DESIGN AND FABRICATION OF PRESS BRAKE FOR HYDRAULIC BENDING MACHINE EXCEEDING

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Abstract. This project is manually operated and useful for bending metal sheets and plates with help of hydraulic machines. This project consists of different parts such as base plate, vertical plate, two round rods, two bush rods and two springs. All the parts of this project we designed by using the software's Auto-CAD and Cinema 4D. We used various machines which are available in our machine shop to fabricate of the project operations such as material cutting, grinding, welding, drilling, horizontal band saw machine, and center lathe etc., for the successful completion of the work. Main application of this project to bend the any sheet metal up to 8 mm thickness from 0^o to 90^o.This project mainly we can use for industry applications.

Keyword. Auto-CAD, Cinema 4D, Press Brake, Hydraulic Bending machine, Sheet metal;

INTRODUCTION

Sheet metal bending and folding accounts for the production of a wide range of consumer durable goods. The demand of goods that fully or at least partly comprise of bent sheet metal parts promises to remain high. Typical products made from sheet metal folding include enclosures, electric boxes, and casings for electrical and electronic gadgets, trays, lids, troughs, air ducts, and chimneys [1].

Bending is a metal forming process in which a force is applied to a piece of sheet metal causing bending of it to an angle and forming the desired shape . The process is typically performed on a machine called a press brake which can be manually or automatically operated. To bend sheet metal, a bottom tool (die) is mounted on a lower, stationary beam (bed) and a top tool (punch) is mounted on a moving upper beam (ram). The opposite configuration is also possible. Bending produces a V-shape, U-shape, or channel shape along a straight axis in ductile materials, most commonly sheet metal. Commonly used equipment includes box and pan brakes, brake presses, and other specialized machine presses [2].

MATERIALS AND METHODS

PARTS OF THE PRESS BRAKE

The press brake is made up of the following components: the base plate, vertical plate, round rod, moving bush, angle plate, spring and support cylindrical piece (Figure 1).

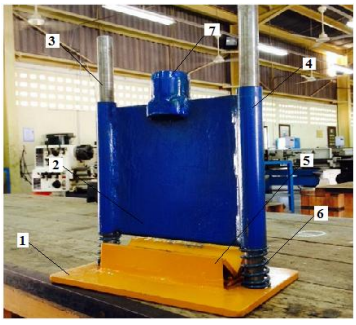

Figure 1: Press brake

S.No	Parts
1	Base plate
2	Vertical plate
3	Round rod
4	Moving bush
5	Angle plate
6	Spring
7	Support cylindrical piece

Table 1.Parts of press brake

DESIGN AND CONSTRUCTION

The design and constructional detail of each of the separate components that make up the press brake is discussed below;

BASE PLATE

This was cut from a mild steel plate of length 333mm, width 220mm and thickness 12mm respectively. This was connected to the angle plate and support cylindrical piece by welding. Figure 2 shows the 2 Dimensional drawing of base plate drawn by using AutoCAD software. Figure 3 shows the 3 Dimensional drawing of base plate by using Cinema 4D software.

Figure 2. 2D drawing of base plate

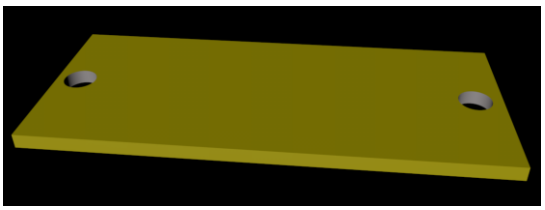

Figure 3. 3D drawing of base plate

VERTICAL PLATE

This was cut from a mild steel plate of length 233mm, width 245mm and thickness 8mm respectively. This was connected to the moving bush by welding. Figure 4 shows the 2 Dimensional drawing of vertical plate drawn by using AutoCAD software. Figure 5 shows the 3 Dimensional drawing of vertical plate by using Cinema 4D software.

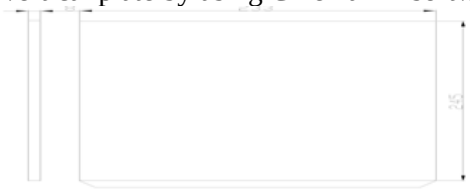

Figure 4. 2D drawing of vertical plate

Figure 5. 3D drawing of vertical plat

ROUND ROD

This was cut from a mild steel rod of length 441mm and diameter 30mm respectively. By using machining on lathe, round rod diameter is reduced to 27.5mm. This was connected to the base plate by using welding. Figure 6 shows the 2 Dimensional drawing of round rod drawn by using AutoCAD software. Figure 7 shows the 3 Dimensional drawing of round rod by using Cinema 4D software.

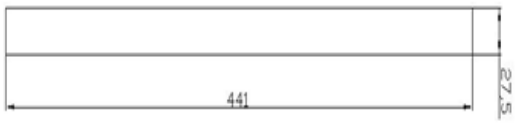

Figure 6. 2D drawing of round rod

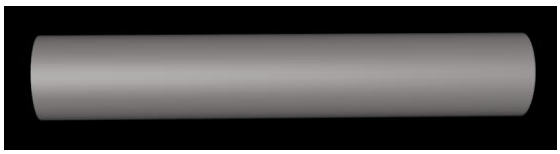

Figure 7. 3D drawing of round rod

MOVING BUSH

This was cut from a mild steel rod of length 250 mm and diameter 40 mm respectively. By using machining on lathe, moving bush outer diameter is reduced to 38mm and made internal hole for

33mm. This was connected to the moving bush by welding. Figure 6 shows the 2 Dimensional drawing of round rod drawn by using AutoCAD software. Figure 7 shows the 3 Dimensional drawing of round rod by using Cinema 4D software.

Figure 6.2D drawing of moving bush

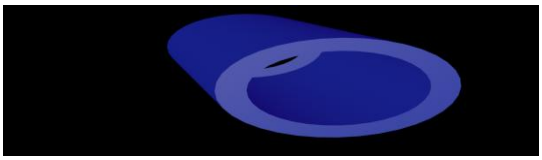

Figure 8.3D drawing of moving bush

ANGLE PLATE

The two plates was cut from a mild steel plate of length 223mm, width 50mm and thickness 10mm respectively. These two plates were connected by welding. These assemble of angle plate connected to base plate by using welding. Figure 9 shows the 2 Dimensional drawing of angle plate drawn by using AutoCAD software. Figure 10 shows the 3 Dimensional drawing of base plate by using Cinema 4D software.

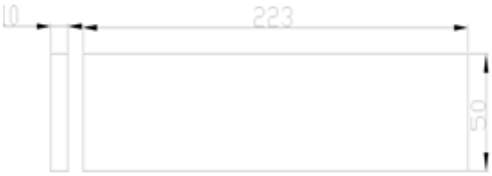

Figure 9.2D drawing of angle plate

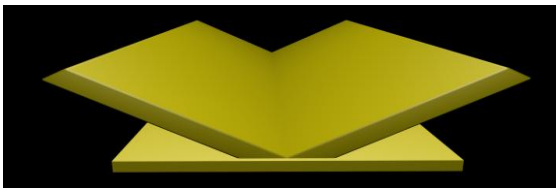

Figure 10.3D drawing of angle plate

SPRING

This was selected from a carbon steel of mean coil diameter of spring is 38mm and free length of spring is 60mm respectively. Figure 11 shows the 3 Dimensional drawing of spring by using Cinema 4D software. All the dimensions of the spring calculated from the design consideration by using formulas.

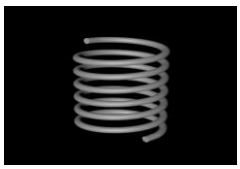

Figure 11.3D drawing of spring

SUPPORT CYLIDRICAL PIECE

This was cut from a mild steel rod of diameter 63mm and length 75mm respectively. By using drilling on lathe, made blind hole of diameter 21mm. This was connected to the vertical plate by using welding. Figure 12 shows the 2 Dimensional drawing of support cylindrical piece drawn by using AutoCAD software. Figure 13 shows the 3 Dimensional drawing of support cylindrical piece by using Cinema 4D software.

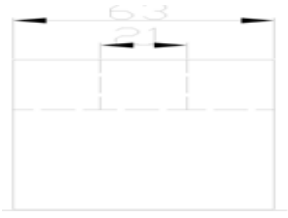

Figure 12. 2D support cylindrical piece

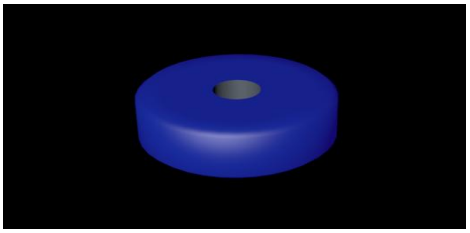

Figure 13. 3D support cylindrical piece

DESIGN CALCULATIONS FOR SPRING

Mean diameter of the spring coil

Wahl's stress factor (K)

$$K = \frac{4C-1}{4C-4} + \frac{0.615}{C}$$

C-Spring Index

Maximum stress induced (τ) on the wire

$$\tau = K \times \frac{8\,W.D}{\pi\, d^3} = K \times \frac{8\,W.C}{\pi\, d^2}$$

W-Maximum load in KN
d- Spring wire diameter

Free length of the spring

$$L = n'.d + \delta + 0.15\,\delta$$

n' -Number of active coils
δ- Deflection of spring

Pitch of the coil

$$= \frac{\text{Free length}}{n' - 1}$$

By using this above formulas we calculated the dimensions of spring [3].

RESULTS AND DISCUSSION

The 5hp electric motor transmits power and rotary movement to the pump pulley, this cause the hydraulic oil from the tank to be sucked via the hose into the pump, the oil passed through the pressure hose into the ram through the valve inlet channel to the upper chamber of the ram thereby building up pressure for pushing down the ram. The ram moved down when the lever on the valve was gently pressed downwards. This requires little effort.

Figure 14. Testing of Press Brake on Hydraulic Bending machine

After the press is completed the lever is pushed up again to return to its position. This caused the hydraulic oil to enter the ram through the lower nozzle thereby pushing the ram up. This upward movement expels the fluid in the upper chamber of the ram back to the tank.

CONCLUSION

The design and development of press brake has been reported. The demonstration showed that the equipment performed well in manually operated hydraulic bending machine. The capacity of the machine is 490 KN. The time required to completely bend the metal plate to 90^o is 4 minutes. The press brake has been designed generally to meet the need of both small scale fabrication workshop and industry. Appropriate design consideration and technicalities have been taken into account to ensure the durability of the machine component.

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