster on trowel and it will be fairly flat – the leading edge will be approximately 10 – 15 mm away from the wall.

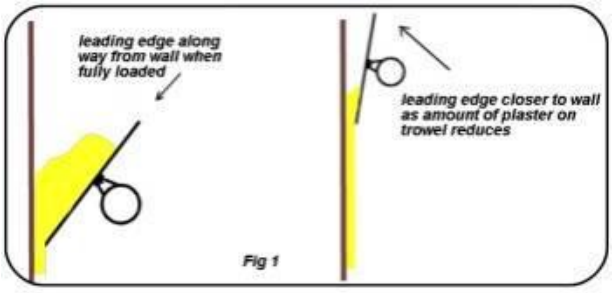

Fig - 01 Working Technique of Plastering For walls

2.2 Identification of materials for the model

A. Frame:

A fixed structural engineering is the load resisting constructed with straight or curved members inter connected by rigid connection is resist movement included with the joint of members.

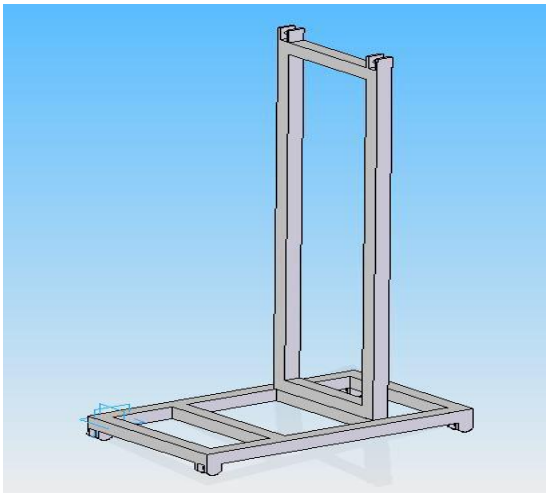

Fig - 02 Frame of Plastering Machine

B. Carriage

A carriage is a movable part design for carrying loads. It houses different components like Slide bearing, wire rope, plastering trowel etc..,

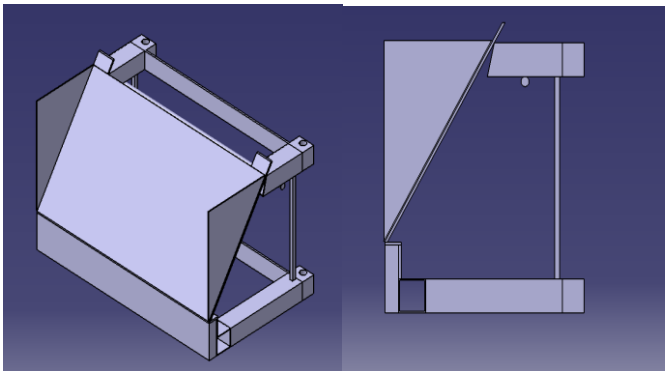

Fig - 03 Carriage of plastering machine

a) Square Hallow Tube
Sides = 2 inch
Wall thickness = 2.5mm
Weight = 3.71 kg/m
It is used in both Frame and Carriage part of the plastering machine.

Fig - 04 Square Hollow Tube

b) Square Solid Bar
Sides = 0.5 cm
Weight = 19.6 kg/m
It is used in carriage part of the machine. Used for structural support vertically to the carriage structure. There are 2 number of square solid bar.

Fig - 05 Square Solid Bar

c) Round Solid Bar
Diameter = 20 mm
Weight = 3.14 kg/m
Diameter = 16 mm
Weight =2.01 kg/m

It is used in both frame and bucket part of plastering machine. One bar is attached to frame part as railing for sliding bearing. There are 2 rods for railing purpose. The height of the railings is 6ft each. In bucket part it is used as support for the rope hook. The length of this bar is 2 ft. it is a single member.

Fig – 06 Round Solid Bar

d) Steel Plate
Thickness = 2mm
Height = 1 ft
Width = 2 ft
Weight = 15.7 kg/m^2

It is used in carriage part of the machine. Steel plate is used as walls to hold mortar which is used for plastering. At the back of the bucket the plate used of rectangular shape. The dimension of plate is 2ft width and 1ft height. Steel plate used for the sides of the bucket is of trapezoidal shape. Dimension of the plates is top 0.54ft, bottom of 0.04ft (12mm), vertical side of 1ft and inclined side of 1.05ft.

Fig - 07 Steel Plate

e) Flat Bar
Thickness = 3mm
Width = 2 inch
Weight = 1.18 kg/m

It is used in frame part of the machine to support the electric hoist. 2 bars of 2ft length used for the purpose. It is used in carriage part of the machine for two purposes in two different places. One is to support wooden trowel. 1 bar of 2ft length used for this purpose. Another 2 bars used for structural support at back of the bucket.

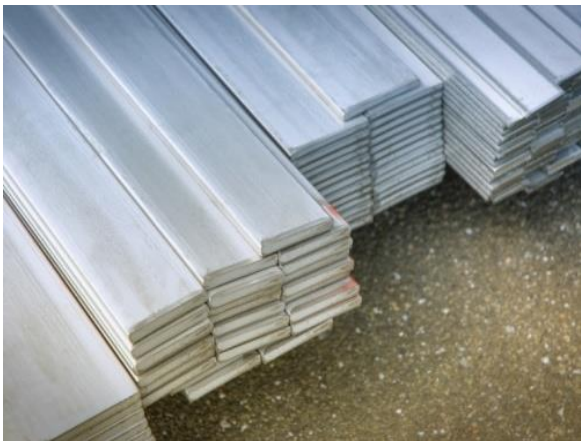

Fig - 08 Flat Bars

f) Electric wire rope Hoist:

A wire rope, wound on a drum, lifts and lowers by winding/unwinding the rope along the length of the drum. This means anything the hoist lifts or lowers will move laterally during the hoisting operation.
Motor power = 0.5 HP
Input Power = 600 W
Standard lift = 30 m
Weight lifting capacity = 300 kg
Rope diameter = 4 mm
Speed = 0.1 m/s

Fig - 06 Electric Wire Rope Hoist

g) Linear Slide bearing
Inner diameter = 20mm

Linear bearings generally use a pad, bushing, or roller system to carry a load on a rail that need not be a straight line. The rail can be most any length. The durability of the

bearing is determined by the load and required speed. Furthermore, rails can generally be any profile simple flat surfaces, round polished rods, or complex profiles with polished ground surfaces on which balls or cylindrical rollers can ride. Hard (Rockwell 60) and ground bearing surfaces work best.

Fig - 07 Slide Bearing

h) Plastering trowel
Material = Teak wood
Density = 65 kg/m^3
Length = 2 ft
Width = 4 inch
Thickness = 1 inch

Float trowel or finishing trowel is usually rectangular, used to smooth, level, or texture the top layer of hardening concrete.

Wooden floats give a sandy texture to plaster and render, and are generally used to prepare the surface for the top coat.

Fig - 8 Plastering Trowel

i) Wheels with locks
Numbers = 4
Load Capacity = 100 kg each
Type = Caster Classics Locking Non-marking Gray Rubber Wheel Swivel Caster
Wheel Diameter = 2 inch
Mounting height of 2.5 inches
Mounting plate = 1.085 x 2.56

It will not scuff or scratch most flooring. Safe for most hardwood, tile, low pile carpet and other smooth flooring.

Fig - 9 Wheels

2.3 Design & Fabrication of Plastering Machine

After collecting the all material (square hollow tube, round solid bar, pulleys, sliding bearings, steel plates) square hollow tubes and flat bars are cut down into the required dimension as per design. These cut parts are assembled using arc welding which gives rise to a frame and carriage. The assembling process consists cutting, grinding, welding and drilling. The carriage is attached to the frame with help of sliding bearings and the wire rope so that the carriage will slide over the vertical guide. The wire ropes are clamped to the pulley which is fixed at the top of frame & is connected to electric hoist motor. The wire rope is driven by electric remote connected to the hoist. The plastering trowel is fixed to the down front of carriage to smoothen the wall.

Fig - 10 Plastering Machine Model

2.4 Working of Plastering Machine

Initially the machine must be placed close to the wall that is to be plastered. The machine needs to be placed in horizontal position. Then the cement mixture that consists of cement and sand within the magnitude relation of roughly around 1:6 is poured into the inclined plane i.e. so called hopper. An admixture is added for more adhesion to the wall. The machine is raised up with the assistance of electric rope hoist which is controlled by a remote. The mortar flows through the inclined plane and the mix is adhered to the wall by the force given by the machine on the wall. The downward movement makes the plaster smooth on the wall.

3. RESULTS AND OUTCOMES

3.1 Comparison

Description	Manual Method	Plastering Machine
Plastering Thickness	12 mm	8mm – 15mm
Plastering Speed	5.0 m^2/h	5.0 m^2/30 min
Workers Required	1 skilled mason + 1 helper can cover up to 40 m^2/day (8hrs)	1 labors for operating machine, 1 labor for pouring of mortar for 40 m^2
Wastage of material	More	Less
Coating	Two or more times	One time
Time Requires	8 Hours per 40m^2	4 Hours per 40m^2
Cost	For wall of 40m^2, ➢ 1 skilled labor charges Rs.700/day (8hr) ➢ 1 Helper charges RS.400/day (8hr)	Non skilled labor required. ➢ 2 labors charges RS.450/each /day

3.2 Cost Estimation:

SL No	Name of parts	material	Quantity	amount
1	Square Hollow Tube	Mild Steel	50 kg	Rs. 3000
2	Steel Bars	Mild Steel	1 no	Rs. 200
3	Flat Bars	Mild Steel	8.62 kg	Rs. 560
4	Solid bar 20mm	Mild Steel	9.1 kg	Rs. 600
5	Wheels	Hard Rubber	4 nos	Rs. 450
6	Trowel	Wood	1 no	Rs. 420
7	Electric Hoist 1. DC Motor 2. Wire rope 20m 3. Pulley 4. Remote control Total		 1 no	Rs. 8000
8	Nuts & bolts	Mild Steel	4 nos	Rs. 150
9	Sliding bearings	Mild Steel	4 nos	Rs. 1500
10	Painting			Rs. 1000
11	Labor charges and others			Rs. 4000
			Total	**Rs. 20380**

4. CONCLUSION

We can conclude that this machine will help us in faster operation of plastering than the manual method. The machine is far less complex and easy in movement due to its wheel mechanism. As far as the quality of plastering is considered, there is still a lot of work and research to be done. But this semi-automatic machine will be helpful in small budget building and also far more superior machine than costly existing machine.

FUTURE SCOPE

There is a possibility of future work to be done on this machine. The application of this machine to plaster is limited on flat surfaces and also to vertical walls. Future work on this machine can be done to make the machine such that it can be applied on slant walls, uneven surfaces like curved walls and also horizontal movement can be made along with vertical movement. Such research will be helpful in building the machine such that it can be used for complicated plastering in complex high-rise buildings completely automated without any manual Labour necessary.

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REFERENCES

[1] Askar Ankush N., Raut Laukik P., March 2017. "DESIGN OF AUTOMATIC WALL PLASTERING MACHINE", INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY, ISSN: 2277-9655.

[2] Kuttarmare Harshal C., Dagwar Dhanashri , Bhoyar Sagar V., Gothe Sujata, Waghmare Diksha, Pandit Aayush, Raut Akshay, February 2017. "DESIGN AND FABRICATION OF AUTOMATIC WALL PLASTERING MACHINE", IJARIIE-ISSN (O) - 2395-4396.

[3] Biradar Arunkumar, Shejwal Vaibhav, Barate Akshay, Barate Sameer, "Automatic Wall Plastering Machine", International Journal of Engineering and Technical Research (IJETR) ISSN: 2321-0869 (O) 2454-4698 (P), Volume4, Issue-1, January 2016.

[4] Mahesha P.K, Sree Rajendra, Design and Fabrication of Automatic Wall Plastering Machine, IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE), Volume 11, Issue 4 Ver. I (Jul- Aug. 2013), PP 01-06

[5] Arivazhagan B., Automatic Plastering Machine, International journal of advanced research in electronics, communication and instrumentation engineering and development, Volume: 2 Issue: 2, 28-Jul-2014

[6] G. Pritschow, J. Kurz, J Zeiher, S. C. McCormac & M. Dalacker, "On site Mobile Plastering Robot: A Practical Design Concept", Dept. of Machine & Robot Systems, University of Stuttgart, Germany.

[7] Johan Forsberg, Roger Aarenstrup, "A Construction Robot for Autonomous Plastering of Walls and Ceilings". Robotics and Automation, Lulea University of Technology, Sweden.