Design, Analysis & Fabrication of Hydraulic Pipe Bending Machine

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***Abstract*— Now a days the world is focusing into automation. Each and every work of human is reduced by a machine, but few areas like construction the usage of machines for bending rods for stirrups which are used to withstand loads in beans and columns are not done by machine because the cost of machine is high and need skilled labors to operate it. In this project is named to do bending operation for stirrups using hydraulic and named as hydraulic rod bending machine. The main objective of our Project is to implement the hydraulic rod bending machine in the construction sites with less cost compared to the existing bending machines, and increasing the productivity of the stirrups. Hydraulic rod bending machine consist of hydraulic cylinder, Hoses, Pulley, Cutting blades, Fixture, Electronic circuits, Switches and wiring. The rod is bent by the hydraulic cylinder piston with holding the rod in the fixture. The main advantage of our project is the square shape of the Stirrups is bent continuously without repositioning the rod in the machine.**

Key words: Hydraulic Cylinder, Hoses, Pulley, Cutting Blades, Fixture, Electronic Circuits, Switches and Wiring.

INTRODUCTION

The project is designed based on the principles of the system is hydraulic type. By usinga hydraulic principle the productivity of the product can be increase. Due to the globalization, it is very much essential for the manufacturer to produce a goods havinghighest possible reliability Metal Bending and Rolling is extensively used in fabricationas an alternative method for casting or forging and as a replacement for a bolted and riveted joint. It is related to human being, it is necessary to design and analysis the jointwith prior attention to safely of its user Bending is a manufacturing process that produces a V-shape, U-shape, or channel shape along a straight axis in ductile materials,most commonly sheet metal. The project is gene based on the principle of Hydraulic system. The hydraulic load has more power compared to the other type of loads like pneumatic and electric By using heavy loads we can increase the productivity of the product. The manual stirrup making process suffers from the many drawbacks. The construction worker not only subject their hands to hours of repetitive motion but also sometimes suffers internal injury to his body organ i'e. disorder carpal tunnel syndrome CTS, slipped dice problem etc.

Bending is a process by which metal can be deformed by plastically deforming the material and changing its shape. The material is stressed beyond the yield strength but below the ultimate tensile strength. The surface area the material does not change much.Bending usually refers to deformation about one axis. In engineering mechanics,bending (also known) as flexure) characterizes the behavior of a slender structural elements subjected to an external load applied perpendicularly to a longitudinal axis ofthe element. The structural element is assumed to be such that at least one of its dimensions is a small fraction, typically 1/10 or less, of the other two When the length is considerably longer than the width and the thickness, the element is called a beam. For example, a closet rod sagging under the weight of clothes on clothes hangers is an example of a beam experiencing bending on the other hand, a shell is a structure of anygeometric form where the Length and the width are of the same order of magnitude butthe thickness of the structure (known as the wall') is considerably smaller. A large diameter, but thin-walled, short tube supported at its ends and loaded laterally is an example of a shell experiencing bending In the absence of a qualifier, the term bending is ambiguous because bending can occur locally in all objects. To make the usage of theterm more precise, engineers refer to the bending of rods, the bending of beam sand thebending of plates, the bending of shells and so on.

Bending is a flexible process by which many different shapes can be produced. Standarddie sets are used to produce a wide variety of shapes. The material is placed on the die and positioned in place with stops and/or

gages. It is held in place with hold-downs. Theupper part of the press the ram with the appropriately shaped punch descends and formsthe v shaped bend.

A beam deforms and stresses develop inside it when a transverse load is applied on it. In the quasi static case, the amount of bending deflection and the stresses that develop are assumed not to change over time. In a horizontal beam supported at the ends and loaded downwards in the middle, the material at the over-side of the beam is compressedwhile the material at the underside is stretched. There are two forms of internal stresses caused by lateral loads:

- Shear stress parallel to the lateral loading plus complementary shear stress on planes perpendicular to the load direction.
- Direct compressive stress in the upper region of the beam, and direct tensile stress in the lower region of the beam.

These last two forces form a couple or moment as they are equal in magnitude and opposite in direction. This bending moment resists the sagging deformationcharacteristic of a beam experiencing bending. The stress distribution in a beam can bepredicted quite accurately even when some simplifying assumptions are used.

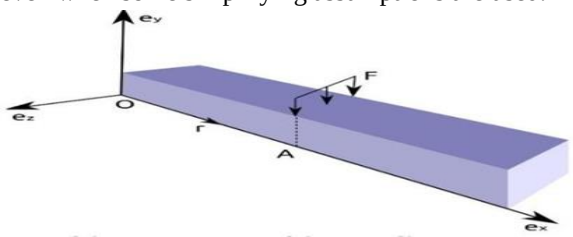


Fig: Bending of Beam

Bending Tools-

In the case of bending tools they are classified by the kind of generated bends. They canbe constructed to adjust the bending angle by reference, stroke measurement or angle measurement. CNC machines usually abstain from a reference part. They grant a high bending accuracy starting with the first work piece. All bends without an extraordinarygeometry belong to standard bends. The distance between a bend and the material end is quite high providing an adequate bearing area. The same with one bend to the next. Typical tools are a so-called bending former combined with a prism with electronic angular measurement or a ordinary prism.

- U Bending: For U-bends where tight and narrow bends are necessary, the bending former is replaced by a bending mandrel. A bending mandrel has a narrow geometry.
- Offset Bending: Offset bending tools are used to assembly two bends with a small distance between in one step.
- Edgewise Bending: Edge bending tools are used, if the bending axis is placed parallel to the tight side of the work piece. Tools for bending on edge may include electronic angular measurement allowing a high bending accuracy
- Torsion Bending: Torsion tools are able to rotate the work piece on thelongitudinal axis. Alternatives are complex assembly groups with standardbends

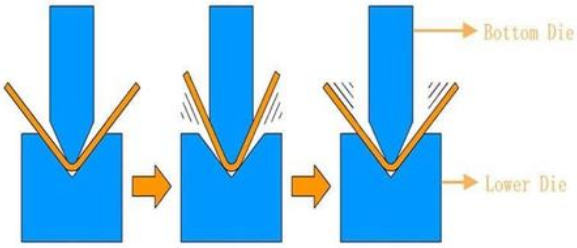


Fig.: Bending Tools

The roller is an agricultural tool used for flattening land or breaking up large clumps of soil. especially after plugging. Typically, rollers are pulled by tractors or, prior to mechanization, a team of animals such as horses or oxen. A Rolling is a machine that isdesigned to roll either tobacco or cannabis into individual cigarettes or joints. To roll a cigarette with cannabis is, one must break up the smoking material as well as remove any stems so they won't puncture the paper Rolling a cigarette with tobacco does not require prep work because the leaf is already shredded. Once the material is ready, oneopens up the rolling machine by sliding one of the rollers up and over, this exposes a channel where the material is loaded. Care must be taken to place a uniform amount ofproduct in the channel or the burn rate will change as the cigarette or joint is smoked. When ready the roller is slid back into position and locks into place. The product is cradled and confined in a round space and gets rolled when the user begins to turn one of the rollers.

PROBLEM STATEMENT

In this project we worked on bar bending by using hydraulic system. This idea comes out as bending of bars and pipes in the industries are the prime requirements. After implementing this idea the prime requirements of industries can be fulfilled satisfactorily. The main concept is that the bar and pipes are bent on by using

hydraulicsystem. It is similar in working like hydraulic jack but instead of lifting we are using that hydraulic energy for bending of bar. This system is very easy to design and fabricate. We began to the project by first attempting to come up with an original idea to fit the problem. After coming up with an idea, we looked to make it simple and less complicated. We followed the various design process to finalize our project. It can significantly impact on the industry requirement of least costly product.

OBJECTIVE

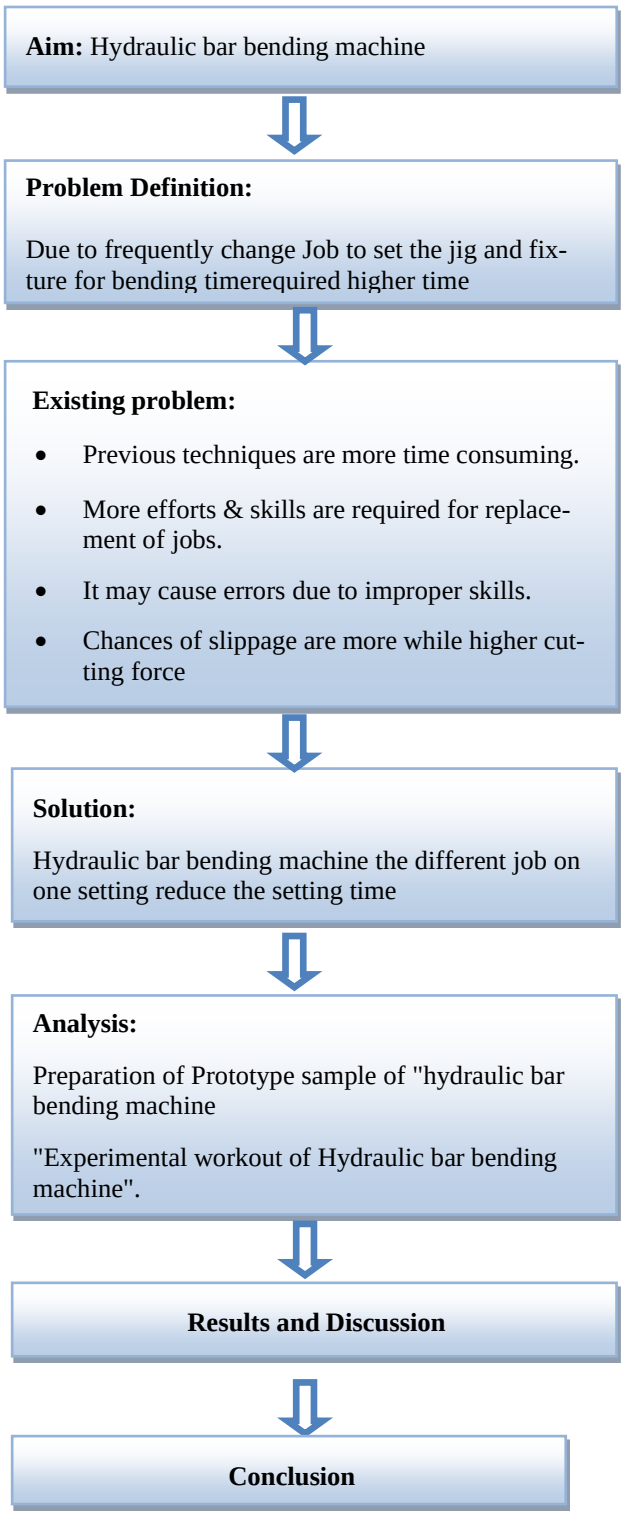
- To make a bending machine to bend metal sheets up to 20 mm.
- Modelling and Simulation of "hydraulic bar bending machine".
- Preparation of Prototype sample of "hydraulic bar bending machine".
- Experimental workout of "hydraulic bar bending machine".

SCOPE

Earlier the methods used for bending of the beams and pipes used were not much usefuland efficient. But by using this project is most suitable for bending of pipes and bar. Here different diameters of pipes can be bent with the ease and effectiveness. The bending of straight reinforcement bars is still mainly done with hand operated machines. Existing hydraulic bending machines are manually operated and requires no power consumption. It also has no maintenance cost and hence it makes cost effective, but when mass production is being carried out its manufacturing lead time and cycle time is very high. This makes it slower and requires some changes Manually operated can be converted into electrically operated or pneumatic operated by using necessary equipment. This makes the device suitable for mass production. This reduces manufacturing lead time and cycle time, but converting manual into automated system requires high initial cost and maintenance cost. It also becomes bulky and complex withthe addition of new components.

This method is useful as it increases the rate of production and finds extensive applications in automobile industries Tubes can also be bent in automatic control. We measure the bends by using venire caliper. In case of flat bend, the mandrel should be advanced. Old age man is always trying to gain more and more luxurious. Man is always trying to develop more and more modified technique with increasing the aesthetic look and economic consideration. Hence there is always more and more scope. But due to some time constraints, and also due to lack of funds, we only have thought and put in the report the following future modifications.

METHODOLOGY



LITERATURE REVIEW

In this section, contribution of different researchers is discussed P.Awachat studied 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 automatic, two-way operation are used in stirrup machine, CNC and manually.

There are various components used in rebar bending machine. Based on survey of existing bending machine and mechanism of sheet material bending processing, the paper researches design mechanism and principle of sheet material bending machine, mainly including design of overall structure, rear stopper and transmission part, and thencarries out calculation and check of bending machine mechanical structure, including workbench intensity and connecting bolt check Sheet material bending machine is one of the most widely used sheet metal cold forming machine, which bends sheet metal tovarious components in different angles by simple general mould under cold condition.

The papers will be helpful present a new concept for rebar bending, which is based on merging the advantages provided by integrating electronic sensors, computer-controlled motors, and data communication with a personal computer.

The project is aimed to do bending operation for stirrups using hydraulics and named ashydraulic rod bending machine. The main objective of our project is to implement the hydraulic rod bending machine in the construction sites with less cost compared to the existing bending machines and increasing the productivity of the stirrups. The researchpresents a new flexible Sending machine and its practical applications. The proposed machine uses a new method. When tubes are fed into the fixed and mobile dies, they arebent by shifting the relative position of the mobile die. The bending radius is controlledby the relative distance and orientation between the mobile die and the tube.

Thokale Manojl et. al (2017)[1] Now days the world is focusing into automation. Eachand every work of human is reduced by a machine, but 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 because the cost of machine is high and need skilled labours to operate it. In this paper is aimed to do bending operation for stirrups using pneumatic and named as pneumatic rod bending machine. The main objective of our paper is to implement the 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, Pulley, cutting blades, Fixture, Electronic circuits, Switches and wiring The rod is bent by the Pneumatic cylinder piston with holding the rod in the fixture. The main advantage of our paper is the square shape of the Stirrups is bent continuously without spositioning the rod in the machine.

D. Zope et. al (2017)[2] Bending machine is used to bend a metal sheet, plate and pipe.The aim of this project is to develop a portable metal bending machine. This machine isused to bend sheets into curve and the other curvature shapes. The size of machine is very small as compared to other machines. And it is convenient for portable work. It is fully made by MS. And it is the easy to be carry and use at any time and any place. It cases human effort and no required skill workers to operate the machine. We are developing manually operated metal bending machine with use of metal shaft, hydraulic bottle jack, pedestal bearing and support (frame) This machine works on simplekinematic system instead of complicated design. This machine can bend up-to 8 mm thick sheet and up-to 2cm diameter of pipe.

Due to its light weight and it is portable so it can be used by small workshop, fabricationshop, small scale industry etc. Bending machine is a common machine in machine shopthat is used to bend a metal. There is no proper small scale bending machine for bendinga pipe. A Metal Bending machine uses roller to bend metal. There are 3 rollers used in bending machine. The common product of metal bending machine is pipe (square andcircular) bending if separate attachment of die is provided, sheet bending During the rollbending process the sheet or plate or pipe is passed through consecutive rollers that gradually apply pressure on pipe. Because of this pressure the change in radius of pipe or sheet occurs.

Vilas Shinde et. al (2016)[3] They worked on Design and Fabrication of Hydraulic Stirrups Making Machine, and they concluded that Since testing the stirrup making machine it is observed that how much time is required to make single piece of stirrup by effective working. The detail description is given as below: Loading and unloading combining clamping the bar to fixture it almost takes only 5 to 6 seconds. Time requiredto forward and backward stroke is about 10 to 11 seconds during which stirrup is madeConsidering machine ergonomics

that is interaction of human operator with machine, it is very easy to operate it because operating switch is provided at suitable place of machine. Again, loading and unloading is not complicated since not very specialized tooling is used it is very simple structure.

Ankit Vyas et. al (2016)[4] The design of pipe bending machine has undergone many changes, development and improvements over a period of time. Bending of pipe plays an important role in many of the industries, instruments, transporting of fluids, etc. Keeping in mind the requirement of bend pipe in various fields we have designed a hydraulic pipe bending machine which can be used at construction sites, small scale industries etc. with less cost compared to the existing bending machines in the market, and it also increases the productivity of the bend pipes. The important parameters to beconsidered in pipe bending are Radius of bend, Angle of bend, Diameter of pipe, and thickness of the pipe. The concept of press bending is used to perform the operation andthe required pressing force is applied with help of single acting hydraulic jack. This typeof pipe bender is used to bend a round pipe of outer diameter within the range of ½ inchto 3 inches, maximum thickness 3 mm and radius of curvature up to 325 mm with maximum 90° bend angle.

studied this available machine from the market

Properties of Hydraulic Pipe & Bar Bending

Sr. No.	Parameters	Values
1.	Material selected as MS	En47
2.	Tensile strength	210 GPA
3.	Yield strength	1158 MPA
4.	Young's modulus(E)	1034 MPA
5.	Poisson ratio	0266
6.	Density	770 kg/mm^2

FINITE ELEMENT ANALYSI OF HYDRAULIC BARBENDING

Finite Element Analysis

Finite element analysis (FEA) has become commonplace in recent years and is now thebasis of a multibillion dollar per year industry. Numerical solutions to even very complicated stress problems can now be obtained routinely using FEA, and the methodis so important that even introductory treatments of Mechanics of Materials such as these modules should outline its principal features. In spite of the great power of FEA, the disadvantages of computer solutions must be kept in mind when using this and similar methods; they do not necessarily reveal how the stresses are influenced by important problem variables such as materials properties and geometrical features, anderrors in input data can produce wildly incorrect results that may be overlooked by the analyst. Perhaps the most important function of theoretical modelling is that of sharpening the designer's intuition; users of finite element codes should plan their strategy toward this end, supplementing the computer simulation with as much closed-form and experimental analysis as possible.

Finite element codes are less complicated than many of the word processing and spreadsheet packages found on modern microcomputers. Nevertheless, they are complex enough that most users do not find it effective to program their own code. A number ofprewritten commercial codes are available, representing a broad price range and compatible with machines from microcomputers to supercomputers 1.

However, users with specialized needs should not necessarily shy away from code development, and may find the code sources available in such texts as that by Zienkiewicz2 to be a useful starting point. Most finite element software is written in FORTRAN, but some newer codes such as felt are in C or other more modern programming languages.

The Purpose of FEA Analytical Solution

Stress analysis for trusses, beams, and other simple structures are carried out based on dramatic

simplification and idealization:- mass concentrated at the centre of gravity- beam simplified as
A line segment (same cross-section)

- Design is based on the calculation results of the idealized structure a large safetyfactor (153) given by experience,

Common FEA Applications

- Mechanical/ Aerospace/Civil Automotive Engineering.
- Structural /Stress Analysis.
- Static/ Dynamic.
- Linear /Nonlinear
- Fluid Flow
- Heat Transfer Electromagnetic.
- Fields Soil Mechanics Acoustics Biomechanics.

Basic step in FEA
Pre-processing:-
The user constructs a model of the part to be analysed in which the geometry is dividedinto a number of discrete sub regions, or "elements," connected at discrete points called"nodes." Certain of these nodes will have fixed displacements, and others will have prescribed Diameters. These models can be extremely time consuming to prepare, and commercial codes vie with one another to have the most user-friendly graphical "preprocessor" to assist in this rather tedious chore. Some of these pre-processors can overlay a mesh on a preexisting CAD file, so that finite element analysis can be done conveniently as part of the computerized drafting-and-design process
Processing:
The data set prepared by the pre-processor is used as input to the finite element code itself, which constructs and solves a system of linear or nonlinear algebraic equations

$$k_{ij}u_j = f_i$$

Where, u and f are the displacements and externally applied forces at the nodal points. The formation of the K matrix is dependent on the type of problem being attacked, andthis module will outline the approach for truss and linear elastic stress analyses, Commercial codes may have very large element libraries, with elements appropriate toa wide range of problem types. One of FEA's principal advantages is that many problem types can be addressed with the same code. merely by specifying the appropriate element types from the library.

Post processing:
In the earlier days of finite element analysis, the user would pore through reams of numbers generated by the code, listing displacements and stresses at discrete positions within the model. It is easy to miss important trends and hot spots this way, and moderncodes use graphical displays to assist in visualizing the results. A typical postprocessordisplay over lay colour contours representing stress levels on the model, showing a full-field picture similar to that of photo elastic experimental results.

Advantages:

- The hydraulic is more efficient in the technical field
- Quick response is achieved
- Simple in construction
- Easy maintenance and repair
- Cost of unit is very less
- No fire hazard problem due to overloading
- Continuous operation is possible without stopping

Disadvantages:

- High torque cannot be obtained
- Load carrying capacity is low

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