

# Design and Development of Universal Metal Bender

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**Abstract-** The aim of this paper is to design and construct a portable manually operated bending machine which is useful to bend a sheet and pipe in required shape & size. Due to its portability it can be used by small workshop or fabrication shop. 3-point metal bending machine is a process of turning the flat sheet metal and pipe of appropriate length into a desired curvature as the manufacturer wants or into a hollow semi-circular shape. It is easy to be carry and use at any time and any place. It requires less skill to operate this machine. The basic components are cylindrical rollers, hand wheel, end support (pedestal bearing) and support (frame). Our objective is to maintain accuracy at low prize without affecting the pipe and sheet bending productivity. This machine can bend up-to 6 mm thick sheet and 1 inch pipe. There is no proper small scale bending machine for bending a pipe and sheet collectively. A roll bending machine uses three rollers to bend a metal – one upper roller and two lower rollers.

**Keywords-** Portable bending machine, Pedestal bearing, 3-point metal bending machine.

## 1. INTRODUCTION

It is difficult so far the “first sheet metal”, definitely skinny sheets of valuable metals were invented within the period by cold operating terribly ductile materials like gold and silver, blow them with stones till were earned terribly refined sheets that were then went to build jewels however conjointly to coat the wood shields or to fabricate armour components.

The real turning purpose within the flat solid production materialized with the introduction of the steel mill. the primary celebrated style of a steel mill dates back no but to architect World Health Organization in one among his drawings, dated 1480 , describes for the primary time the likelihood of “making a fabric pass” between 2 cylindrical rollers with parallel axes to switch its thickness. conjointly during this case it absolutely was provided for the cold machining of ductile materials, particularly for lead, tin etc., however it's not sure that it absolutely was ever engineered. In sixteenth century 2 finishing devices were engineered, one is for coin drawing from gold sheet and also the second is for sheet cutting into strips. the primary complex was employed in 1615, to get lead and tin plates driven by animal or hydraulic force. owing to the exaggerated chance of getting ferric material, the cold rolling of steel is at the same time started. In 1682 a chilly steel mill of notable sizes was gift in Newcastle in European country. the primary elaborated description dates

back to few years later it's a plant in Galles that processed 700 metric linear unit-long bars with one hundred mm breadth, that might get sheets with 1500×700 metric linear unit sizes, the actuation was provided by water wheels . Within the eighteenth century they conjointly started rolling additional complicated shapes: rounds, squares, rails, double-T beams etc. In 1600 lead sheets for the roof covers were extremely requested and at the tip of 1700, within the middle of the commercial revolution, they required rails and semi-finished steel merchandise so there's a prompt ought to develop rolling machine. At the start of the nineteenth century the steel mill structure was primarily the present one: a durable forged iron cage with 2 steel cylinders and also the chance of adjusting, through a screw, the roller distance. With ceaselessly increase in product size, capability conjointly will increase. 3 cylinders (trio) square measure employed in that intermediate is smaller in diameter to diminish the requested power and to permit the rolling within the 2 senses while not reversing motion of the motor.

Sheet metal fabrication plays an important role in the metal production and manufacturing world. Manufacturing is a field of transferring raw material into finished goods. A bending is a process of bending a metal. 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 create desired shapes. Bending machines of the type which operates with rolls called roller bending machines. The roller of bending machine can be two rollers, three rollers, or four rollers. The common product of roll bending machine are tube bending, sheet bending, plate bending and a coil. Universal metal bender is a roller bending machine for converting metal sheet of varying thickness into curve sheet and rolling pipe into 360°.

Market available conventional machines are heavy, fixed and immobile. They occupy lot of space which is utmost important factor for consideration while designing layout of shop. They are expensive hence it is not economically feasible for small scale manufacturer to purchase it. Cost of maintenance and repair is high because most of the parts are expensive and damage in one part hampers the working which results in stoppage the production. There is no integrated machine for bending sheet metal and pipes.

We are interested to design a manually operated bender with same dimensional accuracy of results having same operating cycle time as motor operated machines. We tried to overcome to existing problems in current available

machines. This machine can be used to bend sheet metals up to 6mm of thickness and pipe of 1 inch. It works on simple procedure therefore it does not require skilled operator.

## 2. LITERATURE REVIEW

**Force Analysis of Metal Sheet in Bending Operation on Sheet Bending Machine** <sup>[1]</sup> In the three roller-bending machine, the three rollers rotate. Bending can be done in both sheet metal and bars of metal. For designing a three roller-bending machine, it is required to calculate the exact force for bending. Based on this force, the machine parameters and motor power are decided. On the basis of the results and its analysis, following conclusion can be drawn. From the result's analysis for constant radius of curvature, constant dimensions by changing the material, load increases as the value of modulus of elasticity increases i.e Load is directly proportional to the modulus of elasticity.

**Review on Design and Analysis of Portable Rolling and Bending Machine** <sup>[2]</sup> In this paper we are discussing about the difference in roll pressure distribution was assumed linear. Using this model rolling parameters such rolling force, torque and the developed curvature were easily calculated. Bending moment can be applied in suitable direction. In addition, employing a bending moment at entry of the roll gap in a symmetrical rolling process causes pressure difference on the rolls and warping at the outlet, as happens in an asymmetrical rolling process. In Portable bending machine is device which gives the less efforts of man and gives the required work properly of the construction and other metal fabricated areas.

**Research and exploration of sheet material bending machine** <sup>[3]</sup> Based on survey of existing bending machine and mechanism of sheet material bending processing, the paper researches design mechanism and principle of sheet material bending machine, mainly including design of overall structure, rear stopper and transmission part, and then carries out calculation and check of bending machine mechanical structure, including workbench intensity and connecting bolt check.

Sheet material bending machine is one of the most widely used sheet metal cold forming machine, which bends sheet metal to various components in different angles by simple general mould under cold condition. Along with the popularity of bending machine's application in various industries there were continuously higher requests for bending precision, productivity and automatic operation.

**Study of Portable 3 Roller Pipe Bending Machine** <sup>[4]</sup> The aim of this paper is to develop a pipe-bending machine, which is useful to bend a pipe in workshop. This project is to design and construct a portable pipe-bending machine. This machine is used to bend steel pipes into curve and the other curvature shapes. This machine works on simple kinematic system instead of complicated design. This machine can bend up-to 4-5mm thickness of pipe. Due to

its portability it can be used by small workshop or fabrication shop.

## 3. PROPOSED SYSTEM

The three roll push bending is the most commonly used free form bending process to manufacture bending geometries consisting of several plane bending curves. The profile is guided between bending roll and supporting rolls, while being push through the rolls. The position of the forming roll defines the bending radius. The bending point is the tangent point between tube or sheet and bending roll to change the bending plane. The process is very flexible. The machine is manually operated with same accuracy at low prize without affecting the bending productivity.

The metal pipe and sheet needs to put in the roller and then rolls around it until the desire shape is acquired. The products that can be produced with this machine are various curves, structural elements, automobile parts etc. When the metal sheet and pipe is feed into the roller this causes vertical downward force acting on downward rollers. This load causes a crushing stress or compressive stress on the hydraulic jack. The upper and lower rollers have a support at both the ends, when the sheet and pipe passes between the rollers the support of rollers causes a frictional wear. Wear in friction material result in eccentric motion of in rolling shaft. The more the wear, the lead to dissatisfaction and disturbance in the company manufacturing process who need to send the machine for maintenance.

The entire process of the roll bending may be divided into three steps: namely, 1. Positioning of blank sheet or pipe.

2. Lowering of the centre roller.

3. Feeding of the sheet and pipe.

In the very first step, a flat blank sheet and pipe is fed into the machine by two rotating side rollers until the sheet is properly positioned. In the second step, bottom rollers are displaced upward causes bending of the sheet. In the final step, central splined roller rotates again, so that the sheet and pipe is bent continuously. Sometimes multiple passes are required to obtain required curvature. Sheet bending is the central operation and provision of additional attachments is also provided for pipe bending. There are more chances of sprung back effect to occur in case of sheet. Therefore pre-stressing is needed before bending operation. 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 full 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. Bottom rollers load required to bend the sheet is the function of various parameters viz. sheet thickness, sheet width, sheet material property, shell diameter to be rolled, center to center

distance between bottom two rollers, displacement of top roller, etc.

**Completed Assembly:** Universal Metal Bender



Fig.1: Side View



Fig 2: Front View

#### 4. RESULTS

After Design of three roller bending machine the results obtained are pipe can be bend up to  $160^\circ$  on 1" hollow pipe



Fig. 3: 6mm ms sheet bend by machine



Fig. 4: 4mm ms sheet strip bend by machine



Fig. 5: Sheet 5mm thickness



Fig. 6: Sheet 3mm thickness half circle bend



Fig. 7: Circular Pipe Bend

#### 5. CONCLUSION

The new change within the style can reduce the crushing stress on the actuating mechanism of the rolling machine on that the lower rollers are mounted. The addition within the modification of material can reduce the contact stress within the support finish wherever the roller rolls that end in frictional wear. Thus, the rolling machine can have a less

maintenance, which is able to directly in reduce the maintenance value. The machine capacity is often increased in line with the requirement. Manual bending tends wrinkles and may reduce springback. By its style the defects are often simply overcome. Simpler style not only reduces the defects however additionally contributes to fluid pressure check throughout bending. It ought to be noted the tendency to wrinkle and therefore the cross section of tube deformation square measure reduced. Thus, this machine is often used for bending a skinny walled tube and metal sheet that cannot be achieved with single standard methodology of bending.

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