ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

DESIGN OF AUTOMATIC WALL PLASTERING MACHINE

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DOI: 10.5281/zenodo.439237

ABSTRACT

Due to manual process of wall plastering on construction site, there is a huge 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 solution of these problems is just to automate the process, so that there will be a saving of period and cost and getting good plaster finishing to the walls. The plastering machine can plaster the walls automatically and very smoothly. Due to which the process will fast and there will be saving of cost and time this will helps to reduce the total cost, total time which ultimately responsible for the growth and hence the progress rate of a country is going to increase.

KEYWORDS: Plastering, Plasterboard, AC/DC motor, gears, wire ropes, labor cost etc.

INTRODUCTION

Construction sector is responsible for a progress of any country, because most of the growth of the nation is depending upon industrialization, civilization, transportation etc which compulsorily has their initial stage of building construction or simply construction. It is a biggest economic sector because of it the development trade in most countries amounts to 10-20% of the total national product, still due to labor demand and most of the work is repetitive it is a slow manual process [2]. So for improving the economic growth of the country and indirectly developing the lifestyle of the country's people there must be need of improving the techniques of working. Construction sector is unique sector which required more time and money, having very slow and stepwise process.

Presently in construction sector near about all the processes are manual which required more time for their completion. Due to which the cost of the project is maximum, hence it must be necessary to automate the processes in the construction work and improve the efficiency of it. Wall plastering is the main procedure among the processes followed in the building construction, which is used for plaster the walls of the construction to get smooth and finished wall surfaces. Plastering is also essential to give specified strength to the walls; it protects the walls from moisture from both the sides. Wall plastering also gives good look to the walls and ultimately creates best residential condition in the particular room. But in present days wall plastering is being done manually in most of the part of world i.e. the procedure of wall plastering is being done with the assist of labors. Due to which the process is lengthy. So this is an initiative towards the automation in plastering technique.

EXISTING TECHNIQUE AND ITS DOWNSIDES

The existing technique for plastering the walls is manual i.e. the labors are used to plaster the walls with their hand by using some instruments like flat board or other flat surface object which are made by metal, wood or plastic. Fig. 1 describes the current plastering techniques. In this process the mortar which is the mixture of cement and sand has been spread on the wall which is to be plaster with the help of these objects. After dispersal the mortar the labor need to concentrate to make a skinny film of mortar on the wall, which has been smooth and having good surface finish. Due to which labor need to work repeatedly until he get the required surface finish.

ISSN: 2277-9655
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Fig. 1 Current plastering methods

This process takes long time and consumes additional human power. So due to this slow process the labor cost has also been increase as the labors are working on daily basis. If the labor is not a skilled person then there have been a low quality work and there have been wastage of material. Ultimately the manual plastering technique have some downsides like high cost, more time, material wastage and low quality work due to unskilled labors.

PROBLEM IDENTIFICATION

In the manual plastering technique, the crucial factor is skilled labor because of which plastering has been done on the walls, but presently there is lack of skilled labors due to which it is very inconvenient to complete this process. The labor requires more time to finish the process which increases their wages and hence the total plastering or labor cost increases.

Objectives

From the above discussion about old plastering techniques, problems in old plastering techniques, their downsides, background of the plastering method and the decided aim to be achieve following are some objective have been decided.

1. This Machine will reduce the human work.
2. It will be straight forward in construction and simple to control.
3. Higher excellence of the plaster can acquire.
4. It will be move horizontally from to other place. So that it will be portable.
5. It will assist to save labor cost.
6. It will avoid wastages of the mortar, thus to save the cost.
7. Machine cost will be less than existing machines.
8. It can be control with the help of remote controller.

LITERATURE REVIEW

For the modification of the plastering technique lots of work had been done in the past by many people, but due to some problems or deficiencies in that some machines has not been that much in working condition. For getting an idea about the work done in the record on plastering technique it is necessary to do the literature survey and review. According to that following are some vital points which have been taken from the recoded literature and are very much important for designing new Automatic plastering machine.

History of plastering machine

Ali Al-Hamad, etal [1] stated that the machines were developed firstly have a task of mixing automatically and made mixture due to which it was easy for plastering. The launching of RUMA 1, Putzmeister 1 and Putzmeister Gipsomat developed in sixties century. The AMPA machine is the development in machines.

Israe is the country in which 'TAMIR' had been developed. But these innovations have not been capable to give a step ahead in the plastering industry. Thus even today, the plastering machines developed in the sixties are still considered to be up to date.

Trowel Technique

Mahesha P.K, etal [2] Experimented the trowel operation procedure which is a customary plastering method. The exact plastering procedure is dependent on how the trowel is being used and apply coat of mortar on wall. Receiving a good finish is the grouping of compact force combined with the right angle of trowel, how distant the foremost edge is with the wall. The foremost edge will be approximately 10-15 mm away apart from the wall.

ISSN: 2277-9655
Impact Factor: 4.116
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Fig. 2 Trowel technique

Arunkumar Biradar, etal [3] Demonstrated the trowel technique. The right layer technique is essential with exclusively the trowel getting used to use and end the skim coat. Achieving a well-mannered finish is that the grouping of compact pressure and the correct angle of trowel. So front position of the trowel is an absolute approach from the wall. With the resultant stroke, the plaster is simply spread with the help of trowel on the wall surface.

Fig.2 describes the trowel operation technique in early covering technique. The right layering method is vital with exclusively the trowel used to and finished the skim coat. Achieving a well-mannered end is that the combination of compact pressure and the correct angle of trowel (how so much the front position is from the wall). Layering technique for applying plaster is initiated by trowel burdened with plaster, the front position of trowel need to move step by step addicted to the wall. With resultant hit of trowel used for layering the plaster as only applied. There'll be no plaster on trowel and it'll be quite flat the forefronts are more or less ten-fifteen millimeter unit detached from the wall.

Pre-plastering requirements

Mahesha P.K, etal [2] Stated that the brick structure should be developed in proper manner, with the manufacturer's condition and suggested installation procedure. All pre-requirement must be fulfilled, otherwise failing to permit the condition to fully cure can result in excess contraction and cracking on the pointing lines after the walls plastering. 3 mm deviation in surface alignment is allowable over 1200 mm radius.

Components need to be fabricate

Arunkumar Biradar, etal [3] Shows that the structures of a machine are fabricated by using required necessary components like steel frame, sheet metal, metal bars, lead screw, AC/DC motors, wheels nut and bolts all these can be well assembled as for the requirement.

Ali Al-Hamad, etal [1] explained that, the components need to be fabricated for the machine are ceiling bean, steel tube, upper adjustable touch, conveyor belt, plastering board, resist board, supporting bar, lower adjustable touch, hydraulic base, hydraulic handle, hydraulic pedal, oil window, driving shaft, rollers, driveshaft, gears, pulleys etc.

Drive technology or control components

Mahesha P.K, etal [2] Stated that the microcontroller is family to use on-chip spark recall for program storage, as opposed to one-time programmable ROM, EPROM, or EEPROM used by other microcontrollers at the time. With a single cycle instruction RISC CPU and a loaded attribute set, the structural design ensures fast code execution combined with the lowest possible power consumption.

G. Pritschow, etal [4] Shows that due to small working envelop the controller for mobility of robot should be accurate, which can be a microcontroller. Thus the movable podium should be able to go up and go down the staircase. Compact dimensions will allow the robot to pass through doorways and to work in small rooms. A low-cost PC depends run system will be used for motion control, sensor signal processing and human machine interface.

Mechanical Concept

Arivazhagan.B [5], explained the mechanical design of the plastering machine which consists of the motor pump to push the cement mix, Funnel to load the cement mix, flexible pipe to bear the cement blend to the hopper, horizontal bar guide to move the plastering unit horizontally, horizontal top to grasp the vertical bar guide and move beside the horizontal direction, vertical rail guide to move the hopper vertically, vertical head to grasp the hopper and move beside vertically, cement mix inlet to the hopper, the hopper to hold cement mix provisionally, cylinder slot to discharges the cement consistently with the pressure from the pump present in hopper, metal sheet

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to evenly smudge the cement on the walls. Basic Concept and Enabling Technologies using a Mobile Robot Internal Plastering [6], According to paper, for the mobility criteria in a building site environment a mobile platform capable of hiking and downward stairs is necessary. The best solution is offered by the caterpillar drive which is robust and capable of overcoming inclines of up to 40^{O}. To facilitate automated plastering and to compensate positioning errors the degrees of autonomy are required in a robotic arm.

G. Pritschow, etal [4] Stated that the robotic manipulator must have some degrees of autonomy these are, two degrees of autonomy for plaster application in a plane for a single robot working position. A further degree of autonomy is required to compensate for tilting of the movable machine and thus enable parallel motion of the plastering tool with respect to the wall or ceiling.

Working of plastering Machine

Arunkumar Biradar, etal [3], explained that the initially the machine is placed closed to the wall that is to be plasters.

The plaster is poured into the hopper, with the help of lead screw the machine is raised up and will be lock at some instance. The exciting force is given by the rope and machine mechanism. In that way the plastering is done automatically to the wall by automatic plastering machine.

Mahesha P.K, etal [2], demonstrated that the machine has to be located near the wall which has going to plaster. The machine should be perfectly leveled. Then the mortar is poured into the hopper of the tray. The lifting force is transferred to tray through power screw, which driven by AC motor.

Ali Al-Hamad, etal [1], explained that, the machine works with conventional cement mortar, it can plaster the wall mechanically by stirring up and down in straight up direction. It has two rails for rising and moving automatically, therefore can be used for different height and width of the wall.

Advantages of automated machine over manual plastering

Ali Al-Hamad[1] Mahesha P.K, etal[2], Arunkumar Biradar, [3] Arivazhagan.B[5], G. Pritschow[6], Teng Long[7] stated that Automatic plastering machine needs less time to complete plastering, no skilled labors required, quality of plastering is comparatively good than manual plastering process, less wastage of raw material than manual plastering, automatic plastering has low cost than manual plastering. Less risk of accidents during construction work.

Sr. No.	Paper Title	Name of Author	Findings
1.	Plastering Wall Machine	Ali Al- Hamad, Osaid Hamdallh, Rand Khraishi, Sami Yonis.	❑ 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 wall machine in low cost.
2.	Design and Fabrication Of Automatic Plastering Machine Prototype	**Mahesha P. K. (***M-Tech IAR, Mechanical Engg. MCE, Hassan, India)* **, Sree Rajendra (***Associate Professor, Mechanical Engg. MCE Hassan, India)*	❑ Powerful competition, shortages of trained labor, increase in labor wages and technical advances are forcing quick change in the building structure. ❑ All these problems can be solve out with automation in constructive technique. One of which is plastering, which is extremely slow & costly when doing manually. ❑ They use necessary components like steel frame, sheet metal, metal bars, power screw, AC/DC motors, different wheels nut & bolts for assemble it.

ISSN: 2277-9655
Impact Factor: 4.116
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			❑ Through trails it is noted that the machine is more productive compare to labor with respect to the plastering work.
3.	Automatic Wall Plastering Machine	Arunkumar Biradar, Vaibhav Shejwal, Akshay Barate, Sameer Barate	❑ The development trade in most countries amounts to 10–20% of the total nationwide product, creating it the biggest economic using sector. ❑ It's still labor insist and jointly the majority of the work concerned is cyclic. ❑ The expansion of any country depends on the development trade therefore it's of prime economic significance to several industrial sectors.
4.	On site Mobile Plastering Robot: A Practical Design Concept	G. Pritschow, J. Kurz, J Zeiher, S. C. McCormac & M. Dalacker, (Dept. of Machine & Robot Systems, University of Stuttgart, Germany)	❑ This elaborates basic concepts and technologies for a movable plastering robot used on construction site and operated by skilled worker. ❑ This paper also explained the kinematic structure and control system for a working robot.
5.	Automatic Plastering Machine	Arivazhgan. B. , B. Tech (ECE) – IV year, Manakula Vinayagar Institute of Technology, Puducherry.	❑ Automated plastering machine is exclusive and maybe one type of automated plastering machinery suitable for construction industry. ❑ It makes plastering easy, fast and effortless as compare to manual use.
6.	A Construction Robot for Autonomous Plastering of Walls and Ceilings.	Johan Forsberg, Roger Aarenstrup, (Robotics and Automation, Lulea University of Technology, Sweden)	❑ The time used for plastering the wall is expected to be less than 50% of that required by manual work. ❑ The reason for developing the robot is mainly ergonomic. They also discuss about Mechanical error sources, Navigation errors & Control errors.
7.	Mechanical Design of A Quadruped Robot for Horizontal Ground to Vertical Wall Movement	Abd Alsalam Sh., Rosbi Mamat. (University Technology, Malaysia)	❑ This paper the highlighting given the mechanical structure of a quadruped machine able to walk on ground, go up on vertical walls and perform the ground-wall movement automatically. ❑ It is electrically actuated one.
8.	A Service Robot for Construction Industry	Pablo Gonzalez De Santos, Joaquin Estremera, E. Garcia. (CSIC, Spain)	❑ This explained the required features of the robot manipulator developed for construction. ❑ Also discussed main subsystem i.e. Frame, manipulator, Grasping device, controller & guiding system.
9.	Automatic Wall Plastering and Repairing Robot using Artificial Intelligence	Dr. S. K. Rajesh Kanna. (Dept. of Mechanical Engg, Rajlakshmi Institute of Technology, India) A. D. Jaisaree. (Dept. of Computer science and Engg, Mahendra Engineering College, India)	❑ The movement of the poppet is controlled by a high torque motor. ❑ The robots have been developed to apply the mortar on the vertical walls with pressure and having the capability of self adjusting the mortar thickness. ❑ The machine solves the issues like shortage of labor, raise in labor cost etc. and wastage of mortar is reduced more than 60% thereby reduces the raw substance requirement.

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

10.	Advanced Dry Mortar Technology for Construction Industry	Ir. Raymond Wan MEng, CEng, MIM, MICE, MICT, MHKIE, RPE	❑ Good quality dry mix products are available in the market with improved performance. ❑ Although, dry mortars cannot totally solve all the construction problems, ❑ On the contrary, advanced dry mortars are very complicated powdery mixtures with sophisticated chemical additives of newest technology to provide wide range of superior act to get together complex construction requirements.
11.	Finishing guide For Thistle plaster and Gyproc plasterboard	A Saint-Gobain Company	❑ This guide states the different methods of finishing the wall surfaces by plastering, different accessories for plastering, instruments, techniques etc.
12.	Comparative Study on Mould Growth on Plaster Boards treated with Biocides	Julia Friman Degree project for Master of Science (One Year) in Plant Ecology 30 hec Department of Plant and Environmental Science Göteborg University	❑ This theory aims to match up to the most capable biocide anti fungal result when use as a covering on Plaster plates. ❑ The method contained simple humid boxes, together with a visual and an agar cultivation as assessment. ❑ Dry grass was used as contamination. The testing was designed to compare the biocides with the reason of establishing relative mould growth values.
13.	Basic Concept and Enabling Technologies using a mobile Robot for Internal Plastering.	Reference:- WeiBert M., Leixner, Raddsatz.	❑ The introduction of plastering robots would resemble the revolution in the plastering industry in the sixties when plastering machines helped to improve overall productivity by more than 30%. ❑ The machine construction industry will also have excellent chances at extending their current markets.
14.	A Novel Measurement and Control Method for Automatic Plastering Machine.	Teng Long, En Li, Zaojun Fang, Weiqing Zhao and Zize Liang (Institute of Automation Chinese Academy of Sciences, Beijing 100190, China)	❑ This research proposes a novel method of plastering machine measurement and control method depends on laser triangulation. ❑ This method can't solve some problems such as corner is unreached and the power of vibration can't be compensated.

METHODOLOGY

Methodology to be used is as follows for the designing of automatic plastering machine on the basis of literature survey.

Data and design calculation

Design of plasterboard

By Considering,

1) Horizontal length of plasterboard = 2 feet
   = 0.61 m
   = 610 mm
2) Length of bottom plate of plasterboard (Trowel) = 0.25 m = 250mm

ISSN: 2277-9655
Impact Factor: 4.116
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3) Length of upper plate of plasterboard = 1*1/2 feet
= 0.46 = 460 mm
4) Universal one coat plaster thickness = 12 mm
5) Trowel leading edge will be approximately 10-15 mm away from the wall surface, so consider = 10

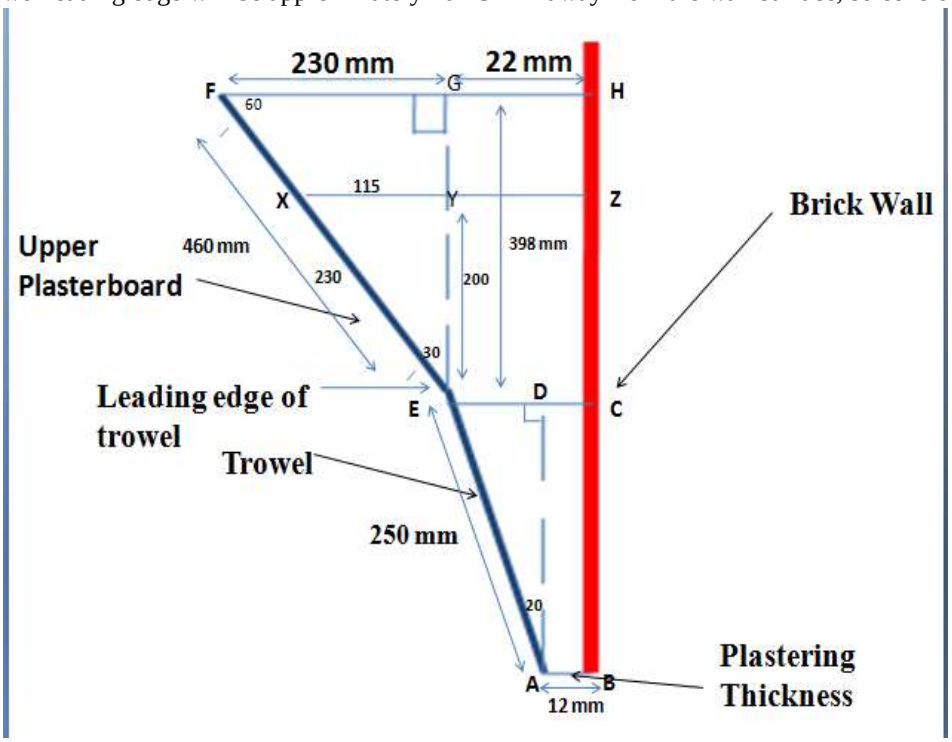

Fig. 3:- 2-Dimensional view of plasterboard

6) Total distance of leading edge from the wall = plaster thickness + leading edge distance
= 12 mm + 10 mm
= 22 mm

Now,

1) In triangle AED,
By Pythagoras theorem,
$AE^2 = AD^2 + DE^2$
$300^2 = AD^2 + 10^2$
AD = 299.83 mm
AD = 300 mm

2) In triangle DAE,

$\sin\theta$ = opposite side/hypo $\sin\theta = 10/300$
$\theta = 20^O$

3) Now, In triangle EFG,
$\sin\theta$ = Opposite side/ Hypo
Sin30 = FG/FE Assume θ= 30
0.5 = FG/460
FG = 230 mm

4) FH = FG + GH
= 230 + 22
= 352 mm

5) In triangle FGE,
By Pythagoras theorem
$FE^2 = FG^2 + GE^2$
$460^2 = 230^2 + GE^2$
GE = 398 mm

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

6) Volume of □ CEXY = L * B * H
= 200 * 22 * 610
= 2684000 mm^3
= 0.0026 m^3
7) Volume of prism EXY = ½ * L * B * H
= ½ * 200 * 115 * 610
= 7015000 mm^3
= 0.0070 m^3
8) Total Volume = Volume of □ CEXY + Volume of prism EXY
= 0.0026 + 0.0070
= 0.0096 m^3
9) The Density of the standard mortar (sand + cement) = 2200 Kg/ m^3
10) Mass of mortar = Volume of mortar * density
= 0.0096 * 220
= 21.12 Kg
11) Load = 21.12 * 9.81 = 207.18 N
12) Mass of plasterboard = 6 Kg
= 6 * 9.81
= 58.86 N
= 59 N
13) Total Load = Load of mortar + Load of plasterboard + Frictional and other load
= 208+ 59 + 200
= 467 N
= 470 N
= 48 kg
14) There are two different sides, so load on single side = 470/2
= 235 N

DC motor specification

Power of motor = 1 hp
= 750 watt
Torque = 240 kg-cm
= 23.54 * 10^3 N-mm

Fig. 4 DC motor

Frequency = 60 Hz
Now, Power = 2∏NT/60
750= 2 ∏*N*23.54/60
N = 304.40 rpm

Design of Shaft
Material for shaft – Fe 360
Yield Strength (Syt) = 220 N/mm^2
Ultimate tensile strength (Sut) = 360 N/mm^2
Now according to A.S.M.E (American Society of Mechanical Engineers)
Shear stress τ = 0.18 * Syt
= 0.18 * 220
= 39.6 N/mm^2
τ = 0.3 * 360
= 0.3 *360
= 108 N/mm^2
Total Load = 47.60 kg

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

= 48 kg
= 48 * 9.81
= 470 N

There are two different sides

So, load on single side = 470/2
= 235 N
RA = 235 N
RB = 235 N

Bending Moment M = RA * 30
=235*30 = 7050 N-mm

So, Twisting moment (Te) = $\sqrt{(Km * M)^2 + (Kt * T)^2}$
= $\sqrt{(1.5 * 7050)^2 + (1 * 23.54 * 10^3)^2}$
= 25806 N-mm

For rotating shaft having gradually applied load,
Km – Combined shock and fatigue factor for bending
= 1.5
Kt – Combined shock and fatigue fact for torsion
= 1

We know, The torsion equation
T/J = τ/r
Where, T = Twisting moment acting upon the shaft
J = Polar moment of inertia of the shaft about the axis of rotation.
τ = Torsional shear stress and
r = d/2, d is the diameter of the shaft.
So, Te = ∏/16 * d^3 * 39.6

d = 14.91 mm
So, get standard diameter of the shaft i. e. 15 mm

Design of worm and worm gear

Material for worm wheel – Phosphor bronze
Material for worm –Cast harden steel
(Sut)worm wheel = 240 N/mm^2
(Sut)worm = 700 N/mm^2
Assume, No. of teeth on worm = Zw = 5
No. of teeth on worm gear = Zg = 25
So, Gear ratio = 25/5 = 5
Beam Strength of worm gear,
By Lewis equation,
$Wt = 6_0 * Cv * b * \prod * m * y$
Where, Wt = permissible tangential tooth load or beam strength of gear tooth
6_0 = Allowable static stress
Cv = velocity factor
b = face width
m= module
y = tooth form factor or Lewis factor
6_0 = 105 N/mm^2 ------For cast iron
Pitch circle dia. Of the worm gear D = 60 mm
Pitch circle (Pc) = ∏D/T
= ∏ * 60/ 25
= 7.54 mm
Outside diameter (Do) = D + 1.0135 Pc
= 60 + 1.0135 * 7.54
= 67.64 mm
Throat diameter (Dt) = D + 0.636 * Pc
= 60 + 0.636 * 7.54

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

= 64.80 mm
Face width (b) = 2.38 * Pc + 6.5
= 24.44 mm
Radius of gear face (Rf) = 0.882 * Pc + 14
= 20.65 mm
Radius of gear rim (Rr) = 2.2 * Pc + 14
= 30.588 mm
Linear velocity of worm gear
Vg = ∏ * D * N/ 60
= ∏ * 0.06 * 5.06/60
= 0.015 m/s
Velocity factor Cv = 6 / 6 + v
= 0.9978
Lewis form factor y = 0.124 – 0.684 / Tg
= 0.0966
Module m, D = m * Tg
m = 2
So, Beam strength of worm gear = 1612.39 N
Now, Wear tooth load for worm gear,

For worm,
Dia. of worm = m * q
= 2 *10
= 20 mm
Axial pitch Pa = ∏ * m = 6.28 mm
Face width = 0.73 * dw = 14.6 mm
Centre distance = dw + D/2 = 40 mm
Addendum = 1m = 2 mm
Deddendum = 1.25m = 2.5 mm
Length of worm = Pa * Zw
= 31.4 mm

Ww = D * b * k
Where, D – pitch circle diameter of worm gear
b – face width of the worm gear
k – load stress factor = 0.345
So, Ww = 505.90 N

Design of Rope

Fig.5 Steel Rope

Type of rope = 6 * 19
Material = Steel wire
Diameter = 3 mm
Minimum breaking stress = 1770 Mpa
Minimum load capacity = 588 kg
Area of wire rope = 0.38 * d^2
= 3.42 mm^2
Diameter of the pulley or drum = 30 * d
= 90 mm

ISSN: 2277-9655
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Tensile strength = $540d^2$ = 4860 N/mm^2
Factor of safety = 3.5 i.e. 3.5 * 2 = 7
Stresses in wire rope,
Direct stress 6d = W + w/ A
Where, W = load lifted
w = weight of the rope
A = C/S area of the rope
So, direct stress, 6d = 69.94 N/mm^2
Bending stress when wire rope winds round the drum or pulley
6b = Er * dw/ D
= 84 * 10^3 *3/ 90
= 2800 N/mm^2
Where, Er – Modulus of elasticity of wire rope = 84 * 10^3 N/mm^2
dw – dia. Of wire
D – dia. Of pulley or drum
Total stress = 69.94 + 2800
= 2870 N/mm^2

Our design load = F.O.S. * total load
= 7 * 470 = 3290 N
So wire rope of diameter 3 mm, 6 * 19 type is satisfactory

Design of Bearings
Specification:-
Bore diameter d = 15 mm
Outside diameter D = 35 mm
Width B = 11 mm
Greece lubrication = 19000
Oil lubrication = 24000
Dynamic load C = 7800 N
Static load Co = 3550 N
Now, Radial and Axial load,
Radial load Fr = 235 N
Axial load Fa = 0 N
Equivalent dynamic load Fe = [X * V * Fr + y * Fa] = [1 * 1 * 235 + 1 * 0]
Fe = 235 N
Req. dynamic load capacity = L = $(Cr/Fe)^a$
Ball bearing a = 3
So, L = 8000 hrs
8000 = $(Cr/235)^3$
Cr = 4700 N
Since, Cr < C, so selected bearing is suitable.

2-D drawing and CAD modeling of plastering machine
On the basis of above design calculation the computer aided design (CAD model) of some parts of the plastering machine and assembly of the plastering machine has been done with the help of Computer Aided Software naming 'CRE-O' by applying Bottom-up approach.

ISSN: 2277-9655
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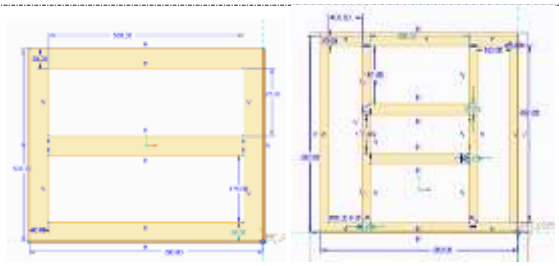

Fig.5 drawing of ceiling beam and base of machine

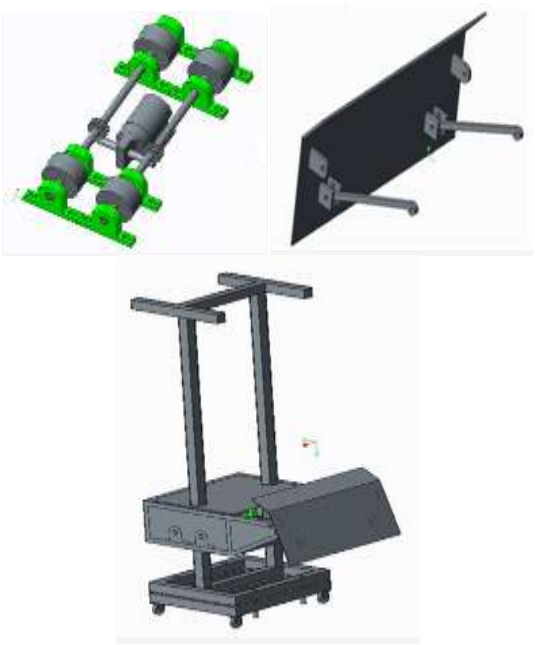

Fig. 6 CAD model of components of plastering machine

CONCLUSION

By studying all the above literatures and the work done following conclusions are obtained.

1. Automatic plastering machine is one type of unique machine will be used in construction industry.
2. It helps to save the time and money.
3. It works with cement mortar which is conventional one due to which no replacement of the material required.
4. The machine is more productive than the conventional plastering technique.
5. Higher quality of a plaster can be obtained with this machine.
6. The thickness of the plaster will be constant over the wall which is generally varying 0.5 to 0.75 inches at different conditions of the wall surface.
7. This machine needs to poured the mortar manually so, it has needed the work automation of loading mortar.
8. It reduces the wastage of mortar up to 60% and hence required fewer raw materials.
9. Due to saving in time, labor cost, raw material, the overall cost of construction is less hence the machine is economically efficient
   than the conventional plastering technique.

RESULT

Table shows comparative result on different objectives, for a 10 feet*10 feet wall by both existing plastering method as well as Automatic plastering machine as follows.

Sr. No.	Objective	Existing method	Automatic plastering machine

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

1.	No. of labors required	2 to 3	1 or 2
2.	Time required (hours)	6 to 7 (hours)	1 to 2 (hours)
3.	Material	More material required compared to plastering machine as there is more wastage of mortar.	Less material required, compared to conventional method as less material wastage is there.
4.	Cost	Comparatively high cost. (As number of labors and time required is more)	Comparatively low cost. (As no. of labors and time required is less)

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