DESIGN AND FABRICATION OF MULTIROD BENDING MACHINE

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Abstract

Nowadays for 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 (man) power and time. It is proposed 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 hydraulic system and indexing mechanism. This will reduce the time taken for bending operation and more than one rod can be bent at a same time. Bending can be done with required dimensions and accuracy is maintained during the entire operation. By changing the dimensions of the die required bents are made on the rods. Along with the ease of operation use of hydraulics also makes it more precise, economical and compact. The entire machine is easily portable and having nice aesthetics as well.

Keywords: hydraulic system, indexing mechanism, bending operation

1.0 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. The earliest manifestation of the stirrup was a toe loop that held the big toe and was used in India late in the second century BC, though may have appeared as early as 500 BC. This ancient foot support consisted of a looped rope for the big toe which was at the bottom of a saddle made of fiber or leather. RCC column is a structural member of RCC frame structured building. It's a vertical member which transfers loads from slab and beam directly to subsequent soil. A whole building stands on columns. Most of the building failure happens due to column failure. And most of the column failure happens not for design fault but for the poor construction practice. So, it is very important to know the construction process of the RCC column properly .Constructing RCC Column involves following four stages of works are Column layout work, Column reinforcement work , Column formwork and Pouring concrete into column. In this stage of works the location of columns are determined practically in field. It is done by laying rope according to grids shown in the drawing and then mark the location of columns related to rope. In drawing, column locations are shown related to grid-line with dimension. Practically, in field, ropes are our grid-line. So we place columns related to rope-line by measuring dimension shown in the drawing. After marking the column locations, we then start to place reinforcement as instructed in the structural drawing. In building, floor height is normally kept 10 feet. If the slab has beam then we have to pour concrete up to beam bottom level.

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. Stirrups of inferior quality act like "weak-links" in a RCC structure and can enhance the chances of collapse of a building under adverse conditions.

In this it is proposed a new idea of manufacturing the machine with automation and sophistication as well as safety precautions.

2.0 Construction of multi rod bending machine

The multi rod bending machine is an electro-hydraulic unit, where the electrical power supply makes the motor to run and the hydraulic power pack provides the necessary force that is required to bend the rods. The base of our system is formed by a strong rectangular frame made of iron plates welded together at the joints. The frame has four supporting legs with a side support to hold the hydraulic reservoir. The frame bears the loads acting during the bending operation which are produced by the cylinder motions (forward and return stroke). There are two double acting hydraulic cylinders residing on the top of the frame. One of the cylinders carries a roller which helps in applying force on the rod while bending. Another cylinder carries a lock nut by which the indexing plate is rotated to allow free rotation of the die during bending of the rod at different edges. The cylinder from which force applied for bending is fixed to the frame by welded joints and the other cylinder is free to move over the frame having one end pinned to frame. Followed by the cylinder the bending assembly comprising the base plate, index plate and the die are placed one over other in front of the cylinders. The base plate is attached to the frame through a centre shaft and welds. It carries the index plate and the die. The index plate is placed over the base plate and it is free to rotate about its centre with the help of the centre shaft. The index plate is designed with grooved edges which make it to perfectly lock the locking nut attached to the cylinder.

Figure 1: Multirod bending machine

The rotation of the index plate is arrested during bending with the help of a locking system fitted to the bottom of the frame. The die is placed over the index plate and hold firmly to it by centre shaft and locking pins. The die is not allowed to rotate independently; it rotates along with the index plate. The locking system is simple spring actuated mechanism having a long rectangular plate one end placed over a rod welded to the reservoir top surface; the other end is connected to the springs. The springs are attached to cylindrical pins that projects into the die through the holes drilled inside the die surface. By pressing the long plate that acts as a handle the pins are retracted and lifted respectively. In order to actuate the cylinders a hydraulic reservoir is placed along the side support of the frame. The rectangular sump contains the oil necessary for hydraulic operation. The reservoir along with the motor,

pump, filter and direction control valve is collectively known as the hydraulic power pack. The oil flow from the tank to the actuators is through the hydraulic hoses and regulated by the direction control valve. During the bending operation the rods are prevented from back track by using a key. The key is a three plate welded closing lid type structure which locks the rod in between the gap provided.

5.2 WORKING PRINCIPLE

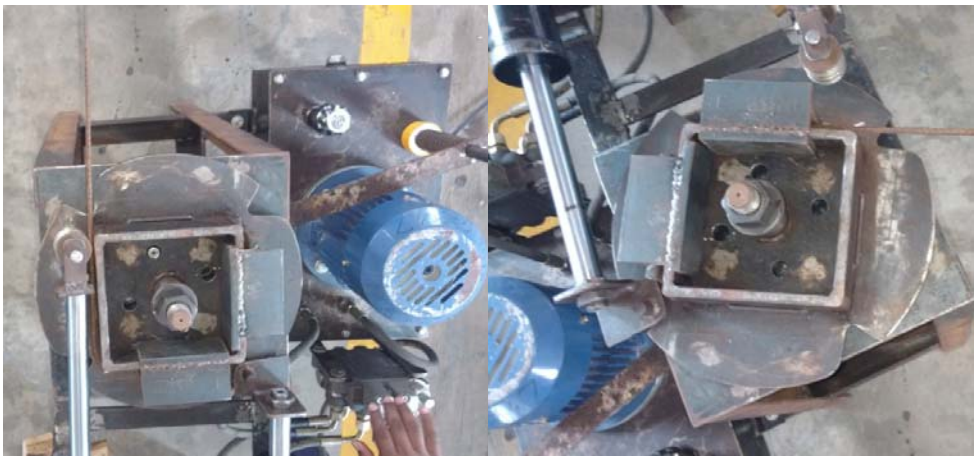

FIGURE 2 Piston and Die arrangement

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. The rods are locked using the locking key before start of the operation. The power supply is on and the motor starts to run, there after the motor is allowed to run for sometime which is to allow proper circulation of hydraulic oil inside the oil reservoir, pump and the direction control valve respectively. While ensuring proper working of the hydraulic power pack the cylinders are also checked by moving the piston (forward and retraction). After completing the preliminary checkups the left side lever of the DCV is pushed front which moves the left side cylinder's piston forward, there by applying some force to the rod in front of it. The rod is bent along the outer surface of the die by the guidance of the grooved roller attached to the front end of the left side piston. After reaching the full forward position the piston is stopped and then retracted slowly along the same path as it is travelled before. Now the die is indexed to its next edge by actuating the right side piston. The right side piston carries a locking plate along with a pin. The locking pin engages with the curved profile of the indexing plate making the die and the index plate to rotate during the forward motion of the right side piston. The piston motion is arrested when the die has turned completely to its next edge and the retraction of the piston happens. Now we have the same setup as it is in the starting stage of bending, by doing the same procedure the rod is bent along the outer surface of the die and by indexing the die again and again the required shape (square) of the stirrups is obtained. Finally the completed stirrups are taken out form the die for use.

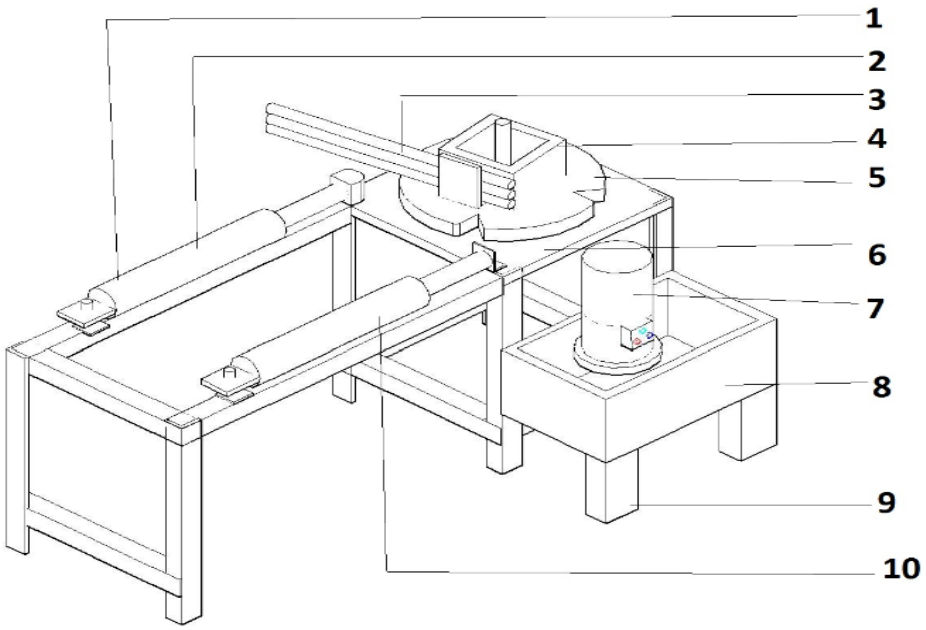

Figure 3: 2 D view of multirod bending machine

Table 1. List of components

SI.No.	Component name	Quantity
1	Bending cylinder	1
2	U bend lock	2
3	Given rod(6mm)	3
4	Required die	1
5	Indexing plate	1
6	Base plate	1
7	Electric motor	1
8	Hydraulic tank	1
9	Frame	1
10	cylinder (Index)	1

5.3 ADVANTAGES AND APPLICATIONS

•Reduction of man power employed.
•Improved output.
•Increased safety.
•Easy handling & movement of machine.
•Easy access to all areas.

5.4 CONCLUSION

With the implementation multirod bending machine the manual usage and cycle time is reduced. This hydraulic and controlling system is totally environmentally friendly and contains no hazardous. They are compact in size and

reliable. For making 20 stirrups without using multirod bending machine the time consumed was about 1 hr and by utilizing multirod bending machine the time consumed was about 15 minutes and hence the time consumption was reduced of about 45 minutes and the productivity was improved.

Before (20 stirrups)
After (20 stirrups)
1Hrs. 15 Min.

Thus multi rod bending machine is used for making stirrups(automatic) with improved output and increased safety.

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