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Design & Fabrication of Roller Bending Machine

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ABSTRACT

Mechanical Engineering without production and manufacturing is meaningless.Production and manufacturing process deals with conversion of raw materials inputsto finished products as per required dimension, specification and efficiently usingrecent technology. The new development and requirements inspired us to think ofnew improvements in manufacturing field.The aim of this project is to develop a roller bending machine which is useful tobend a metal strips in workshop. This project is to design and construct a portable roller bending machine. This machine is used to bend metal strips into curve and theother curvature shapes. The size of machine is very convenient for portable work. Itis fully made by steel. Moreover, it is easy to be carry and use at any time and anyplace. It reduces human effort and also required less skill to operate this machine.We are designing manually operated roller bending machine with use of rollers,Shafts, Bearings and support (frame). The roller bending machine is manuallyoperated. Therefore, our objective is to increase accuracy at low price withoutaffecting the bending productivity. This machine works on simple kinematic systeminstead of complicated design. Due to its portability it can be used by smallworkshop or fabrication shop. Bending machine is a common tool in machine shopthat is used to bend a metal.convenient for movable work.

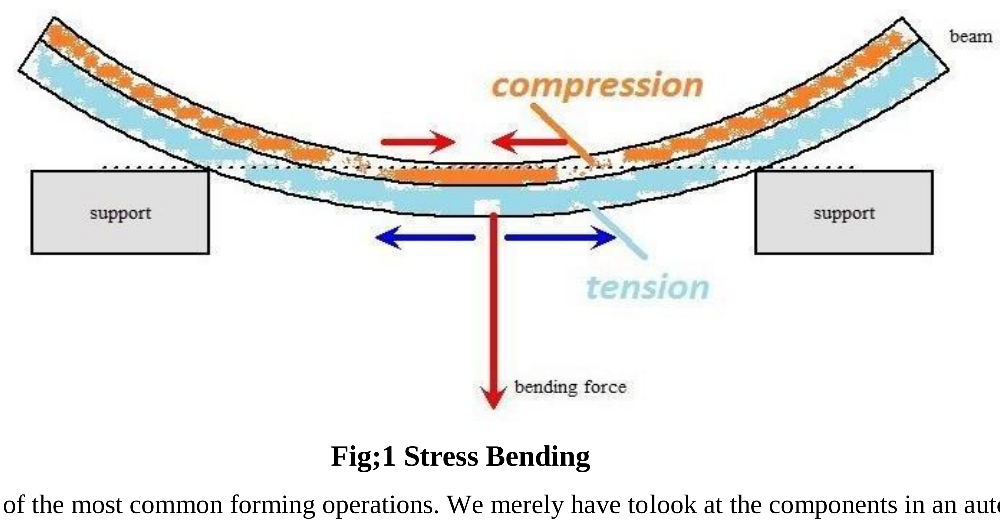
➢ INTRODUCTION

In metalworking, rolling is a metal forming process in which a metal plate is passed through a pair or more rolls. Rolling is a complex process which is determined by the properties of the material being rolled; its thickness being a major factor. The parameters used in designing and fabricating the 3-rolls plate bending machine depends on these properties and the corresponding thickness of the material in use. In this process, the diameter of the metal plate or sheet being rolled does not change after the rolling. That is to say, that the initial and final thickness will be equal. The presence of cracks is also avoided during the course of the process. Thiswas shown in the plastic and elastic deformation process in later stages (Boljanovic, 2004). For the plastic deformation, the plate is expected to be able to retain its thickness after roll bending. Considering the magnitude of stresses that exist during the roll bending process of steel, as well as non-reduction in the thickness of the material, the roll bending process can be analyzed in two ways: i. Bending in the centrally located inner zone, on both sides of the neutral zone, is a domain of elasticplastic deformation, while ii. Bending in the outlying zones (on both the inside and outside of the bend), is a domain of pure plastic deformation. Bending in the actual sense, is a domain of elastic-plastic deformation and can be considered as a

linear stress problem (Carden et al., 2002). In the rolling process, the radius through which the sheet steel is bent must be smaller than the required radius because of the spring back formation (Ahmed et al., 2012). They also show that the amount of spring back depends on several materials and such machine properties as the elasticity modulus, shape of the stress-strain curve, sheet thickness, roller dimensions, and so on.

To study the spring back phenomenon produced on steel sheets, the rolling process is often used. Yang and Shima (1988) discussed the distribution of curvature and calculated bending moment in accordance with the displacement and rotation of rolls by simulating the deformation of a workpiece with a U-shaped crosssection in a three-roller bending process.10 Kim et al (2007) proposed a formulation to determine the bending force on rollers, the driving torque, and the power in the three-roll bending of a thin plate. Analytical solutions of bending process have been presented by several researchers (Kim et al., 2007; Dongjuan et al., 2007; Wagoner and Li, 2007); however, for inverse analysis of springback in free bending process, a state of plain strain and negligible shear deformation is assumed (Behrouzi et al., 2008). Asghari et al (2008), determined the force and power required to drive the three-roller plate bending machine, when it is unloaded with a workpiece and when it is load to roll a maximum of 5mm steel plate. Adsul et al (2013) stated that the factors that should be considered while calculating bending force are material properties, width, thickness, number of passes, bending radius, force developing mechanism and link. The aim of this study is to design and fabricate a motorized 3- rolls plate bending machine to bend a metal plate up to 6mm in thickness and 100mm in width into cylindrical forms.

- **BENDING**



Fig;1 Stress Bending

Bending is one of the most common forming operations. We merely have tolook at the components in an automobile or at a paperclip to see how many partsshaped by bending. Bending is usually defined as the deforming of the sheet metal along the straight line around a straight axis called neutral axis, result in the plane surface at an angle to the original plane. During bending the top layersare subject to compression and the bottom layer are subjected to tension. The width of the part in the outer region is smaller and in the inner region it is largerthan the original width because of the poisson ratio as shown in fig.1.

- **Types of bending operation are classified into**

 U-Die bending
 V-Die bending
 Roll bending
 Bending in the four slide machine
 Curling
 Dimpling
 Flanging
 U-Die bending with spring pad.

➢ Roll bending

A continuous form from of three-point bending is roll bending, where plates,sheet and rolled on each end, one of the support can often be swung clear topermit the removal of closed shapes from the rollsshapes can be bent to adesired curvature on forming rolls. These machines usually have three roll in theof a pyramid, with the two lower rolls being driven and the position of the upperroll being adjustable by a frame.

➢ Types of bending Machines

- **Tube Bending**

The Forming Roller method of tube bending is recommended for all large bends where the Centerline radius is at least 4 times the outside diameter of the tube. It can also be Successfully employed for bending pipe or heavy wall tubing to smaller radiiand is the most Practical method of bending very small diameter tubing.

- **Circle Bending:**

This operation is somewhat involved by the fact that most materials “spring back” after they have been formed. To compensate for this, it is often necessary to use a Radius Collar having a smaller diameter than that of the circle required. Actual size can best be determined by experiment, as the “spring back” varies in different materials. Material should be precut to exact length before forming.

- **Channel Bending –**

The same general bending rules which cover the forming of channel with “flanges out” also apply when it is formed with “flanges in.” Since it is necessary to compress the flanges as they are bent inward, the operation shown below

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requires considerably more bending pressure than when forming with the "flanges out" and it is recommended that the largest possible radius be used to allow for compression of the material. if a sharp 90° bend is desired, it can be obtained by cutting a notch out of the channel flanges before forming around a special Zero.Metal Rolling Machine is classified into two types based on the arrangement ofthe rollers. They are as follows.

- Pinch type machine
- Pyramidal type machine

This machine is of pinch type here only the top roll serves as a driven, bottom roller are idler and rotates on friction with the work metal blank.

➢ INDENTATIONSANDEQUATIONS

Shaftdiameter:

Forgreaterstrength45c8 (steel)iscommonforshafts

$S_y t$=580 N/mm^2

$S_u t$=770N/mm^2

Usingmaximumshearstress theoryof failure:

$$r_{max} = \frac{16}{\pi d^3}\sqrt{(k_m m_b)^2 + k_t m_t}$$

$$m_t = \frac{(60 \times 10^6)p}{2\pi n}$$

$$V=\frac{2\pi n_g r_l}{60}$$

$$N_g = \frac{v60}{2\pi r_l}$$

$$= \frac{0.092 \times 60}{2 \times \pi \times 0.025}$$

= 35 RPM

Forrollerspeed of 35rpm&with 2.69kw

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$$m_t = \left(\frac{60 \times 10^6 \times 2.69}{2 \times \pi \times 35}\right) = 7.33 \times 10^5 \text{N} - \text{mm}$$

$$k_b = 1.5 \quad k_t = 1$$

$$r_{max} = 0.3 s_{yt} = 0.3(580) = 174 \text{N/mm}^2$$

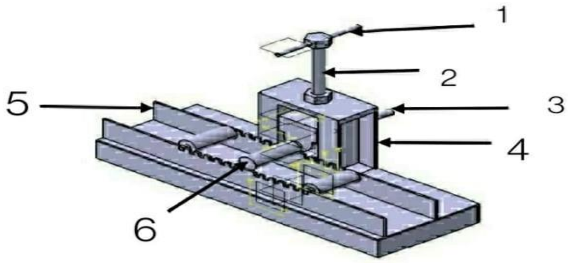
$$\tau_{max} = 0.18 s_{ut} = 0.18(720) = 138.6 \text{N/mm}^2$$

Taking the mini value of 138.6 N/mm^2

$$d^3 = \left(\frac{16}{\pi \times 138.6}\right)\sqrt{(1.5 \times 1942300)^2 + (1 \times 734931.65)^2}$$

d=47.97mm≈50mm

- **FIGURES AND TABLES**



SR.NO	PART NAME
1	Tommybar
2	Height adjusting screw
3	Middle roller driving end
4	vertical support channel
5	Bend adjusting roller
6	Bend adjusting roller

Fig;2 Proposed setup

- **CONCLUSION**

The design and fabrication of a low cost 3-rolls plate bending machine to bend a metal plate up to 6 mm thick mild steel plates has been carried. The major components of the machine designed were: the rolls shaft diameters.

- Time required is less as compared to previous process.
- Less skilled workers can operate this.

- Its Portable and easy to operate.
- It can bend upto 6mm plate easily.
- There will be more productivity as compared to manual one.
- Its more accurate than previous manual method.

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