Design and Analysis of Sheet Bending Machine

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Abstract— Bending of plates and sheets are extensively use to produces the parts such as flanges, angles etc. In bending operation a flat sheet metal is formed into a curved by the applying the bending stress. By the help of die and punch sheet get bend plastically without change in thickness. This project is rooted on the urge of Daulat Industries, Nagpur. The aim of the project is to design a sheet bending machine which is capable of bending 5mm thick stainless steel sheets of 8ft wide and 4 ft length in size. In this research we will develop a CAD model of sheet bending machine and optimization of machine using FEA. This paper is majorly based on the literature review, and also contains needs to design, research methodology of the project.

Key words: Sheet Bending Machine, Design and Optimization of Machine

I. INTRODUCTION

Sheet Bending is a manufacturing process that 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 braces, brake presses, and other specialized machine presses. Typical products that are made like this are boxes such as electrical enclosures and rectangular ductwork.

In press brake forming, a workpiece is positioned over the die and the punching tool presses the sheet to form a shape. Usually bending has to overcome both tensile stresses and compressive stresses.

There are three basic types of bending on a press brake, each is defined by the relationship of the end tool position to the thickness of the material. These three are Air Bending, Bottoming and Coining.

\begin{figure}
\centering
\includegraphics[width=0.5\textwidth]{fig1.jpg}
\caption{Simple diagram of sheet bending machine}
\end{figure}

II. LITERATURE REVIEW

AljosalVanisevic, PlavkaSkakun: Bending is one of the most common metal forming technology and it can be applied not only in sheet metal forming but also in forming of wires, rods, strips, pipes and bars. However, in car production, ship building and home appliance manufacturing sheet metal bending is most widely employed. One of the most significant sheet metal bending operations is V – Die bending. This process consists of two phases: air bending and coining. At the end of the operation punch moves to the upper position. After unloading, due to elastic recovery, so called “spring-back” or “spring-forward” phenomena occurs. Current paper elaborates negative spring back (“spring forward”) and stress state in the deformation zone in V – Die bending operations of sheet metal of different thicknesses and different steel materials. Reasons for spring back phenomena have been clarified. Experimental investigation has been carried out as well as the measurement of work piece bend angle after deformation. For stress analysis within the deformation zone numerical simulation was used. For FEM simulation Simufact Forming software was applied. In this paper the concept of the negative spring back and stress state in the deformation zone in V die bending operation of sheet metal of different thickness and materials are explained.[1]

Aniruddha Kulkarni, MangeshPawar, PravinYadav, Amit Patil, SohanJagtap: Sheet metal fabrication plays an important role in the metal manufacturing world. Sheet metal is used in the production of materials ranging from tools, to hinges, automobiles etc. Sheet metal fabrication ranges from deep drawing, stamping, forming, and hydro forming, to high-energy-rate forming (HERF) to create desired shapes. Fascinating and elegant shapes may be folded from a single plane sheet of material without stretching, tearing or cutting, if shape rolling of sheet metal is the bending continually of the piece along a linear axis. This causes alteration of the original form of the sheet as it passes through a pathway of series of rollers. The present invention relates to plate bending machines of the type which operates with rolls. Such machines involve certain well-known difficulties in respect of bending plates into conical shape. The invention has for its object to remedy this drawback and to enable, by including auxiliary means, the bending of conical mantles and the like. In this paper the process of manufacturing or bending of sheet metal by using power operated sheet bending machine is given. Discussion about the productivity analysis of manually or power operated sheet bending machine is done. It also gives information about limitation of manually operated sheet bending machine and power operated sheet bending machine.[2]

Mr. Nitin P. Padghan, Mr. Prafulla D. Deshpande, Dr. C. N. Sakhale: 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, aluminum alloys and titanium alloys. Rolling machines with both three and four rolls are indispensable 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,
- Positioning of blank sheet or plate.
- Lowering of the center roller.
- Feeding of the plate.

In this paper Force Analysis of metal sheet in bending operation of sheet bending machine is explained. It explains to analyse the force and power for motor the designer takes the help of analysis software.[3]

Gwangwava, Mugwagwa and Ngoma: A sheet folding machine that can be operated through hydraulics by two hydraulic cylinders or manually (with the cylinders disengaged) was designed. The design need emanated from the strained national electrical grid system that has recently seen industrialists and households in Zimbabwe experiencing major power cuts. The machine enables manufacturers to schedule heavier jobs during periods when power supply is up and lighter jobs during power cut periods hence run their workshops throughout the daily production shifts. The two hydraulic cylinders can be disengaged from the machine’s folding beam so that manual operation can be done through a manual clamping lever system. The folding force at full capacity is 294.6 KN (29.46 Ton), total bending length of 1.8 m and working height of 1 m. The folding force decreases significantly in manual operating mode to 500 N, considering that on average an operate can manually exert that force. A student version of Simulation X 3.5 was used to simulate the hydraulic operation of the machine.[4]

Qiulei Du and Lin Jin: In the mid 80’s AMADA developed F/NE/BENDER precise downside-action bending machine, which adopts parallel pressurized series to make top and bottom beams deform uniformly under different load and bending length, and uses two or three sets of rollers to guide and improve partial load resistance. As the world’s largest forging machine company, for more than 20 years, AMADA has been committed to developing and producing of downside-action bending machine, developed dedicated 5-axis robot and built sheet metal bending flexible manufacturing cell. The British company, Press & Shear, always manufactured upside-action bending machine, but developed E/GaForm downside-action bending machine series in 1991. All of the above show that downside-action bending machine has very strong vitality and a big market, and it will coexist with upside-action bending machine for a long time in the future. However, downside-action bending machine has its limitations. It is generally believed that downside-action bending machine is appropriate for the situation where pressure is lower than 1200 KN, working length is less than 3200 mm and stroke is short. In this paper Force Analysis of metal sheet in bending operation of sheet bending machine is explained. It explains to analyses the force and power for motor the designer takes the help of analysis software.[5]

III. NEED OF DESIGNING THE SHEARING MACHINE

- The DAULAT INDUSTRIES was revealed that there is a requirement for sheet bending machine to bend 5 mm thick sheets of stainless steel (ss).

- There are various bending machine available in the market to perform this task. But the Deputy General Manager at Daulat Industries is insisting to design and fabricate the machine in house.

- After having a detailed conversation with the general manager it was decided that the designing and optimizing part of the sheet bending machine would be done on this project.

- In this project, the design and optimization of a sheet bending machine which is capable of bending 5 mm thick stainless steel sheets will be designed and optimized with the help of CAD and FEA software.

- With this project the company will be benefited from the improvement of computer technologies and thus will be able to reduce cost of procuring a sheet bending machine.

IV. RESEARCH METHODOLOGY

In present study, we create the CAD model of Sheet bending machine. The analysis of the design will be performed. If required the optimization and analysis of optimized design will be performed after that results will be discussed and design will be finalized.

V. CONCLUSIONS

The company DAULAT INDUSTRIES Nagpur, will be benefited from the improvement of design and thus will be able to reduce the fabrication cost of sheet bending machine without negotiate the performance parameters after the accomplishment of the project.

REFERENCES


