

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 8, Issue 6, June 2019

Rod Bending Machine for Varriable Stirrup Sizes

Magbert Fernandes¹, Prescily Morais¹, Devanand Adelkar¹, Branzio Dacosta¹, Aaron Desouza¹,
Dr.H.K. Amarnath²

UG Student, Department of Mechanical Engineering, Don Bosco College of Engineering, Fatorda, Goa, India¹

Professor, Department of Mechanical Engineering, Don Bosco College of Engineering, Fatorda, Goa, India²

ABSTRACT: In construction works, bending of rods is necessary for constructing the pillars. Bending of such rods is done manually by setting angle plates. This wastes lot of labour, power and time. With this project we propose to replace the manual work and reduce time taken for bending by designing an alternative machine to replace the manual work which works by the principle of rack and pinion system. The main objective of our project is to implement the rod bending machine in the construction to make it more precise, more economical and increase the productivity of the stirrups. The rod is bent by the bender which is connected to the gear of the rack and pinion system. The main advantage of our project is the variable size of the Stirrups which are bent continuously without repositioning the rod in the machine.

KEYWORDS: Stirrup, Rack, Pinion.

I. INTRODUCTION

A stirrup is a closed loop of reinforcement bar that is used to hold the main reinforcement bars together in an RCC structure. In a column, the stirrups provide the lateral support to the main bars against buckling. When used in beams, a stirrup is termed as shear or transverse reinforcement since it withstands the shear force. Stirrups can be of various shapes depending on the design and shape of the load bearing member e.g. Circular, polygonal, a U-stirrup or a crosstie. However the most commonly used shape in normal construction is a rectangular or a square one. Traditionally, in India, the stirrups are made manually at the construction site by the bar benders using rudimentary practices. In most cases, such stirrups do not comply with the prescribed standards. Beside dimensional inaccuracies, this can lead to improper locking of the ends thereby increasing the chances of failure during earthquakes. We propose a new idea of manufacturing the stirrup with some automation.

II. LITERATURE REVIEW

VikashPatil shows how they have developed a machine to bend a pipe of Aluminium and copper. They have used the compressed air to perform the bending operation. This makes the machine or the process much more efficient over the manual operated bending machine.

P. Sureshkumar designed Hydraulic Rod Bending Machine based on the principle of Hydraulic system. The hydraulic load has more power compare to the other type of loads like pneumatic and electric. By using heavy loads we can increase the productivity of the product.

This is a paper on sheet Metal bending Machine by Aniruddha Kulkarni. The paper deals with manufacturing or bending of sheet metal by using power operated sheet bending machine. Especially discussion made the productivity analysis of manually or power operated sheet bending machine.

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 8, Issue 6, June 2019

This paper on the design and fabrication of multi-rod bending machine is by M.R.Thansekhar. The rod to be bent is cut to proper dimensions and then placed along the outer surface of the die with its projecting side perpendicular to the left side cylinder.

III. CORE COMPONENTS OF MACHINE

Rack and Pinion Gear

A rack and pinion is a type of linear actuator that comprises a circular gear (the pinion) engaging a linear gear (the rack), which operate to translate rotational motion into linear motion. Driving the pinion into rotation causes the rack to be driven linearly. Driving the rack linearly will cause the pinion to be driven into a rotation.



Pneumatic Cylinder

Pneumatic cylinders are mechanical devices which produce force, often in combination with movement, and are powered by compressed gas. To perform their function, pneumatic cylinders impart a force by converting the potential energy of compressed gas into kinetic energy. This is achieved by the compressed gas being able to expand, without external energy input, which itself occurs due to the pressure gradient established by the compressed gas being at a greater pressure than the atmospheric pressure. This air expansion forces a piston to move in the desired direction.



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. By one of several methods, an air compressor forces more and more air into a storage tank, increasing the pressure. When tank pressure reaches its upper limit the air compressor shuts off. The compressed air, then, is held in the tank until called into use. The energy contained in the compressed air can be used for a variety of applications, utilizing the kinetic energy of the air as it is released and the tank depressurizes. When tank pressure reaches its lower limit, the air compressor turns on again and re-pressurizes the tank.



Solenoid Valve

A solenoid valve is a type of electronic mechanical device which is used for controlling liquid or gas flow. An electrical current administers the solenoid valve that is flowed through a coil. When the coil gets energized, a magnetic

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

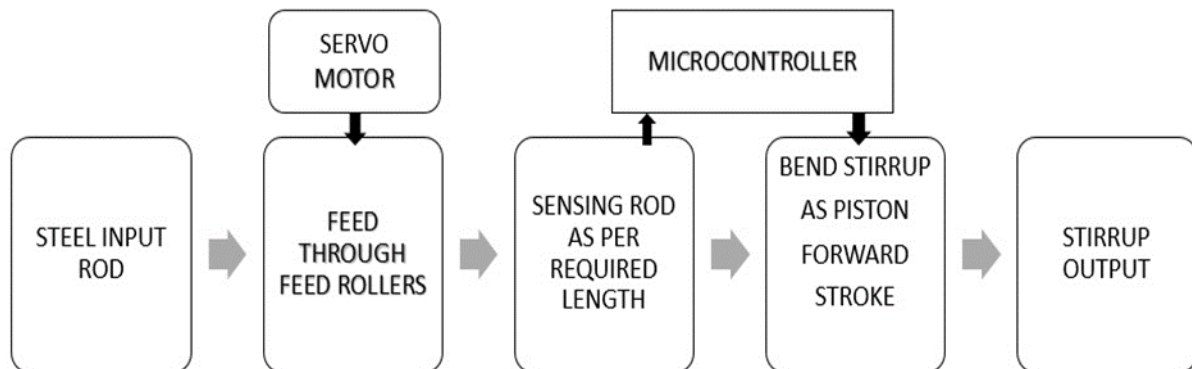
Vol. 8, Issue 6, June 2019

field is made, creating a plunger inside the coil to have motion. Based on the design of the valve, the plunger will either open the solenoid valve or close the valve. In the coil if the electric current is detached, the valve will go back to its non-energized state. These valves are used in the fluid operation pneumatic and hydraulic systems, to manage cylinders, fluid operation motors or huger industrial valves. Automated irrigation sprinkler systems also use these valves with an automatic controller. Residential washing machines and dishwashers utilize solenoid valves to control water input into the machine. They are also very much used in paintball gun triggers. Solenoid valves are mostly called simply as "solenoids."



IV. CONCEPTUALIZATION AND MODELLING

The rod is inputted in the mechanism which feeds with the help of the feed roller which is operated by the servo motor. The servo motor creates a backward and forward motion. With the utilization of proximity sensors and arduino microcontroller, the pneumatic piston is made to move forward and backward. From this operation the rod is bent into the shape of a rectangular stirrup. The proximity sensors are sensors that are used to detect objects which are nearby without having any physical interactions. therefore when the rod is inserted, the proximity sensor senses the rod and the signal is sent to the micro-controller which commands the feed rollers to start and advance the rod and the rod is bent to the pre-programmed dimensions and then cut by the cutter.



Electrical Circuit Schematic Diagram

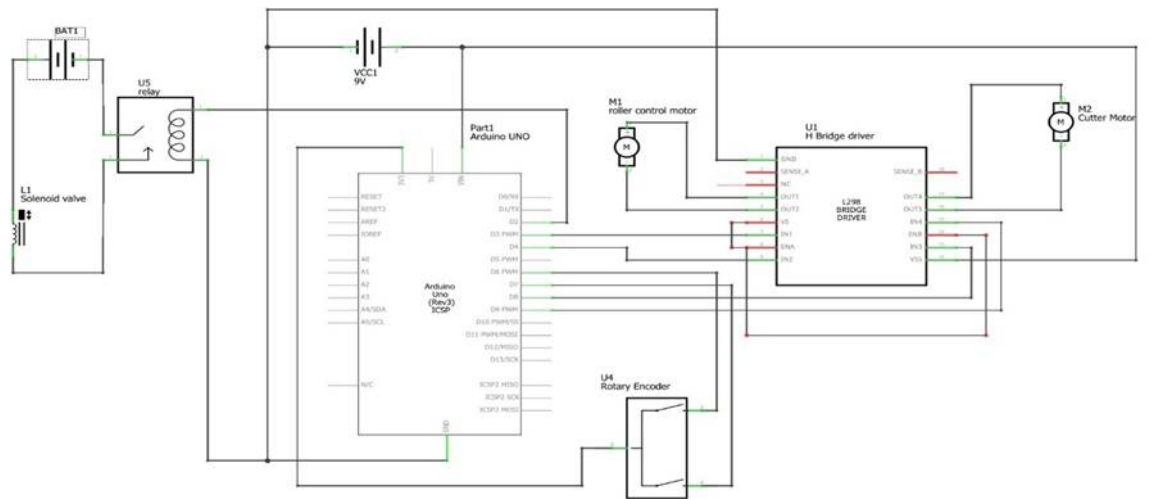
The Arduino microcontroller is connected to the roller motor, the cutter motor and the solenoid valve. It relays information sent to it from the encoder sensor and accordingly operates the feed rollers, the solenoid valve and the cutter motor to perform the Rod Bending Action and Cutting to form a stirrup.

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

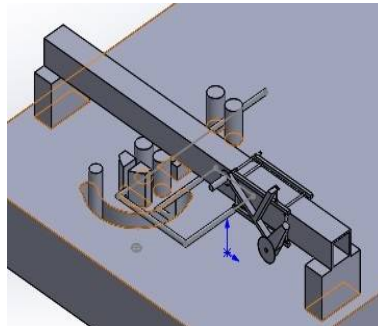
Visit: www.ijirset.com

Vol. 8, Issue 6, June 2019

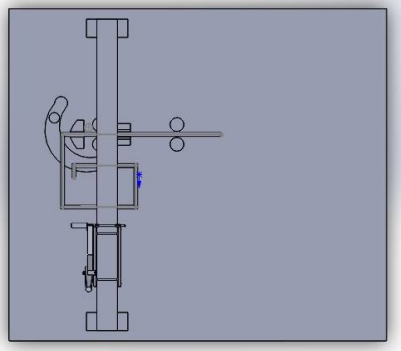


3D Cad Models

- a) Isometric View: In this view the cutter can be seen moving towards to cut the newly formed stirrup.



- b) Top View: In this view the bend of the rod can be seen and the shape of the stirrup.



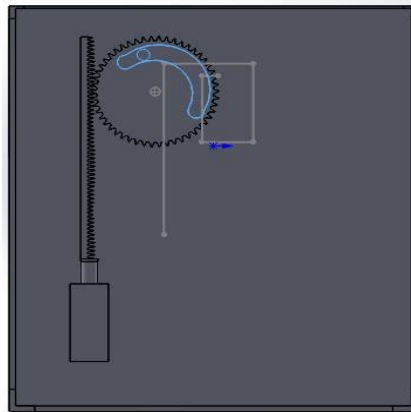
International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 8, Issue 6, June 2019

- c) Bottom View: In this view the setting of the rack and pinion system can be seen along with the Pneumatic cylinder.



V. CALCULATIONS

To calculate the force required to bend : 8mm rod used is of Tata Tiscon, with yield strength of 700N/mm²

$$\sigma_{\text{yield}} = 678 \text{ N/mm}^2 = 700 \text{ N/mm}^2$$

$$\sigma_{\text{ultimate}} = 722 \text{ N/mm}^2$$

$$\sigma_b = (M_b) * (y/I)$$

Where

M_b = Bending Moment

σ_b = Bending Stress (n/m²)

I = Moment of Inertia (mm⁴)

y = distance from neutral axis (mm)

$$M = F \times L = (F \times 80) \text{ N-mm}$$

Where

F = force

L = Fixed Length

$$I = (\pi / 64) * d^4 = (\pi / 64) * 8^4 = (\pi / 64) * 84 = 201.06 \text{ mm}^4$$

$$\sigma_b = (M_b) \times (y/I)$$

$$700 = (F \times 80 \times 4) / (201.6)$$

$$F = 440 \text{ N}$$

Case 1 for 2 rods: $F \times 2 = 440 \times 2 = 880 \text{ N}$

Case 2 for 3 rods: $F \times 3 = 440 \times 3 = 1320 \text{ N}$

Torque required to bend the rod

$$T = F_b \times L$$

Since there is space restriction L is fixed and since we know the bending force required we can calculate torque.

$$T = F_b \times L$$

$$= 440 \times 80$$

$$= 35.2 \text{ Nm}$$

The above torque required to bend the rod is achieved by the action of the pneumatic cylinder which is controlled by the solenoid valve.

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 8, Issue 6, June 2019

VI. CONCLUSION

The manually controlled rod bending mechanism is converted into semi-automatic machine by which maximum operating time will be salvaged. Therefore the efficiency will be more. In this project the human intervention is for loading and unloading the rod. To conclude, this project is made keeping in mind that any manually operated machine can be converted to programmable machines by using gear, pneumatic, electrical and electronic devices. To achieve this aim one should have the adequate knowledge on how to utilize the devices. Thereby enabling the existing old machines to be modified and made automatic by which the initial cost, to purchase new automatic machines may be minimized.

REFERENCES

- [1] V.B.Bhandari (2012) "Design of Machine Elements" McGraw Hill, ISBN 978-0-07-068179-8
- [2] Er.R.K.Rajput (2006) "Strength of Materials" S.Chand, ISBN 81-219-2594-0
- [3] .Dr.R.K.Bansal (2010) "Fluid Mechanics and Hydraulic Machines" Laxmi Publications, ISBN 978-81-318-0815-3
- [4] PSG College of Technology "PSG Design Data Book"(2012)
- [5] www.sciencedirect.com .
- [6] <https://www.slideshare.net/purneshaloni5/theory-of-bending> .
- [7] <https://globalgarage.org/wiper-motor-repair-tips/>.
- [8] <https://www.pneumatictips.com/where-use-pneumatic-hose-tubing/> .
- [9] <http://encoder.com/applications/> .
- [10] <https://www.slideshare.net/purneshaloni5/theory-of-bending> .
- [11] Aniruddha Kulkarni, Mangesh Pawar, Pravin Yadav, Amit Patil, Sohan Jagtap, "Sheet Metal Bending Machine", International Journal Of Innovations In Engineering Research And Technology, Volume 2, Issue 3, ISSN: 2394-3696 March.-2015.
- [12] I.Muhammed Hanoofa , S.Ravi Vishwantha , P.Sureshkumara , N.Saravananb, "Design and Fabrication of Hydraulic Rod Bending Machine", International Journal of Innovative Research in Science, Engineering and Technology, Volume 3 , Special Issue 2 , April 2014, ISSN (Online) : 2319 – 8753, ISSN (Print) : 2347 - 6710
- [13] C. Anbumeenakshi , M.R.Thansekhar, Thanamani.M, Santhoshkumar.R , Parivallal.S, Senthilkumar.K, "Design And Fabrication Of Multirod Bending Machine", International Journal Of Current Engineering And Scientific Research (IJCESR), ISSN (PRINT): 2393-8374, (ONLINE): 2394-0697, Volume-5, Issue-1, 2018
- [14] <http://encoder.com/applications/> .
- [15] <https://www.pololu.com/product/2191> .