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Design and Fabrication of Pneumatically Operated Bar Bending Machine

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Abstract – *This study is focusing on design and Fabrication of Pneumatically operated Bar Bending Machine. Which is capable of making stirrups used in construction fields by bending FE500 iron rod in square shapes. Now a days in construction sites rod bending for making stirrups are not done by machines due to which it requires more time and human power too. The rod bending machines which are available in market are expensive and typical due to which we need more skilled and trained labourers to operate this machine. Therefore The main objective of our project is to make cheap and reliable rod bending machine or stirrups making machine which is pneumatically operated containing pneumatic cylinder, hoses, pneumatic valve, etc and it can be use in construction sites to make stirrups rapidly and continuously. It is cheap and easy to transport.*

Key Words: Stirrups, Pneumatic operation, Bar bending, pneumatic valve and pneumatic cylinder.

1.INTRODUCTION

The stirrups used in columns and Beams to withstand loads are generally made by using conventional method .As population is increasing rapidly the demand for human livings, flyovers, industries, etc. is increasing this leads to increase in demand of stirrups continuously which cannot be fulfill by using conventional rod bending method. To fulfill this demand we will require continuous work, less human effort and more productivity which is only possible by automation. This project is aimed to do bending operation for stirrups using pneumatic system and named as pneumatically operated Bar bending machine. The main objective is to implement this pneumatic rod bending machine in the construction sites with less cost compared to the existing bending machines, and increasing the productivity of the stirrups. Pneumatic rod bending machine consist of Pneumatic cylinder, Compressor, Hoses, pneumatic valve, Fixtures, etc . The rod is bent by the force exerted by the Pneumatic cylinder piston on the plate with holding the rod in the fixture. The main advantage of our project is the square shape of the Stirrups is bent perfectly. In this project the bending machine is a semi-automatic bending machine, in which the loading and unloading of the component is done manually and the bending of the rod is done pneumatically. This continuous work of the stirrups making machine can increase the productivity and save time, money and effort.

2. LITERATURE

1. Vala Bhargav, Unal Mohmmadaamir, Tank Kishan and Prof. Nikunj Gevariya worked on Design and Analysis of Bar-Bending Machine. Presently, stirrups are made manually, which suffers from many drawbacks like lack of accuracy, low productivity and resulting into severe fatigue in the operator. Bar-bending machine is a semi-automatic type of machine which utilizes less man-power. This reduction in manual work results increased output. The Principle advantages are less time consuming, production of identical stirrups, higher production rate than old traditional method.Our goal is to develop & design a machine to achieve high production rate with less man power & of desired accuracy.

2. Thokale Manoj, Kothwal Satish, Kotkar Rahul, More Suyog and Pawase Mahesh worked on bar bending machine there are few areas like construction, the usage of machines for bending rods for stirrups which are used to withstand loads in beams and columns are not done by machine. In this paper is aimed to do bending operation for stirrups using pneumatic and named as pneumatic rod bending machine By using conventional method it is not possible to reduce construction time and building it as early as possible. So, Automation in construction system is requires.The paper is designed based on the principles of pneumatics and the system is automatic type.

3. R. Sasikala, M. Rakshana, T. Thinaa, P. Thirupponvel worked on bar bending machine using pneumatic system The main intention of this project is to automate the bar bending process using pneumatic system to reduce the cost and enhance the productivity. Conventional Methodologies involve major labour work, layout setup, high cost etc. Existing hydraulic system are cost high enough, so to make cost effective, Pneumatic bar bending system is proposed here. This paper discuss about the

construction and process of pneumatic based bar bending system, also the associated practical implications during implementation.

4. Mr.Pratik K. Channe, Mr. Ajay S. Tiwari, and Mrs. Mrunal worked on Bar bending machine penumatically operated It is primarily designed for bending. The bend has been made with the help of punch which exerts large force on the work clamped on the die. The bending machine is designed in such a way that, it works automatically. The automation strategy, when implemented is believed to result in reduced cycle time, costs and improved product quality. Other possible advantages are repeatability, increased productivity, reduced labor and integration of business systems. Automation is achieved with the help of Electro pneumatic system.

3. SOLID CAD MODEL

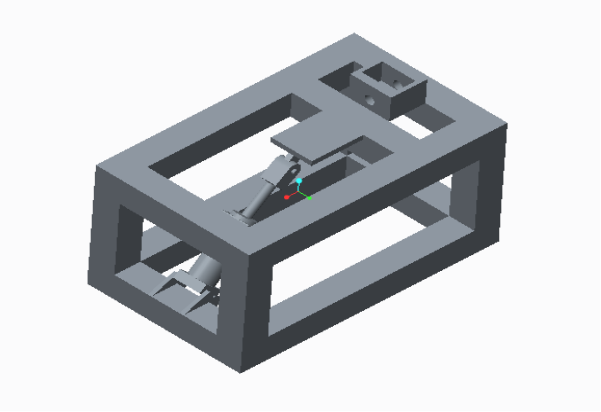

Fig 3. solid cad model

4. DESIGN CALCULATIONS

In this design we need load to bend the TMT rods. The ultimate tensile stress and elongation for the TMT rod are given by the TMT manufactures in Table 1

Table 1: Properties of TMT rod.

Mechanical properties		
property	Minimum value	
	FE 500	FE 500D
Yield stress (N/mm^2)	500	500
Ultimate tensile stress (N/mm^2)	545	585
UTS/YS Ratio	1.08	1.1
%Elongation	12	16

Pneumatic Cylinder is employed to provide the force required for bending the rod to form stirrups.

*Calculating force required to bend the TMT ROD

$$\text{Bending stress} = \sigma_b = \frac{\sigma_{yield}}{FOS} = \frac{585}{2} = 292.5 = 300\ N/mm^2$$

Also, $\sigma_b = \frac{My}{I}$

M = bending moment
y = distance from neutral axis
I = Moment of Inertia
d = Diameter of rod

where, $M = F \times L$

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

$$\text{Moment of Inertia, } I = \frac{\pi d^4}{64} = 490.87 mm^4$$

$$\text{Therefore, } F = \frac{\sigma_b \times I}{y \times L}$$

$$= \frac{300 \times 490.87}{5 \times 70}$$

$$F = 420.74\ N$$

Calculating dimensions required of Pneumatic cylinder

Standard cylinder DSBC ★

- The universal cylinder
- Standard profile with two sensor slots
- Numerous variants

- Diameter: 32, 40, 50, 63, 80, 100, 125 mm
- Stroke length: 1 ... 2800 mm
- Force: 483 ... 7363 N
- Double-acting
- Position sensing
- Fixed/adjustable/self-adjusting cushioning

$$P = \frac{F}{\frac{\pi}{4} d^2}$$

$$0.5 = \frac{421\ N}{\frac{\pi}{4} d^2}$$

Therefore, $D = 32.6\ mm$

Selecting standard cylinder diameter as 50mm for more strength and easy bending action.

5. MAJOR COMPONENTS DETAILS

- **Pneumatic Cylinder**

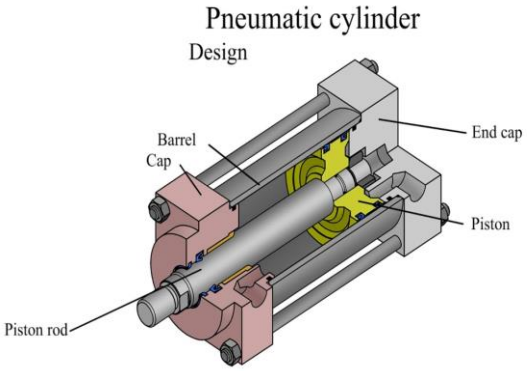

Fig. 5.1 Pneumatic cylinder

Pneumatic cylinders are mechanical devices which use the power of compressed gas to produce a force in a reciprocating linear motion. Like hydraulic cylinders, something forces a piston to move in the desired direction. The piston is a disc or cylinder, and the piston rod transfers the force it develops to the object to be moved. Engineers sometimes prefer to use pneumatics because they are quieter, cleaner, and do not require large amounts of space for fluid storage. Because the operating fluid is a gas, leakage from a pneumatic cylinder will not drip out and contaminate the surroundings, making pneumatics more desirable where cleanliness is a requirement.

In our project a double acting Pneumatic cylinder is used. A double acting cylinder acts in two directions, forward and backwards. The movement of the pneumatic cylinder is controlled by DCV.

- **Pneumatic Valve**

A pneumatic valve is an mechanically operated valve. The valve is controlled by a lever. In the case of a two-port valve the flow is switched on or off; Multiple pneumatics valves can be placed together on a manifold. pneumatic valves are the most frequently used control elements in fluidics. Their tasks are to shut off, release, dose, distribute or mixfluids. They are found in many application areas. it offer fast and safe switching, high reliability, long service life, good medium compatibility of the materials used, low control power and compact design

Fig.5.2
Pneumatic valve

- **Air Compressor**

An air compressor is a device that converts power using an electric motor, diesel or gasoline engine, etc. into potential energy stored in pressurized air i.e., compressed air.

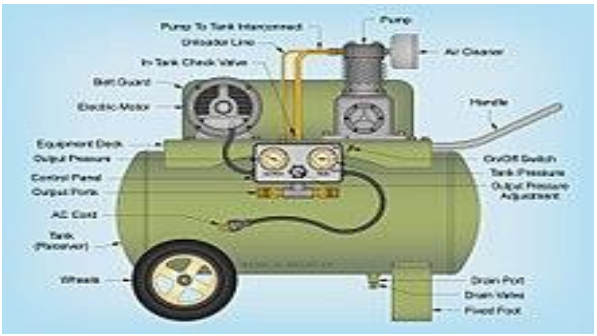

Fig.5.3 Air compressor

6. WORKING

The hardware consists of pneumatic cylinder constructed with steel, pressure gauge, and rod. A rod which is to be bent is taken. The length of the rod is as per requirement. As our project is semi-automatic, human interference is needed. The rod is placed on the pneumatic cylinder machine manually. Pressure is set in the pressure gauge .The pressure can be maintain as per requirement. When the rod is placed, the point where it should be bent is marked on it. With the help of pneumatic cylinder, the force is applied on the rod for bending. When the pressure is applied, the piston pushes the rod to the forward direction of the machine. Due to the pressure applied, the rod will get bent.

7. CONCLUSIONS

This type of bending machine is very useful to small scale bending industries because they can't afford the expensive hydraulic bending machine. In this machine the manually controlled press is converted into automatic machine. So,

we can save maximum operating time and the output will also increase compared to manual. In this project the humans have to only load and unload the TMT bars. It can be also called as semi-automatic type bending machine. This machine can also be converted into fully automatic machine so the loading and unloading will be done automatically.We can achieve many types of shapes by using many types of fixtures in bed. This system is easily handle by any worker. The worker don't have to be someone knowledgeable. Because of it's cheap and simple design this machine can be sell everywhere with ease.

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