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Design & Development of Three Roller Sheet Bending Machine

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Abstract:- Metal forming can be defined as a process in which the desired size and shapes are obtained through plastic deformation of a material without any significance loss of material. Bending is a metal forming process in which straight length is transformed into a curved length. Roller forming is a continuous bending operation in which a long strip of metal is passed through consecutive sets of rollers, until the desired cross sectional profile is obtained.

The roller bending process usually produces larger parts of cylindrical or conical cross sections in large quantity. Normal practice of the roller bending still heavily depends upon the experience and skill of the operator. Trial and Error is a common practice in the industry. Rolling process always began with crucial operation of pre bending both ends of the work piece. This operation eliminates flat spot when rolling a full cylindrical shape and ensures better closure.

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1. INTRODUCTION

Roller bending process can be used to deform a sheet or plate to hollow shapes of constant (i.e. cylindrical, elliptical) or varying cross sections like cone frustum. Cylindrical and conical shells are the basic components used for the various engineering applications like cylindrical tanks, boiler chambers, heat exchanger shells, pressure vessels, tunnels, etc. The process can be performed using many materials such as carbon and alloy steels, aluminium alloys and titanium alloys. Rolling machines with both three and four rolls are indispensible to the production of cylinders with various curvatures. The rolling process is usually performed by a three roll bending machine often called as pyramid type, because of the peculiar arrangement of the three rollers. The entire process of the roll bending may be divided into three steps: namely,

1. Positioning of blank sheet or plate.
2. Lowering of the center roller.
3. Feeding of the plate.

In the very first step, a flat blank sheet is fed into the machine by two rotating side rollers until the sheet is properly positioned. In the second step, center roller is displaced downward causes bending of the sheet. In the final step, two side rollers rotate again, so that the sheet is bent continuously.

The rolling process always began with the crucial operation of pre bending both ends of the sheet. This operation eliminated flat spots when rolling a fall cylindrical shape and ensured better closure of the seam. The success of three roller bending process heavily depends on the experience and skill of the operator.

2. LITERATURE SURVEY

- **M. Hua et al** [1] developed, in the paper, an analytical model to study the mechanics of continuous plate edge bending mode of the four roll bending process, solving governing differential equation for the large deflection of an elastoplastic thin plate with an arbitrary strain hardening law for the material. The effect of material strain hardening on the mechanics is also studied and compared with those for a perfectly plastic material.

- **M. Hua et al**[2] discussed design consideration, working principle and bending mechanisms the four roller bending machine. Generalised procedure of four roller bending machine is also explained.

- **Jong Gye Shin et. al** [3] in the paper, developed a logical procedure to determine the center roller displacement, in the three roll bending process, which is required in the fabrication of curved rectangular plates with a desired curvature. To this end, the mechanics of the process was analyzed by both analytical and finite element approaches. Comparisons of the results reveal that a simple analytical procedure, based on the beam theory, yields a reasonably accurate relationship between the center roller displacement and residual curvature. With further development and refinement, the procedure proposed in this work has great promise for practical application, particularly for the automation of the process.

- **Dr. C. C. Handa et. al** [4] discussed about the productivity analysis of manually and power operated sheet bending machine considering time required to complete one pipe, total expenditure required to manufacture one pipe, number of operators and labors

required during both operations, etc. Limitations of the manually operated sheet bending process over power operated sheet bending machine is also discussed.

- **P.G. Mehar** [5] in his M. Tech Thesis studied the manually operated and power operated sheet bending machine. Experimentations were conducted on sheet in order to measure actual no. of passes, time required to complete bending process etc. Also, productivity of sheet bending process is analyzed in **depth**. Design of various components of power operated sheet bending machine considering various theories of failure in elastic region and values for bending force, power required, spring back radius etc. for different diameters, thicknesses and width of sheet metal has been determined.

3. PROBLEM IDENTIFICATION:

Manufacturing is a field of transferring raw material into finished goods. There are many manufacturing firms that can be found such as automobile factories, bakery factories, electrical factories, etc. Many of the factories produce their products in mass production. So, these factories or companies are competing each other to get their products in the market. Therefore, they must have good manufacturing facilities to improve their productivity. Except this machine is power operated machine so that it requires motor, gear bore, and gearing arrangement. Here motor supplies the power to the gear box. Now this gear box transmits the power to the gears and at last it transmits to the roller. In the process the sheet is insert in between the lower rollers and upper roller than with the help of screw given at both of machine is lowering by revolving with rod. Now this screw roller at the end, and when screw rotates in downward direction then roller is also lowered their position. Now much distance the upper roller should came or the setting of roller is depends upon the thickness & diameter of sheet which is to be bend in the machine. Once the setting of screw is over, operator start the machine, the sheet passes towards the other side of the machine. After the one pass, again the setting of screw is to be done if requires and next pass is again start; it is restricted up to the cylindrical pipe is made. After getting a cylinder pipe, some positions of pipe is welded called tacking. After the welding, the welded position of pipe is passing through the roller. Then this pipe is removed from the machine by removing the base after removing the screw the side body is tilled to the side. Before tilting the body, one rod is inserted in between the upper roller and lower roller, and then the body is tilled and removes the pipes from the machine.

The manual process causes fatigue to labors, lowers the efficiency of labors and there by lowers the working efficiency of sheet bending operation. So the main causes get a desired curve on a 3 roller sheet bending machine, it is generally used by apply force by using a screw jack which is approximate & depends on experimentation and labor skill, so that it is a trail and error method carried out by skilled labor because of this applied force may vary person to person and may get different sizes of the cylinder shells.

3.1 Study Objective of Research

This research pertains literature review reveals that trial and error experience of operator is still a common practice in the industry. Sequential bending on a roller bending machine is widely used in practice but involves very high amount of labour in marking, locating, shifting and inspecting the sheet after each sequential bend. An operator must have knowledge of different machine parameters to obtain cylinders with desired diameter. Overall objective of the research work is

- Modeling and Simulation of sheet Bending Machine.
- Force Analysis of Sheets with Different Materials and Different Thickness.

3.2 Research Methodology

It involve the study of present 3 roller sheet bending machine.. In this we will first identify the mechanical elementwill find out the dimension of the machine component from vidarbha Industry.

Figure 3.1 roller sheet bending machine form vidharbha Industry

1. Productivity analysis of manually operated and power operated sheet bending machine
2. Modeling of metal sheet bending machine.
3. Simulation of sheet metal bending machine with different materials.

4. Forces analysis of metal sheet by analytical method.
5. Bending force analysis of metals sheet during bending operation by software approach .

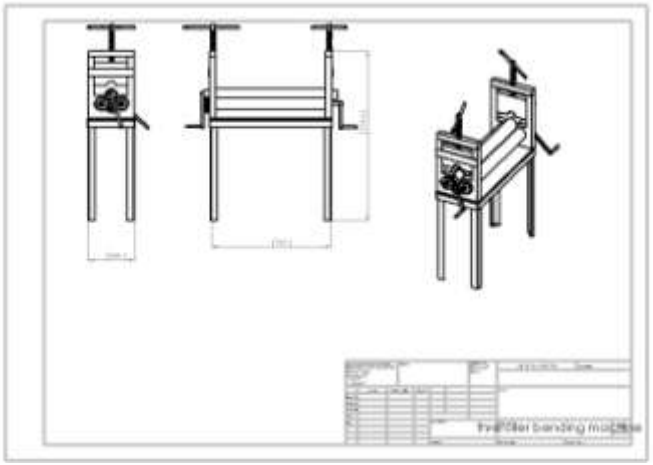
4. MODELLING:

The importance of modeling and simulation in manufacturing technology is increasing due to the need for continuous reduction of development times. This necessitates the optimization of the production processes, the enhancement of product quality and a reduction of costs. The application of numerical modeling is especially resorted to in the development of new production methods and in the use of new materials. Specialized software solutions are available to optimize the design of castings (solidification analysis), welding process (resistance welding, gas metal arc welding), heat treatment and metal forming (sheet metal processing, tube bending, extrusion, rolling, drawing, forging etc).

4.1Steps Of Modeling

4.1 Isometric View of 3 roller sheet bending machine

4.2 Exploded View of 3 roller sheet bending machine



4.3 Orthographic Projection of 3 roller bending machine

5. RESULTS & DISCUSSIONS

After Design of three roller bending machine completed for sheet thickness of 0.8mm to 1.5mm bending of sheet metal.. These results are changing according to the material and according to the loading condition and finally depend upon the thickness of the sheet.

Materials are used for Design of three roller bending machine are as follows

1) Cold rolled sheet metal (CRCA)
2) Hot rolled sheet metal (HR)

Thickness of sheet usedpractically varies from 0.8mm to 1.5 mm. The experimental performed on sheet having dimensions (250 x 400) mm . The power gainedbyupper roller through different gear drive system and this load is applied on the sheet.A sheet passes through between the upper and lower roller the sheet goes bend.This process iscontinue till therequired result is obtained.

The stress induced on the sheet is calculated by the analytically as well as virtually using analysis software. For virtual analysis CAD MODEL is generated in creo parametric 2.0 and converted into iges format .

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