Design, Modification and Analysis of Sheet Metal Bending on Bending Machine

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Abstract: ***This bending press is used for bending different components which are used in their products that is disc harrow, rotary tillers, reversible hydraulic plough, bund maker, front end loader, cultivator, sub soiler, leveler, ridzer etc. Bending press operates on hydraulic principal. While during the bending operation, there is certain angular deflection occurs in both side of sheet. In an idle condition when work piece is not placed on work table the motion of both the ram is same in downward direction. While the work piece is placed on work table there is certain angular deflection occurs in both side of ram.***

Keywords: Bending Press, Ram, Sheet Metal.

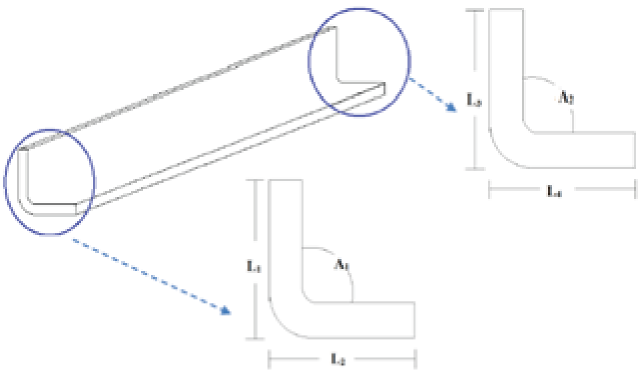
1. Introduction

In the Industry, There is a Hydraulic Bending Press. They were using this bending press for bending operation of different components of the Agricultural implements. But they were facing a problem while performing bending of sheet metal. In Ideal Condition, The Machine Run Properly, But When the Work piece is placed for bending operation, bending error occurs in angular measurements at both the side of plate. To overcome from this situation, we are providing a mechanism to obtain equal amount of bending in angular measurement at both the side of plate.

When bending is done, the residual stresses cause the material to spring back towards its original position, so the sheet must be over-bent to achieve the proper bend angle. The amount of spring back is dependent on the material, and the type of forming. When sheet metal is bent, it stretches in length.

2. Problem Specification

When The Work piece is placed for bending operation, bending error occurs in angular measurements at both the side of plate. To overcome from this situation, we are providing a mechanism to obtain equal amount of bending in angular measurement at both the side of plate.



SR No.	t Thickness (mm)	Bend Angle (Degree)	Spring Back (Degree)	A1 (Degree)	A2 (Degree)	α-Angular Deflection	Avg. Angular Deflection Avg.
1.	5	90°	4	92°	104°	12°	
2.	5	90°	4	94°	105.5°	11.5°	12°
3.	5	90°	4	93.5°	106°	12.5°	
4.	5	90°	4	92.5°	106°	12°	

Subjected to BEND sheet metals having thickness 4-6 mm. Angular deflection of 12 Degree.

3. Design Methodology

3.1 Maximum Bending Force

$$F_{max} = \frac{K * UTS * L * t^2}{W}$$

Where,
K = Constant 1.33
UTS = Ultimate Tensile Strength
L = Length of Plate
T = Thickness of Plate
W = Width of Plate

3.2 Design of Rod

Bending Stress

$$\sigma_b = \frac{M}{Z} = \frac{M\,y}{I}$$

M = F * L
T = F * l
Shear stress

$$\tau = \frac{T * r}{J} = \frac{T\left(\frac{d}{2}\right)}{\frac{\pi}{32} * (d)^4}$$

Maximum Principle Stress

$$\sigma_1 = \frac{\sigma_b}{2} + \sqrt[2]{\left(\frac{\sigma_b}{2}\right)^2 + \tau^2}$$

Minimum principle Stress

$$\sigma_2 = \frac{\sigma_b}{2} - \sqrt[2]{\left(\frac{\sigma_b}{2}\right)^2 + \tau^2}$$

According to Von Mises Theory

$$\sqrt[2]{(\sigma_1^2 - \sigma_1 * \sigma_2 + \sigma_2^2)} = \sigma_{all}$$

3.3 Design of lever

The maximum bending stress acting on lever

$M_L = F * l$

The section module of lever cross section

$$Z = \frac{I_{xx}}{y} = \frac{\frac{1}{12}(T_1 - t)h^3}{(\frac{h}{2})}$$

The maximum bending stress induce in lever

$$\sigma_{bL} = \frac{M_L}{Z}$$

3.4 Design of pin joint

The maximum bending moment

$$M = \frac{P}{2}\left[\frac{t}{2} + \frac{t_1}{3}\right] - \left[\frac{t}{4}\right]$$

The maximum bending stress induce in pin joint

$$\sigma_b = \frac{M\ x}{I_{yy}}$$

3.5 Design of rectangular bar

Tensile stress induce in bar

$$\sigma_t = \frac{P}{h * t}$$

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