TO DESIGN AND DEVELOP LOW COST AUTOMATIC WALL PLASTERING MACHINE

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Abstract: The construction technique in all industrial countries of the world are characterised by a wide range of mechanisation. Construction is labor-intensive and is conducted in dangerous and inaccessible areas. Plastering is widely used as a finishing technology for both interior and exterior walls made from bricks, concrete or timber. Plastering of exterior walls provides heat insulation, sound absorption and protection against air pollution and weather. The application of plaster to interior walls improves the indoor climate by humidity regulation and serves the purpose of compensating inevitable tolerances of the brickwork, thus providing a clean, level surface for further finishing tasks.Special plaster material can also protect against fire or radiation. 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.
Robots are widely used to help human workers in construction sites. Introduction of robotics and automation in this area started in the early 90s aiming to optimize equipment operations, improve safety and performance. Therefore the importance of construction robotics and automating the construction works has grown rapidly. The automatic wall plastering machine will help to save labor cost up to 85%, increase productivity by 10-15 times, get professional quality finishing in less time, reduce valuable time and project cost, manufacture automatic wall plastering machine in low cost etc.

Keywords: Aautomatic wall plastering, save labor cost, Time saves.

Introduction: A multi-functional tool is necessary in order to apply and smooth the plaster. Plaster thickness for normal applications varies between 5 mm to 30 mm. For thin plastering a thickness of between 3 to 6 mm is standard. The plastering tool must be adaptable enough to apply plaster with this thickness. 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. The integration of the human worker in the automated plastering process is also necessary due to the complex working environment of the building site and mainly involves supervision and visual quality control.

1.1 **The requirements for good plaster:** Plaster has important requirements in the fresh and hardened States. In the fresh state plaster must be workable, cohesive and plastic. And have good water retention. The properties of fresh plaster depend on the materials used, especially the sand, and on mix proportions. In the hardened state, plaster must be: strong enough to hold paint and withstand local impact and abrasion; free of unsightly cracking; well bonded to the substrate; have an acceptable surface texture; and have acceptable surface accuracy.

1.2 **The properties of plaster:** The properties of plaster in both fresh and hardened states depend to a large extent on the properties of the materials used. Cements for plaster should comply with the requirements of SANS 50197-1 or SANS 50413-1. CEM l and CEM ll A cements are used in plaster with good results. CEM ll B-V or W cements are recommended for plaster exposed to damp conditions during service. Sand is by far the major constituent of plaster and has a significant influence on its performance and material cost. Important physical properties of sands are: Clay content, Grading, Maximum particle size and Particle shape. The specification of Specifications for plaster work should cover the following aspects: Selection of materials, Mix proportions, and Application, Finish and surface tolerances. Mix assessment may be done as follows:

- Mix 2.5 kg of cement and 12,5 kg of sand to a uniform color on a non-absorbent surface.
- Add water slowly while mixing until the mix reaches a consistence suitable for plaster.
- If 2.5 ℓ of water is needed, the sand is of good quality.
- If 3 ℓ is needed, the sand is of average quality. If 3.75 ℓ is needed, the quality of the sand is poor; and if more water than that is required, the quality is very poor.

2. Literature Survey: While important advance with the automation of concrete and asphalt mixing was already achieved in the sixties, the development of the necessary prerequisites for mobile construction machinery first began with the introduction of microelectronics in the beginning of the eighties. For years the personnel, technological and economic conditions for the automation of construction machinery and plants in Europe were characterised by an extensive lack

of skilled workers and a growing average age of the staff, demands for effective humanisation of nearly all construction works, increased requirements on the quality of the work execution, a need for works in dangerous and inaccessible areas of operations, an increase in performance and reduction of costs for improvement in economy, and by the competition on international markets of construction machinery [1].

Plastering is widely used as a finishing technology for both interior and exterior walls made from bricks, concrete or timber. While plastering of exterior walls provides heat insulation, sound absorption and protection against air pollution and weather, the application of plaster to interior walls improves the indoor climate by humidity regulation and serves the purpose of compensating inevitable tolerances of the brickwork, thus providing a clean, level surface for further finishing tasks [2].

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 [3, 4].

The rapidly developing area of construction automation leads construction managers to critically evaluate the feasibility of replacing conventional construction processes by automated systems. This decision requires careful analysis of tangible and intangible factors such as need-based criteria, economic criteria, technological criteria, project specific criteria, and safety/risk criteria. [5]

The introduction of self-optimizing and self-organizing systems (e.g. robots) will require organizational adjustments on the construction site as well as in the planning and design phase. Issues such as safety, job enrichment, high quality, vanishing craftsmanship, optimal usage of resources and preventive maintenance, are basic incentives to study the application of both system theory and cybernetics to construction operations [6, 7 and 8]. It is almost inevitable that intelligent machines will find their way into construction. Introduction of robotics and automation in this area started in the early 90s aiming to optimize equipment operations, improve safety and performance [9, 10].

2.1 Plastering Tool: A multi-functional tool is necessary in order to apply and smooth the plaster. Plaster thickness for normal applications varies between 5 mm to 30 mm. For thin plastering a thickness of between 3 to 6 mm is standard. The plastering tool must be adaptable enough to apply plaster with this thickness. Fast tool change for plastering of large and small surfaces must be provided for. High levels of plaster smoothness and angular accuracy of the plastered surface are aimed for. Over a distance of 2.5 in a variation from a plane of less than 8 mm is to be achieved. Set-up and cleaning cycle times are to be kept to a minimum thus helping to increase acceptance in the building site environment [2].

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2.2 Objectives

- To save labor cost up to 85%
- To increase productivity by 10-15 times.
- To get professional quality finishing in less time.
- Reduce valuable time and project cost.
- To manufacture automatic wall plastering machine in low cost.

2.3 Automation of the Plastering Process: 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. The fine smoothing of the plaster is still to be carried out by the plasterer as the considerable level of expertise required is not achievable by a robot. The integration of the human worker in the automated plastering process is also necessary due to the complex working environment of the building site and mainly involves supervision and visual quality control.

2.4The 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, e 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.
- While the robot is applying plaster to a wall or

ceiling, the human operator has the following tasks

- Preparation of further walls and ceilings to be plastered,
- Visual quality control of the plastered wall, manual refinement of edges, comers and niches of the plastered surfaces and
- Fine smoothing of the plaster.

2.5Introduction to automatic wall plastering machine [11]: Automatic wall plastering machine is unique machine for plastering wall. It is capable to plaster on bricks wall with cement mortar, ready mix, lime mortar and gypsum mortar.

Table 1.Automatic Wall Plastering Machine V/S Manual Plastering

	AUTOMATICWALL LASTERING MACHINE	MANUAL PLASTERING
Speed/ 8 hours	500-750m2	Less than 30m2
Labour Intensity	Effortless	Hard work
Plastering Quality	Always High Quality	Depend on worker
Workers Required	Much less	More
Labour Cost	Electricity Charges only	Insurance/accommodation.

2.6Thus the advantages of Automatic Wall Plastering Machine are as under:

- Can Plaster up to 500m^2 to 750m^2 per day.
- Increase productivity.
- Portable, stable, free and easy to move.
- High quality performance.
- Reduce valuable time and project cost.
- Can plaster below and above window opening.
- Easy to clean and maintain.

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