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Design and Analysis of Re-Bar Bending Machine

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ABSTRACT— Presently, stirrups are made manually, which suffers from many drawbacks like lack of accuracy, low productivity and resulting into severe fatigue in the operator. Reduce the manually work fully automatics, two way operation are used in stirrup machine, CNC and manually. There are various components used in rebar bending machine, within which many more are electronics such as motor, microcontroller (89c51), printed circuit board, IC232 (MAX232), cable RS232. Power supply is given to controller (Microcontroller-89c51), and then signal is given to PCB (printed circuit board) at which max 232 step down to 5v from 15v. Also signal is given to motor. The signal from MAX 232 is further send to motor which perform bending. Finally the stirrups are formed by bending.

Keywords: - motor, microcontroller, PCB, IC232, RS232, power supply

I. INTRODUCTION

The bending of straight reinforcement bars is still mainly done with hand operated machines. The controls require humans to set turning angles and to select the appropriate pegs and pins for the turning table. There are various machines which are used for making stirrups which works on hydraulic and pneumatics. But those machines require storage tank or compressor which makes them heavy and immobile. Therefore, for portable machine, we are making rebar bending machine works on motor and microprocessor, which eliminates the need of storage tank or compressor. Here, the rod which we are bending is either circular or square in cross-section.

II. DESIGN

The formula we used for calculating stress in rod is following:

$$\sigma = My/Ix$$

Where,

- *σ is the bending stress.*
- *M is the moment about the neutral axis.*
- *y is the perpendicular distance to the neutral axis .*
- *Ix is the moment of inertia about the neutral axis x*

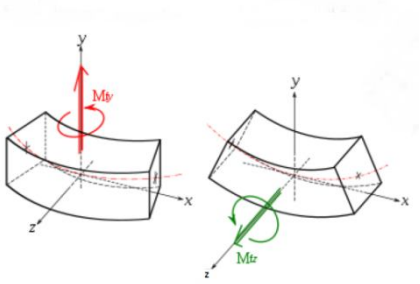

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FIGURE 1: Bending stresses in rod.

1. Torque on the gear by the motor

$$T = \frac{P \times 60}{2 \times \pi \times N}$$

Where,

P- Power (700w)

T- Torque

N- Speed in rpm (90 rpm)

T= 74.27 N-mm

2. Force required to bend the bar

Bending equation,

$$\frac{M}{I} = \frac{\sigma_b}{y} \qquad (a)$$

Where,

For solid circular shaft,

$$I = \frac{\pi}{64} \times d^4$$

$$y = \frac{d}{2}$$

$$\sigma_b = \frac{SyC}{FOS} = 93.33 N/mm^2,\ SI\ grade\ 20;$$

Syt= 271 N/mm^2, FOS=3

Considering simply supported beam with point load at the centre.

$$M = \frac{W \times L}{4} \qquad (b)$$

But,

Torque supplied by the rotating disc to this shaft,

Where,

L – Centre distance between centres of the shaft

L=105mm

W= 510 N (by using ANSYS software)

Put the value in eq. (b) we get

M= 13.38 KN-mm

a) Diameter of bending bar

Substituting the values in eq. (a) we get

d= 12 mm

3. Torque required to bend the bar

$$T = \frac{\pi}{16} \times d^3 \times \tau$$

Where,

d = 11.34mm

T= 74.27 N-mm

$$74.27 = \frac{\pi}{16} \times 11.34^3 \times \tau$$

$$\tau = 0.21 N/mm^2 < 93.33 N/mm^2$$

III. TESTING

According to above setup, we constructed machine. We tested the machine by supplying power supply. first time, the motor failed, because of need is more than supply. Then second time, the tool breaks due to less hardness. Then we used more hardness metal(high carbon steel) rod. Third time again motor fails. Then we used motor of 3kw power which is capable of bending.

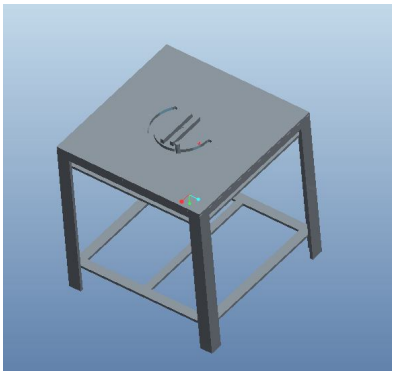

Fig. CAD model re-bar bending machine

IV. RESULT CONCLUSION

1. It saves man hour inputs for data handling, processing and programming the NC Machine.
2. Flexibility in the manufacturing strategy, enabling the batches to be produced by building elements or any other sorting criterion.
3. Enabling just-in-time delivery due to the elimination of errors and improved communication.
4. It is portable machine as it does not contain any compressor or storage tank.
5. It produces bend up to 8mm diameter.

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