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Conceptual Design Of Fixture For Automate Exterior Wall Painting And Design And Analysis Its Main Component

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Abstract:

The study deals with the modeling of fixture which will be use for automated spray painting of outside wall of building. It also includes the detail design, modeling and analysis of lead screw which is maim component of this fixture using CAD software like Pro-E and ANSYS.

Keywords*: Fixture, Lead screw, Pro-E, ANSIS.*

1.Introduction

As we know it is very risky to paint outside wall at elevated height keeping this thought in mind the project progresses. The objective of the project is to design of fixture for automated spray painting of building wall. Painting of tall building is a risky job and needs a supporting structure to be setup before the painting starts. Due to long setup time, the time required for painting increases.

Basically this fixture is design to paint outside wall of a building. Fixture is placed on top of tare ace wall and fixture is used to give vertical and horizontal motion to color pipe. It consists of two motors of which one is attached to lead screw for horizontal forward and backward motion. Other motor is attached to gear for vertical upward and downward motion of color pipe.

2.Literature Review

For a low complexity and low cost, the support system chosen must have simple configuration, a scalable work area and requires less complex control system [1]. Development of the support system forms the most important part of automated wall painting. A suitable support system must be selected from various alternatives for suspension kinematics mechanism, path planning and motion tracking. The path traversed by the paint head is distorted and needs improvements in velocity control [1].

This paper designed a wall-climbing robot for painting the hull surface. The robot walked with caterpillar, permanent adsorption and driven by AC servo motor, the paint system was controlled by solenoid valve and pressure pump. This paper gives idea of painting a wall by using spray which will move horizontally and vertically. For robot movement this thesis uses magnetic plate. This is costly item in the fixture [2].

In book “A Text Book of Machine Design-2003”, detail procedure for power screw design is mentioned. It includes the entire basic concept which helps in designing the tool easily. This book also gives some important standard values related to lead screw design [4]. “Design Data-Data Book of Engineers-1968” compiled by Faculty of Mechanical Engineering PSG college of Engineering include all the design formulae related lead screw design [5]. For the analysis of lead screw procedure is followed given in paper [3].

3.Objective

Development of model of fixture to achieve following objective

- To avoid human risk of working at height.
- To save the time of painting.
- To minimize the cost of painting.

4.Methodology

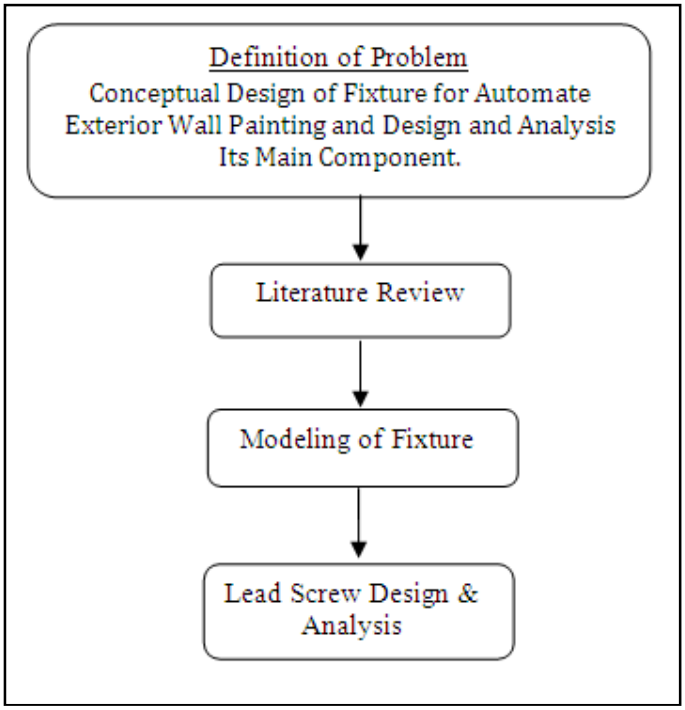

Figure 1

5.Conceptual Design

Fixture model is developed considering the following concepts.

5.1.Fixture Location

- It has to placed on tare ace wall in order to paint the wall throughout building height
- With this placement it will be easier to move spraying pipe up and down whenever required.
- It will easy to access with the fixture.

5.2.Path Selection

- Fixture has to be design to move spraying pipe horizontally forward and backward and also vertically up and down in order to get color pattern as shown in figure.
- During the horizontal motion fixture has to hold the pipe.

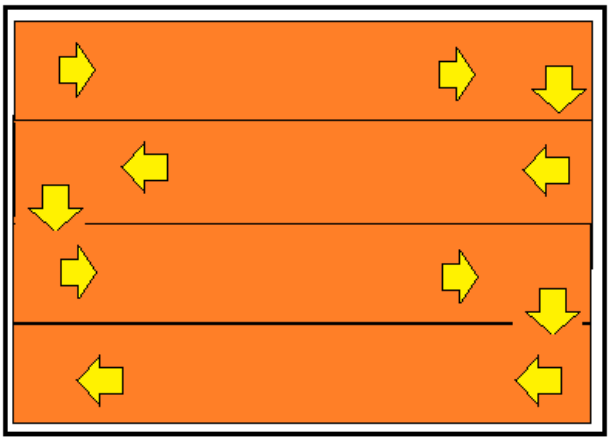

Figure 1: Path of spraying by pipe

6.Vertical Up & Down Motion

- As per the path explain above color pipe has to move up and down.
- A gear pair with motor is used to perform this type of motion
- Pipe is fitted in between the two pulleys which are connected to gears. Using friction between pipe and pulleys, pipe is moved up and down as shown in figure below

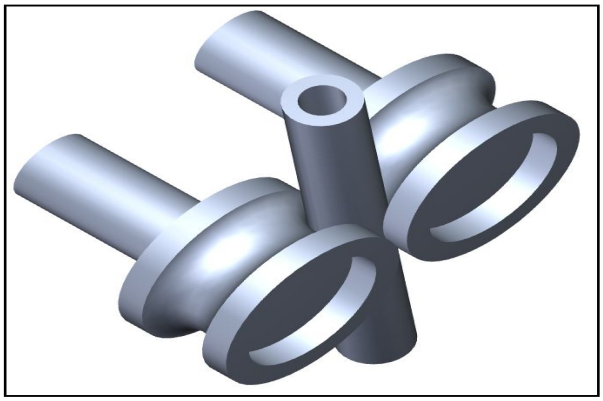

Figure 3: pulley arrangement for pipe up & down motion

7.Lateral Forwarn & Backward Motion

- For this motion lead screw with motor is used to move trolley having gear pair and pipe assembly as shown in figure below.
- With this we can have good control on spray.
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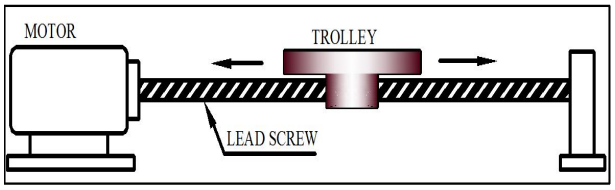

Figure 4: Lead screw and motor arrangment for lateral motion

8.Holding Pipe During Lateral Motion

- During lateral motion pipe should not move down due to weight of pipe and color inside it.
- Therefore it is required to hold the pipe. Following figure shows the arrangement done to hold the pipe.

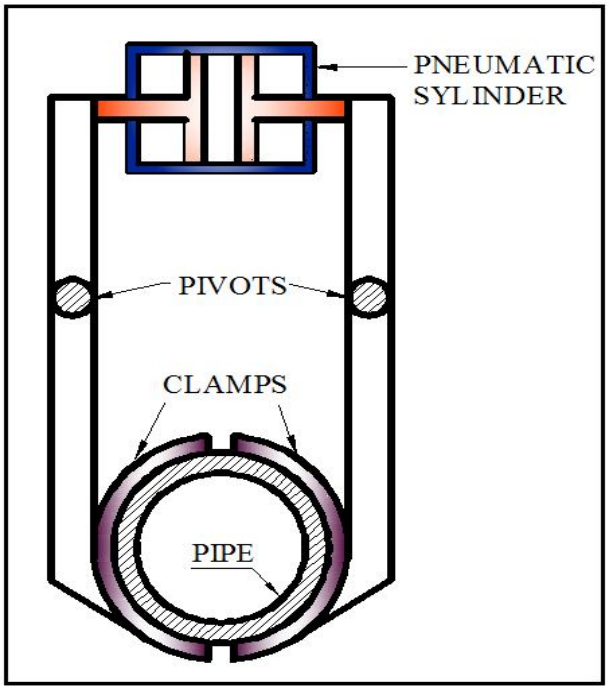

Figure 5: Pipe holding system

9.Pipe Design

- It is not possible to use single pipe to the length of building height, therefore number of pipes having length 2 to 3m are used.
- Pipes are connected to each other by making internal threads on one end and external threads to other end as shown in figure below.

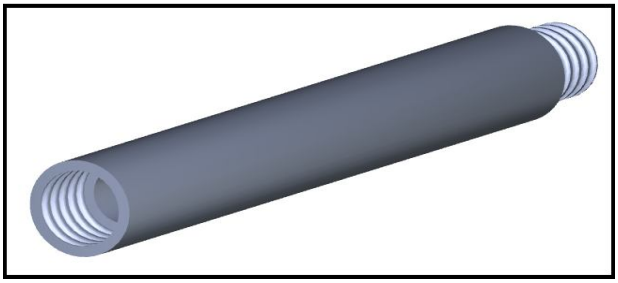

Figure 6: Pipe model

10.Final Concept

- Considering all the conditions as discuss earlier final model is developed which will be efficiently used for the painting purpose which is shown in following figure.

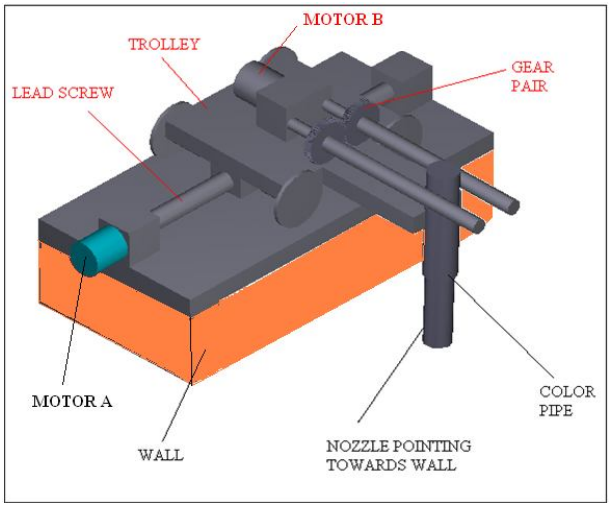

Figure 7: Model of fixture

11.Lead Screw Design, Modeling and Analysis

11.1.Design

- As lead has to move trolley mounted on it, its weight is considered while designing the lead screw. We get the following dimensions from standard thread profile.

Nominal or major diameter (d) mm.	**Minor or core diameter (dc) mm.**	**Pitch (p) mm.**	**Area of core (Ac) mm²**
34	30.5	7	730.5

Table 1: Dimensions Of Lead Screw

- Acme thread profile is used to get more strength to lead screw.
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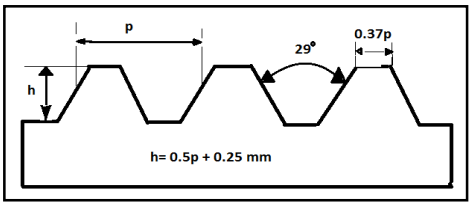

Figure 8: Acme thread profile of lead screw

11.2.Modeling

- 3D model of lead screw in Pro-E considering length 1000mm.

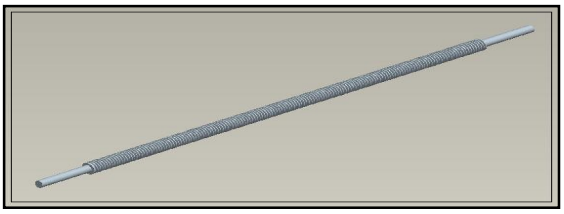

Figure 9: Model of lead screw

11.3.Analysis

- Set the analysis title: "Static deflection of lead screw"
- Preferences: Structural, Discipline: h method
- Preprocessor:
  - Element type: The elements chosen for the present work is SOLID-45.
  - Material properties:

Modulus of elasticity of steel= 2 x 105 N/mm2 Poisson's ratio = 0.3 Density = 7800 N/mm3.

- Model generation:

The model is done considering lead screw as a rod of core diameter in ANSIS.

- Boundary conditions:

A force of 3500N obtained from theoretical calculation is applied on the middle portion of lead screw. The ends of lead screw are constrained to all degrees of freedom.

- Static deflection of lead screw is 1.067 mm which is acceptable.

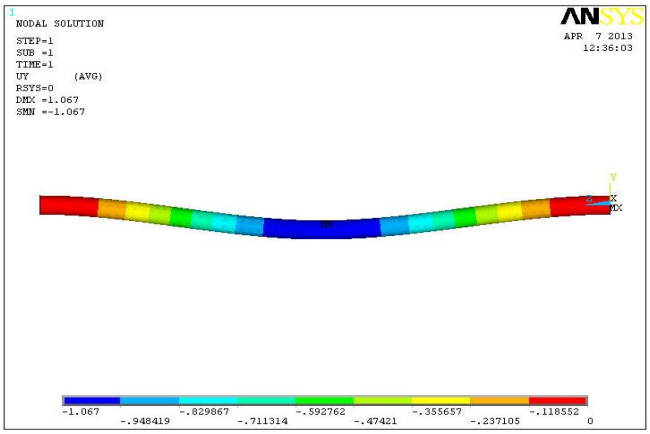

Figure 10:-Static deflection of lead screw

Sr. no.	Diameter of lead screw(mm)	Deflection(mm) (ANSIS)	Remark
1.	20.5	5.211	Not adequate
2.	30.5	1.067	Adequate

Table 2: Comparison Of Deflection Of Lead Screw

Above table shows that, selecting 30.5 mm diameter of lead screw gives quite less deflection rather than selecting 20.5 mm diameter lead screw.

12.Conclusion

Fixture model is simple in construction and will work efficiently. With this fixture it will possible to avoid the risk of painting tall building at elevated height. It will reduce the cost and time of painting considerably as compare to manual painting. Analysis shows that lead screw is adequate to use in fixture.

13.Reference

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