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Development and Testing Of Sheet Metal Rolling Machine

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Abstract - The sheet metal industry is a large and growing industry. Different types of machines are used for different operations. In this project the sheet metal rolling is very simple in operation by using roller which is coupled with motor. This machine produces cylindrical objects of different diameters. In normal practice of the roller bending, heavily depends upon the experience and skill of the operator. Trial and error is a common practice in the industry. This project reduces the man power so that the human errors are reduced.

This machine consists of three rollers of 80mm dia and 1.37m length which are meshed with a gears at the end and the gear box is coupled with a 2hp motor. This machine is simple in construction and working. In this project the IR sensors are used for safety purposes. The system automatically stops, when the IR sensor detecting the any parts of the operator touches the roller. The lifting of top roller is automated by using lead screw which is rotated by 12v DC motors. The Fabricated machine is tested by rolling sheet metals of various thicknesses (1mm to 3mm) and its performance characteristics are studied. Break even analysis is done for finding the break-even point by using variable cost, rate of interest and investment cost.

Objectives and scope of project: The main objective of the project is to develop a Sheet Metal Rolling machine with automated top roller adjustment , implementation of IR sensor for safety purposes and to assess the performance of the machine under various conditions.

I. INTRODUCTION

Sheet Metal industry is a large and growing industry. There are many special purposes machines used in this industry to-day. The proper selection of the machines depends upon the type of the work under-taken by the particular industry. There are many examples of Sheet Metal work, which can be seen in everyday lives. The metals generally used for sheet metal work include black iron sheet, copper sheet, tin plate, aluminium plate, stainless sheet and brass sheet. Sheet metal fabrication ranges from deep drawing, stamping, forming, and hydro forming, to high-energy-rate forming (HERF) to create desired shapes. Fascinating and elegant shapes may be folded from a single plane sheet of material without stretching, tearing or cutting, if shape rolling of sheet metal is the bending continually of the piece along a linear axis. This causes alteration of the original form of the sheet as it passes through a pathway of series of rollers. The present invention relates to plate rolling machines of the type which operates with rolls. Such machines involve certain well-known difficulties in respect of rolling plates into various shapes.

The project “SHEET METAL ROLLING MACHINE” finds huge application in Sheet Metal industry. Rolling is the process of bending sheets to a curved form. The article in the shape of cylinders is made by rolling roller. Rolling operation can be done on hand or power operated rolling machines. In forming cylindrical shapes a gradual curve is to be put in the metal rather than sharp bends. The gap between the rollers can be regulated by hand operated screws..

II. SELECTION OF MECHANICAL AND ELECTRICAL COMPONENTS

A. Mechanical Components:

1) Roller
2) Ball bearing
3) Stepped shaft
4) Spur gear
5) Pulley

B. Electrical and Electronics Components:

1) Motor
2) IR Sensors

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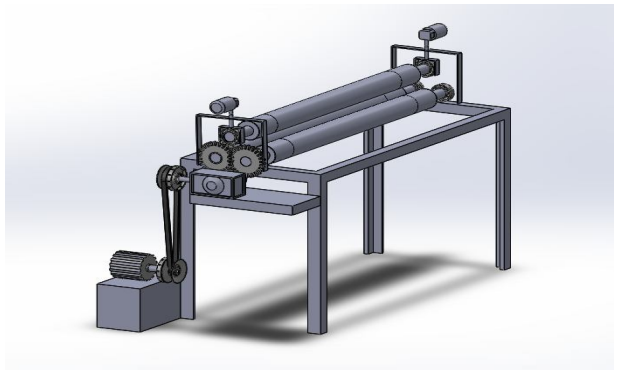
C. Design and fabrication of sheet metal rolling machine

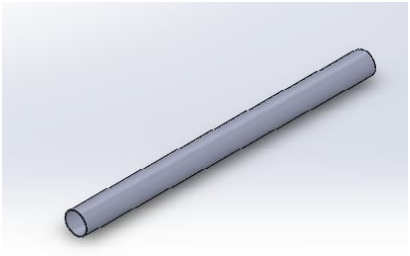
The various models of the project were designed using the software solid works version 2013. The design of sheet metal rolling machine involves the design of various components shown in table 3.1 below. The designing of the various components first involves the basic study. After the basics has been studied the inputs for designing is selected. And appropriate material for each component is selected and then the dimensions of each part were selected such that the design is safe. The component is designed such that it has good life and should perform the operation for desired product.



Conceptual view

D. Roller

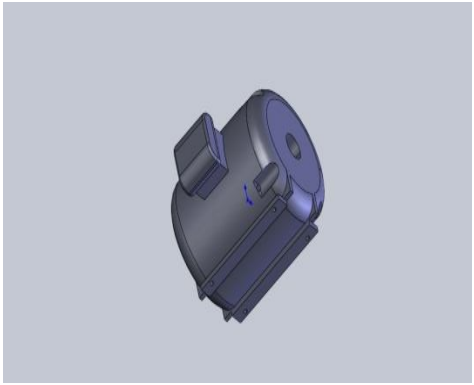
The roller is to bend the sheet metal. This machine is designed for rolling the sheet up to the length of 4feet so,rollers of length 4.5feet is selected.



3D view of roller

E. Motor

Three-phase asynchronous motors can be considered among the most reliable electrical machines. They carry out their function for many years with reduced maintenance and adapts themselves to different performances according to the requirements of both production as well as service applications.



3D view of motor

F. Stepped shaft

According to the standard diameter of rollers the stepped shaft diameter is selected. This shaft is machined to get 80mm diameter of

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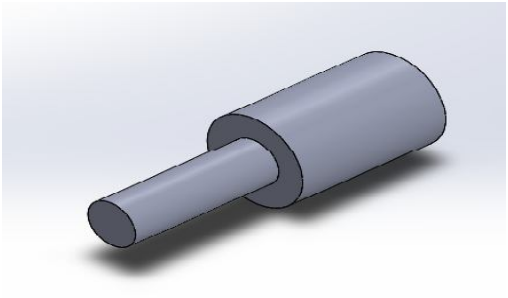
larger section and 40mm diameter of smaller section. Deflection of sheet (δ) to get required radius of curvature of 40mm is 39.10mm. In order to connect the roller to the bearing and gear, the length of the smaller section of 150mm is selected.



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3D view of stepped shaft

G. IR sensor unit

The IR transmitter and IR receiver circuit is used to sense obstacles crossing the sensor. It is fixed to the frame stand with a suitable arrangement.

III. EXPERIMENTAL PROCEDURE

The upper roller is lifted by using screw rods which is rotated by using DC motor and the sheet metal is introduced between the top and the bottom rolls, the gap between the top and bottom rolls are adjusted as per the required diameter by regulating the screw rods. When the AC motor is rotated, the gear box which is keyed to the shaft transmits power to the spur wheel, and the spur wheel rotates, the spur gear which is fixed to the spur wheel also rotates and so do the two spur gears which are keyed to the bottom roller. Both bottom rollers rotate in the same direction. Now the sheet metal is bent, the top roller presses the sheet and gives it to the curvature, the cylindrical shape is formed. The formed material can be slipped off by removing the top roller.

IR sensor is used to detect the any obstacle (man hand) inside the machine, this will automatically off the motor. The top roller movement is automated by using screw rod mechanism. When the DC motor is switched ON with screw rod mechanism, it will used to up and down the roller. After finishing the rolling operation in sheet metal, the finished metal is removed through the side of the machine which can be able open and close.

IV. SHEET METAL ROLLING MACHINE

sheet metal rolling machine

V. RESULT AND DISCUSSION

A. Test results

The testing is made on the machine using sheet metal of various thickness (1mm, 2mm, and 3mm) to test how the speed of the

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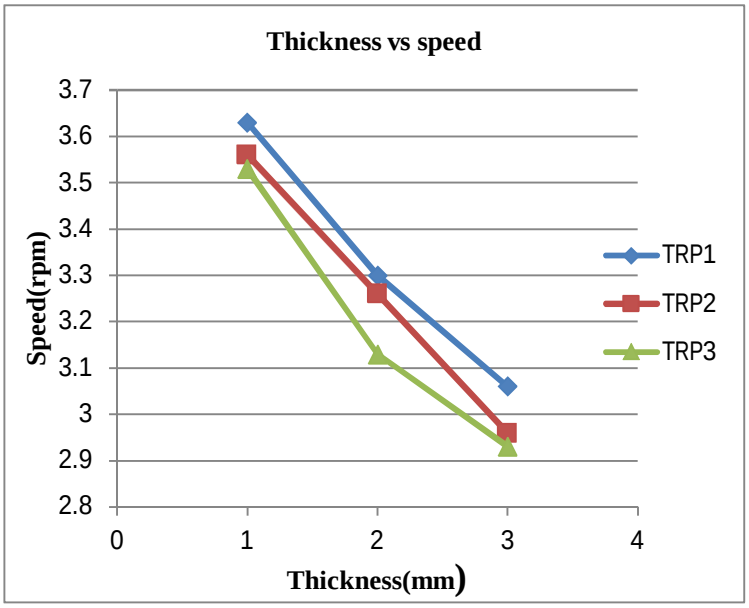
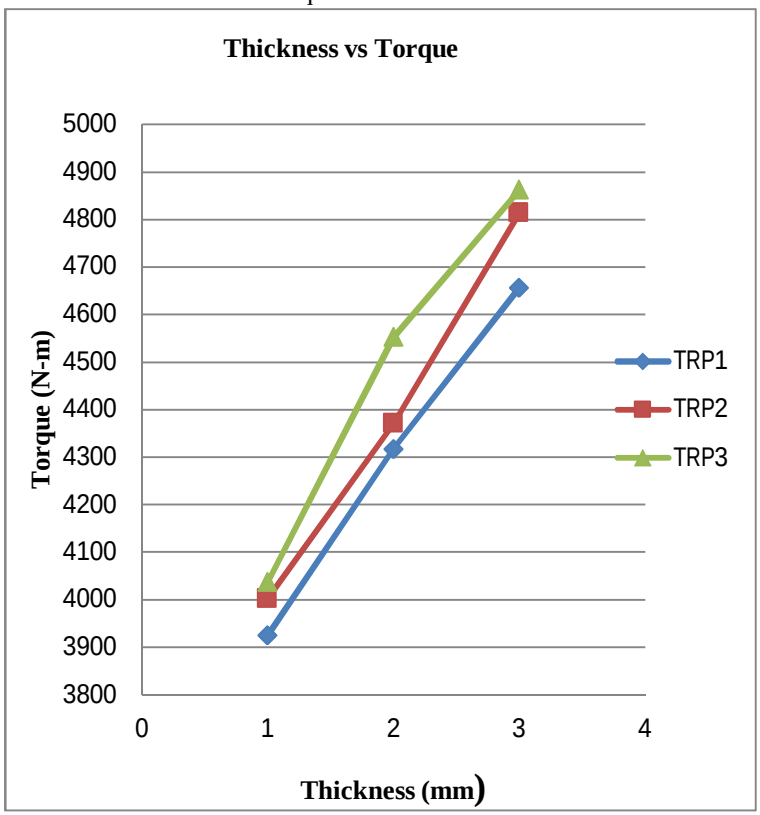
roller, torque will vary while rolling sheet metal of different thickness. The testing is made for three trails to measure the speed of the roller and the values are noted. It is shown in the graph. And the graphs are plotted so that it is easy to understand how the speed and torque varies with varying the thickness of the sheet. The graph is plotted between thickness of the sheet and the speed of the roller.



Thickness vs speed

The graph is plotted between thickness of the sheet and torque



Thickness vs torque

The graph is plotted between thickness of the sheet and timetaken for one revolution

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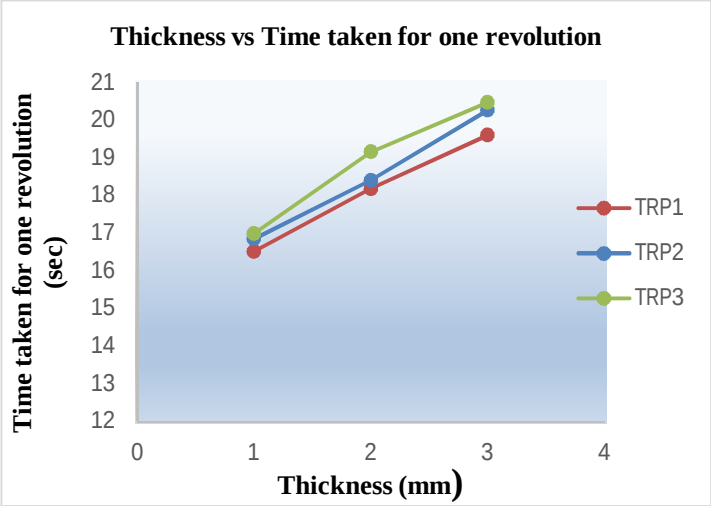

Thickness vs time

VI. CONCLUSION

The major benefits of the project are to increases the production rate. since the top roller motion is carried out by the humans using labors manually. The existing process consumes more time. In this existing process only 160 sheets are rolled in one shift (8 hours) per day. This causes low production rate. This project rolls 200 sheets in one shift. Thus the production rate is increased in the industries.

Another benefit of this project is to reduce the human effort of the worker. Due to reduction in human effort causes the increases in efficiency of the production.

IR sensor reduces the accidents during the rolling process. If any obstacle (man hand) inside the machine, this will automatically off the motor. It will increase the safety level of the operation.

The manpower need for this process is reduced which reduces the labor cost of the product.

A. Achievements of the project

This project is fabricated and the sheet metal rolling process is automated and also the lifting of top roller is made automatic by using a DC motor and IR sensor and alarm is fitted to it for safety purposes. This machine increases production and reduces the manpower and also the safety system is fitted to it will prevent the accidents. This project successfully placed in the sri shakthi institute of engineering and technology in the department of mechanical engineering.

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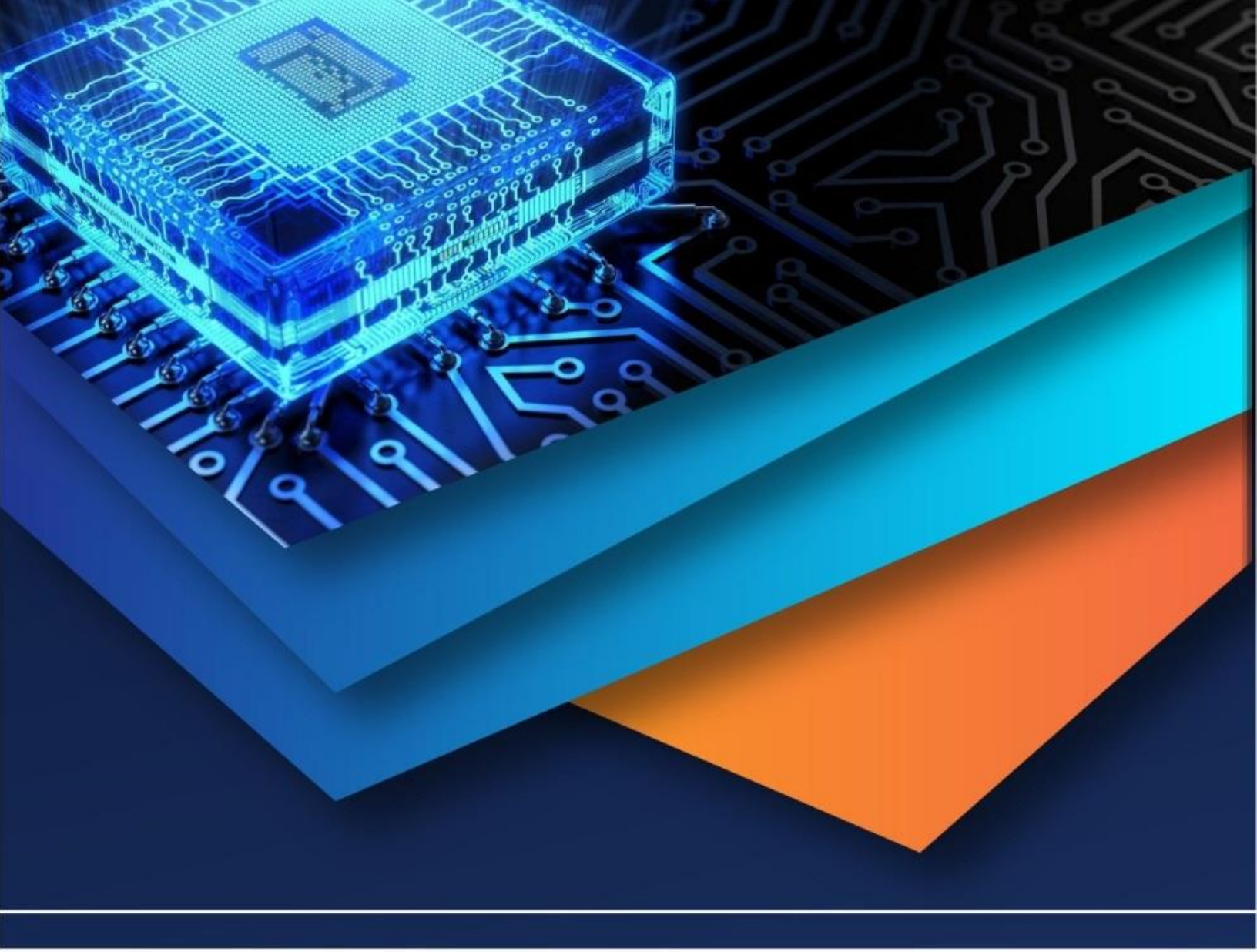

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