

# PNEUMATIC SHEET METAL CUTTING MACHINE

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**ABSTRACT:** Pneumatics systems are extensively used in a wide range of industries and factories and manufacturing sector entities. Pneumatics system are noted for their simplicity, reliability, and ease of operation. Also they are suitable for fast and rapid application of force. The purpose of this project is to therefore design a simple, easily operated pneumatic sheet metal cutting and bending machine that is sturdy and strong. A pressure of 6-8 bar is enough for operating the unit. The pressurized air passing through the tubes to the cylinder, forces the piston out whose power through the linkage is transmitted to the punch. The work piece thus got is for required dimensions and the piece can be collected through the land clearance provided in the die. The die used in this is fixed such that the die of required shape can be used according to the requirement. This enables us to use different type punch dies resulting in a wide range of products. Different types of punch as requirement can be thus got. According to the work material the operating pressure can be varied.

## I. INTRODUCTION

The shearing machine and bending machine is most important in sheet metal industry. This machine should be used for straight cutting machine with wide application. But in some industry hand sheet cutter and hand bender are used. For that machine to operate the human effort are required. The machine should be simple to operate and easy to maintain, hence we tried out to develop the Pneumatic Shearing and Bending Machine. In shearing operation as the punch descends upon the metal, the pressure exerted by the punch first cause the plastic deformation of the metal. Since the clearance between the punch and the die is very small, the plastic deformation takes place in a localized area and the metal adjacent to the cutting edges.

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In bending operation the bend has been made with the help of punch which exerts large force on the work clamped on the die. The bending machine is designed in such a way that, it works automatically. The machine is designed by observing the factors to improve the efficiency and to reduce the cycle time by producing quality output. Automation of machine is achieved with the help of pneumatic system. This involves the design of an efficient system which reduces the human effort and help to increase production output. It also includes pneumatic system, pneumatic component and shearing die and bending die.

The production output of hand- operated machines is low. Because of this problem, we are developing a pneumatically operated cutting and punching machine. Pneumatics is the branch of engineering which uses pre-compressed air or inert gas as a means to drive machinery. Certain properties of air make it extremely suitable for its usage in modern machinery. The advantage of using a pneumatic system is that it can generate a considerable amount of force while being cost-effective.

## II. LITERATURE SURVEY

Sheet metal bending is one of the most widely applied sheet metal forming operations. The understanding of the bending mechanics is aimed at obtaining two kinds of information important for industrial applications. The first one is the spring back prediction for die design and shape control. The second is an estimation of the bend force for selection of press capacity, strength analysis and design of dies. Here an attempt is made to review the status of literature in pneumatic based on various criteria. The work done by various authors are explained below.

Vallance and Matlock (1992) studied the friction behavior of zinc-based coated sheet steels and laboratory scale friction analysis techniques that involve sheet sliding over cylindrical dies.

Mai Huang and Gardeen (1994) presented a literature review of the spring back of doubly curved developable sheet metal surfaces and provided a bibliography on the spring back in sheet metal forming. Reviewing the literature, it is found that researchers have been studying the phenomenon of spring back for nearly six decades. There have been diverse efforts to evaluate and/or decrease spring back in the sheet metal forming industry for a long time.

Perduijn and Hoogenboom (2000) derived a simple explicit bending couple curvature relation for small and larger curvatures and they verified the model with experimental results. Sanchez (2007) focused on a systematic analysis of testing equipment as a measurement system of the friction phenomena on sheet metal under plane strain. It provides experimental references in order to optimize the usage of lubricants and sheet metal. Samuel (2012) analyzed the spring back in axisymmetric U-bending processes with a finite element program and discussed the effect of tool geometry and blank holder force on the final shape after spring back. The parameters studied include punch radius, punch speed, forming load and forming temp.

Developed a pneumatic machine that would perform cutting as well as bending operation to reduce the cost of operation performed on steel metal. Further modification in their design can also increase the cutting force.

T. Z. Quazi studied the influence of punch-die clearance in blanking process. Their investigation showed that by decreasing clearance the required blanking force increased. They found that 10% is the optimum clearance is required for minimizing blanking force.

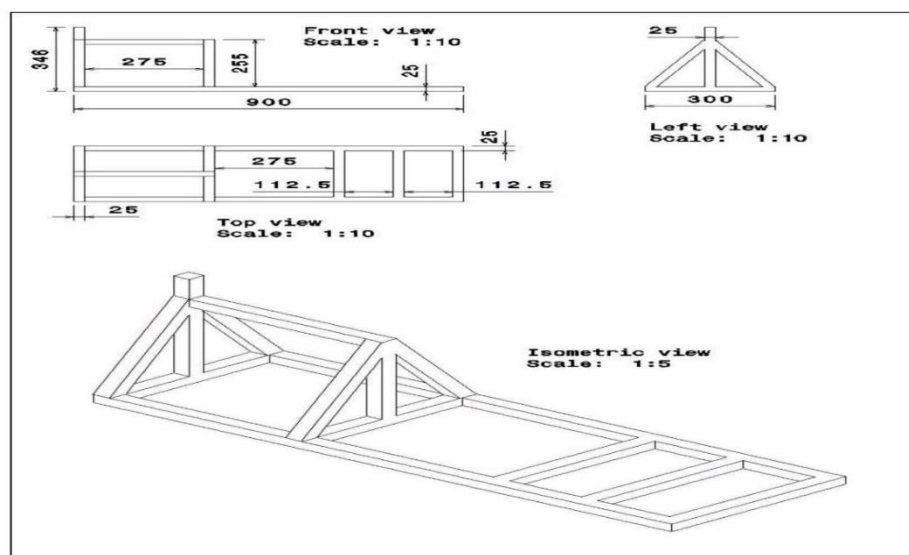
Viraj N. Suryawanshi fabricated a pneumatic punching machine to reduce punching cost on metallic sheet.

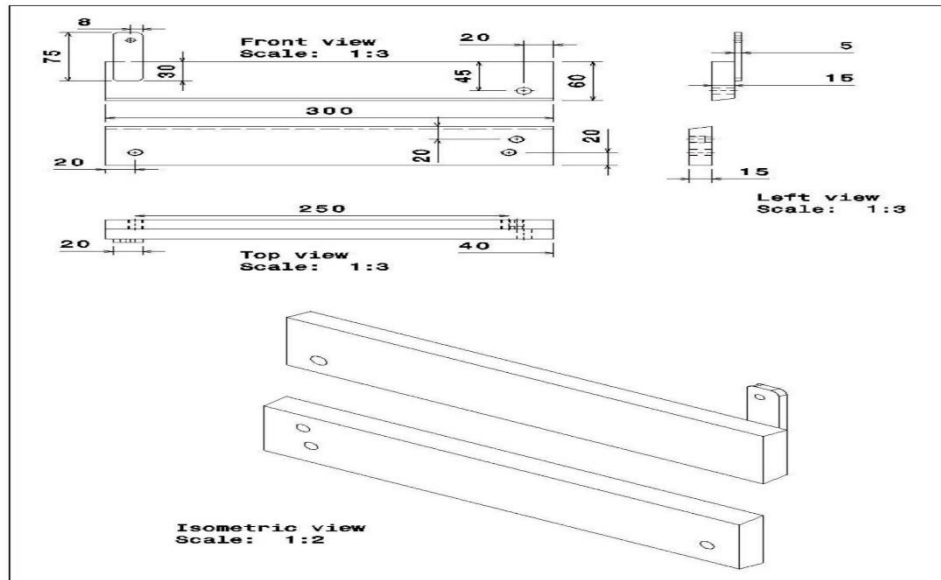
K. K. Alaneme investigated the reasons behind the failure of mould dies in a punching machine. They found out that die failure happened because of improper heat treatment thus reducing the toughness and fatigue resistance of die material.

Neeraj Pandita developed a pneumatic sheet metal cutting machine which is better in comparison to manual driven sheet cutters. The efficiency of the cutter can be increased by further enhancement in cutting blade. Sudeep Kelaginamane et. al. [6] designed a PLC controlled pneumatic punching machine. The machine reduced the production time and increased productivity from 60 units per hour to 420 units per hour.

A. K. Gupta studied the influence of parameters like blanking force, clearance, blanking layout on sheet deformation. They found that the tolerance in the dimension of the punch hole can be minimized by increasing the compressor pressure. They found that variation in the dimension was more in case of a galvanized iron sheet as compared to the aluminium sheet.

### III. PROJECT DESIGN & COMPONENTS





## IV. CONSTRUCTION

### 4.1.1 Raw Material Used

1. Mild Steel bars for base frame.
2. 35C8 material for shearing blades.
3. Cylinder fittings like fork end, base plates, support links.
4. Angle section for blade fitting.
5. Connecting link.
6. Blade link.

### 4.1.2 Ready Items Used

1. Pneumatic double acting cylinder.
2. Direction & flow control valves.
3. Pneumatic pipe & pipe fittings.
4. Bolts & nuts.
5. Antirust coat & paint.

### 4.1.3 Machines & Tools Used

1. Cutting Machine.
2. Hacksaw Cutting Machine.
3. Sensitive Drilling Machine. 4. Horizontal Milling Machine. 5. Electric Arc Welding Machine. 6. Hand Grinder.

7.Surface Grinding Machine.8.Tap & Tap Holder.

### **PNEUMATIC CYLINDER:**

Pneumatic cylinders (sometimes known as air cylinders) are mechanical devices which use the power of compressed gas to produce a force in a reciprocating linear motion. In pneumatic cylinder a compressed air is used as working fluid and convert it into kinetic energy as the air expands in an attempt to reach atmospheric pressure. This air expansion forces a piston to move in the desired direction.

The piston is a disc or cylinder, and the piston rod transfers the force it develops to the object to be moved. Engineers prefer to use pneumatics because they are quieter, cleaner, and do not require large amounts or space for fluid storage. Because the operating fluid is a gas, leakage from a pneumatic cylinder will not drip out and contaminate the surroundings, making pneumatics more desirable where cleanliness is a requirement.

### **PNEUMATIC COMPRESSOR:**



## **V. WORKING PRINCIPLE**

The pneumatic machine includes a table with support arms to hold the sheet, stops or guides to secure the sheet, upper and lower straight - edge blades, a gauging device to precisely position the sheet. The table also includes the two way directional valve. The two way directional valve is connected to the compressor. The compressor has a piston for a movable member. The piston is connected to a crankshaft, which is in turn connected to a prime mover (electric motor, internal combustion engine). At inlet and outlet ports, valves allow air to enter and exit the chamber.

When the compressor is switched ON, the compressed air is flow to inlet of the pneumatic cylinder. The sheet is placed between the upper and the lower blade. The lower blade remains stationary while the upper blade is forced downward. The upper blade is slightly offset from the lower blade, approximately 5–10% of the sheet thickness. Also the upper blade is usually angled so that the cut progresses from one end to the other, thus reducing the required force. After the material is cut, adjust the pneumatic hand lever to the mid position i.e. normal position and then the compressor is switched OFF. The following figure shows general layout for the machine.

### **ADVANTAGES:**

- The pneumatic is more efficient in the technical field.
- Quick response is achieved.
- Easy maintenance and repair.
- Low investing cost.

### **APPLICATIONS:**

- For Paper cutting
- For sheet cutting
- For stamping operating
- For bending operation

**DISADVANTAGES:**

1. Sheet more than 2 mm thickness cannot cut easily.
2. Compressed air is must.
3. Foundation is required also safety major must be taken

**VI. FUTURE SCOPE**

We only have thought and put in the report the following future modifications. Pneumatic sheet cutting machine is a very versatile machine and has a lot of applications because of its flexibility and ease of doing operations. This machine can be converted into a punching machine by removing the blade and adding a punching die to the end of the piston. By increasing the pressure, we can cut more sheets collectively. Because of its enormous use in industries, a higher production rate can be achieved by balancing the forces and making the design more compact. Software and advanced controlling systems can improve the machine performance. By replacing the pneumatic circuit with a rack and pinion arrangement, it can be converted into a rack and pinion operated machine. The electric motor air compressor can also be replaced by an IC engine installed compressor where we are deprived of electric energy. In this machine, the ideal stroke wastes the air which moves out through the out port of the control unit. In the future, a mechanism can be developed to use the air again for the working of the cylinder.

**VII. CONCLUSION**

Now we know that a pneumatic cutting and bending machine is very less expensive as compared to a hydraulic cutting and bending machine. The range of the cutting and bending thickness can be increased by arranging a high pressure compressor and installing more hardened blades. This machine is advantageous to small sheet metal cutting and bending industries as they cannot afford the expensive hydraulic cutting and bending machine. Pneumatic systems are used in controlling train doors as well as bus doors, automatic production lines, and mechanical clamps. The sheet metal cutting process is a main part of all industries. Normally the sheet metal cutting machine is manually hand operated one for medium and small scale industries. The sheet metal cutting machine works with the help of a pneumatic double acting cylinder. The piston is connected to the moving cutting tool. Sheet metal cutting machine can be used to cut the sheet metal of minimum thickness without manual hard work. This machine can also be installed in the lab for the experiment and demonstration to engineering students. This machine is advantageous to small sheet cutting industry as they cannot afford to the extensive hydraulic shearing machine. In this project I have tried my best to fabricate a pneumatic sheet metal cutting machine which can cut the sheet metal in small pieces.

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