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Experimental of Analytical Test with Design and Fabrication of Hydraulic Pipe Bending Machine

S. Santhosh Kumar (PhD scholar) [1], Jayaram Dasari[2]
[1, 2]*Lecturer, Mechanical Engineering Department, St. Joseph College of Engineering and Technology*

Abstract: ***Hydraulic operated equipments are used in various fields. Some of them include lowering and raising of chair hydraulically in in various shops and office, In an automobile hydraulic jack is raised for grease job. Stepping on the brake pedal creates the hydraulic power, which stops the rotation of the four wheelers or two wheelers to stop. In order to bend pipes, rods and bars hydraulic bending machine is the most suitable equipment. It exerts force on the pipe and bends it to the suitable angle depending on the dies used. Actuation of hydraulic jack is simple and easy to maintain .In industries , they use presses and load appliers to bending applications. These are bulky and expensive. Hydraulic bending machine is portable , flexible and less expensive than those which are discussed earlier. Hence it is better to replace conventional machines by hydraulic pipe bending machine. It helps in reducing size, space occupied , cost employed can be minimized. Manually operated bending machine requires no maintenance and power consumption. During mass production it can be converted into automated or electrically operated jack so that the rate of production can be increased. Applications of bending machines are found to be production industries , petroleum , chemical ,automobile etc.***

I. INTRODUCTION

Researchers have decided the design of simple hydraulic bending machine which is affordable small and medium enterprises. This design will be capable of making a bending operation easy and safe where by most of challenge faced by artisan will be solved. By using simple hydraulic bending machine, time consumed by the fabricators for doing bending operation will be less, accurate bending angle will be obtained , number of accident will be reduced but also there will be less loss of man power. Also fabricator will be able to make a complicated shape with the help of this machine. This increase the production capacity of the industry and gradually this will develop economic of the country. The operating procedure of hydraulic pipe bending machine is simple when compared to other pipe bending machine. Biggest improvements were placing the hydraulic cylinder near the die holder. The hydraulic pipe bending press is most bend accuracy due to the less deflection in the table. The die holder is used to hold the die in the proper position.

Therefore the hydraulic bending machine will be one of the most flexible machines on the market , allowing the fabricator or iron worker to shear , punch , bend , scroll and press thousands of different parts.

II. HYDRAULIC PIPE BENDING MACHINE

The Hydraulic pipe bending machine is one of the most flexible machines in the market allowing the fabricator or iron worker to shear, punch ,bend , scroll and pressing. When considering industrial machinery, the hydraulic pipe bending machine is the perfect machine shop tool for the metal fabricator . the hydraulic pipe bending machine fits and any small to medium sized industry when machinery for larger scale production must necessarily make way for machinery with distinctly lower production costs.

III. METHODOLOGY

A. Materials And Methods Of Hydraulic Pipe Bending Machine

Hydraulic jack consist of piston, piston rod , screw rod and hydraulic ol. The hydraulic jack reciprocating handle is move upward and down ward continuously, so that the compressed oil goes to the hydraulic jack piston. The end of the piston rod the moving die is fixed . The compressed oil pushes the hydraulic jack piston forward. Already the pipe to be bended is fixed in between revolving die and moving die. The die is supported by the die holders. By changing the die in the hydraulic pipe bending machine, we have to produced life front shape of bended pipe such as V shape , L shape etc. The ram is strike the pipe forcibly, so the pipe is bended accordingly to the shape of the die in the die holder. The main components in a portable hydraulic pipe bending machine are hydraulic cylinder , ram, oil tank ,plunger pump, release valve lever, handle, die ,die holder ,helical spring and hydraulic drive.

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B. List Of The Materials Of Hydraulic Pipe Bending Machine

Table -1 List of the materials of hydraulic pipe bending machine

SL.NO	NAME OF THE PARTS	MATERIAL	QUANTITY
1	Hydraulic jack	C.I	1
2	Spring	steel	2
3	Oil	Servo 38	250ml
4	Moving die	C.I	1
5	Revolving die	M.S	2
6	Die holder	M.S	2
7	Frame stand	M.S	1
8	Shaft	M.S	2
9	Bush	M.S	2

Materials for construction were selected based on the availability, durability and purchasing costs. This is done with a view to reducing the overall production cost of the machine. Mild steel was used for the construction of the base unit. Metal plates were used for the construction of the housing unit. Hollow shaft was used for the construction of the rollers and circular rod for the pins and die.

IV. PROCEDURE OF DESIGN OF HYDRAULIC PIPE BENDING.

A. Design Consideration

A 5 ton hydraulic jack was selected for the operation of the machine as an accessory selection of close coiled helical spring . A close coiled helical spring of stiffness 2.5 KN/m was also selected as an accessory incorporated to the hydraulic system to return the piston back into the cylinder of the hydraulic jack after each operation.

1) *Frame:* A flat platform is formed on the top of this base structure. On this platform two mounting points are fixed. These mounting points are kept very strong in nature as they have to withstand huge lateral forces during working of the device. Set of combination of two numbers of affix able meshing pulleys of various diameter are fabricated or machined.
   Material used- mild steel.
   Dimension design : four supports
2) *Supporting Pulley:* The peripheral cross area of pulley in pairs in any set is kept same either semicircular or half square depending on the pipe to be bent like circular or square cross section. Other pipes can also be bent but for that special pulleys have to be made.

Material Used : cast iron
Dimension design
Diameter of pulley D: 50mm

$$S: d \times v^2$$

Where , s : shear tress d : density v : velocity

$$V = 3.4\ DN/60$$

Speed of the pulley N = 0.032 rpm
Crown height h = 0.3mm
Pulley width b = 25mm

3) *Hydraulic Jack :* hydraulic jack with semi circular pulley as design is fixed on the frame in between two pulleys and below it by calculating working diatance

a) Capacity of hydraulic jack = 7 tonne
b) Stroke length = 140mm
c) Piston diameter = 40mm
d) Cylinder diameter = 90mm

4) *Springs:* Quick retraction springs are attached to hydraulic jack upper end for easy and fast retraction of jack shaft. Springs should be designated in such way it will not add more pressure or force for upper movement of the hydraulic jack.

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Length (mm)	Width (mm)	Thickness (mm)
40	35	30

V. ANALYTICAL ANALYSIS OF COMPONENTS OF MACHINE

A. Frame Structure

Maximum load per member = 26 x 1000x 9.81/4
= 63765 N
Permissible valiue of stress = 247 Mpa
Factor of safety = 1.5
Thickness of plate = 15mm
Allowable stress = Permissible stress/ Factor of safety
= 247/1.5 = 164Mpa
Required width of frame member = Max load per member/(
allowable stress x thickness)
= 63765/(164 x 12)
=33.6mm

B. Bobbins

Maximum load per member = 26 x 1000x 9.81/2
= 127530 N
Permissible valiue of stress = 247 Mpa
Factor of safety = 2
Material = mild steel
Inner diameter of hole for bobbins = 16mm
Allowable stress =123.5MPa
Generated stress = max.load/ area
$=127530/(3.14 \times 27.5^2 - 8^2)$
=31882.5 N
Material selected = hardened steel bolt.
Permissible stress = 10202.4MPa

C. Bolts

Maximum load =31882 N
Permissible stress = 7848 MPa

D. Welds

For fillet welds in welding design we have to calculate weld shear stress for applied bending moment on rectangular beam
Throat thickness = 0.707 x flange thick
= 0.707 x 5 = 3.54mm
Total maximum laod = 26 x 1000 x 9.81 = 25480N
Normal stress = external applied load/ (throat thickness x length of weld)
254800 /(3.54 x 160) 28.116 MPa
Factor of safety = 98.3/28.116 =3.4962

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VI. DESIGN AND DRAWING

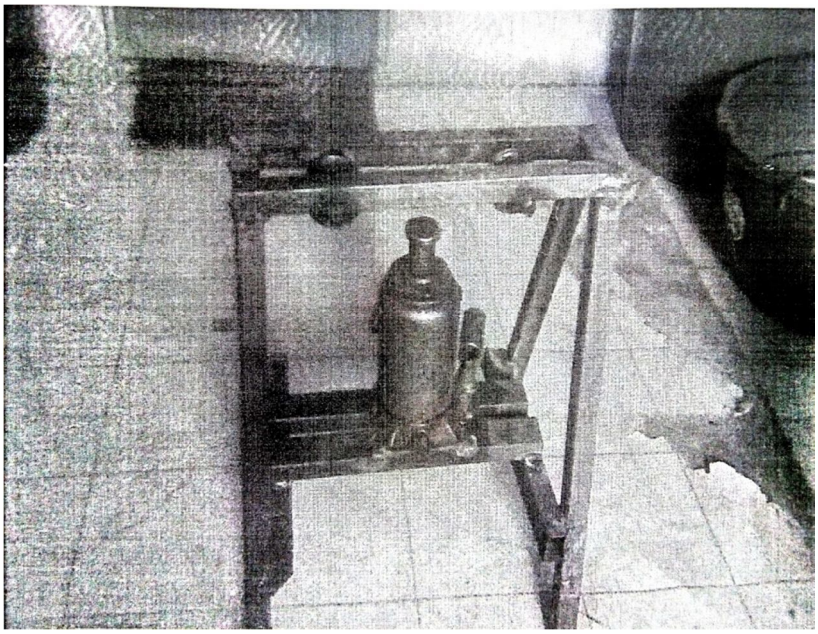


Figure 1. assembly of machine

A. *Machine descriptions*

1) *Frame:* It consists of vertical member (made from 50 x 40x 10 mm angle iron) long horizontal bar (50 x40 x 10 mm) ,short horizontal bar (10 x50 x40 mm) and leg brace (50 x 40 x40 mm) to brace the legs. The holes for fastening of the lower flaps were drilled and the frame was mounted on the ground.
2) *The Housing:* This is made up of the metal plate welded together to form the following. This accommodates the hydraulic jack. A slot is made on the plate to allow the movement of the handle. The dimensions of the housing are length =40mm, breadth = 35mm height = 50mm thickness = 30mm.
3) *The Roller:* The rollers were made up of hollow shaft machined to the required length of 30mm and 24mm diameter. A groove of radius 15mm was also made on each roller to accommodate the pipe to be bent.
4) Pins: The pin were contracted from a circulated rod mof 24mm diamtere and length of 10mm they can be shown below.
5) *Hydraulic Jack:* Hydraulic jack with semi circular pulley is fixed on the frame in between two pulleys and below it by calculating working distance. Provision for adjustment of jack should be there to achieve any type of shapes and curvature.

B. *Observations*

After assembly of the machine is done the first testing of the machine is done on the 1 ¼ inches die with 1 ¼ inches diameter pipe. The profile of the pipe does no squeezes and gets a proper bend. In order to get the deformation of the pipe the bending is done for the maximum angle that can be achieved.

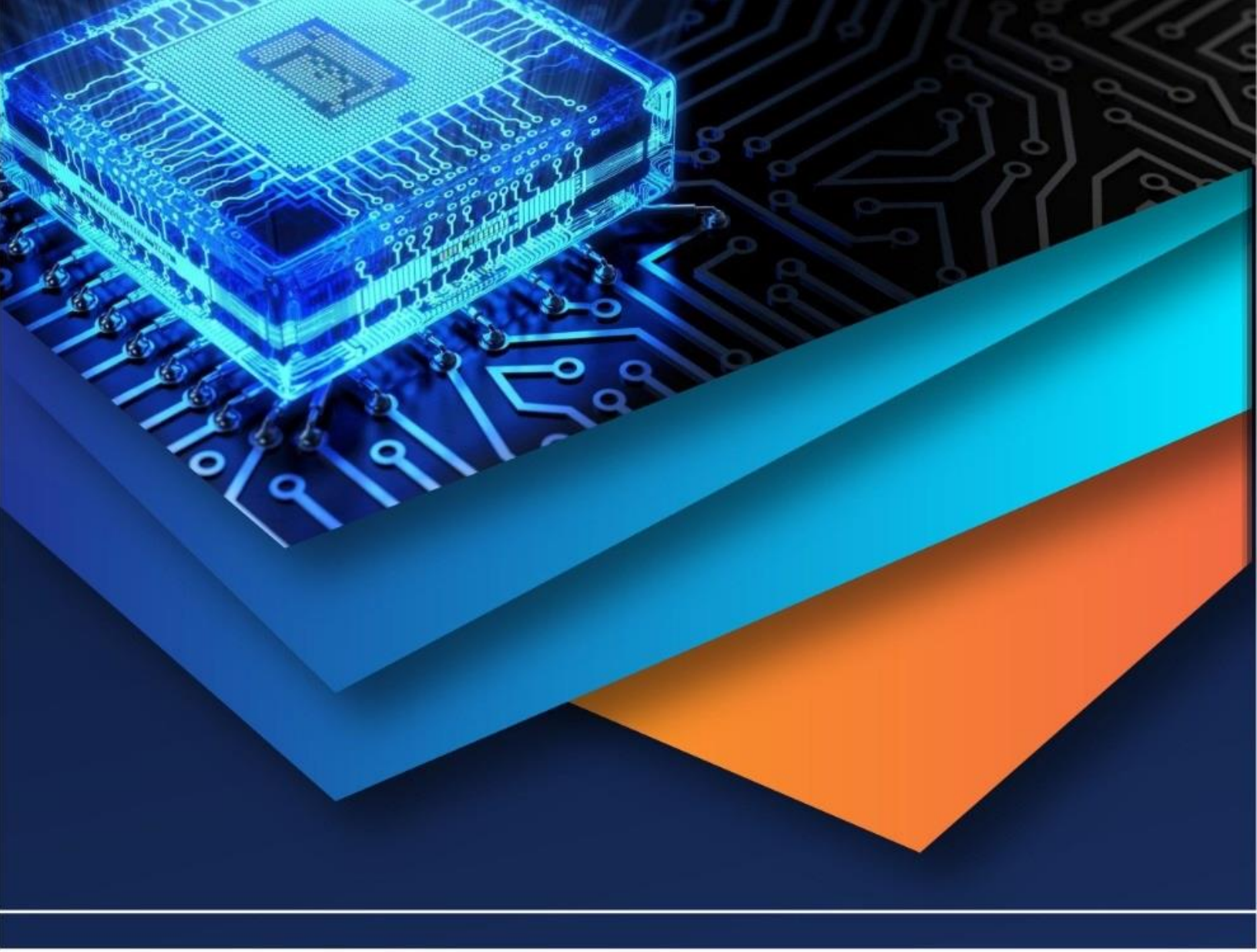
VII. CONCLUSIONS

This work has provided an excellent opportunity and experience to use limited knowledge. It has gained a lot of practical knowledge regarding , planning , purchasing, assembling and machining while doing this project work. The work is a good solution to bridge the gates between institution and industries. The work is completed the work with the limited time successfully.

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