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# Design and Fabrication of Precise Wood Engraving Machine

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**Abstract -** The "Precise Wood Engraving Machine" project is primarily used to accurately and correctly cut mild steel, plastic, and wood plates into various shapes. The pantograph, a mechanical linkage connected in a parallelogram-based fashion and used for copying and scaling line drawings with complex images, is included in this machine along with the conventional cutting tools. The working principle of a four-bar mechanism in which one link is fixed while the others pivot. These other links move in sync with the tracing link. This device is inexpensive and highly useful. In this project, a model of the "Precise Wood Engraving Machine" will be created using CAD software such as AutoCAD, Pro-E, Solid Works, etc. The machine's performance would be reduced if the components that are readily available in the marketplace were taken into account, which would result in a poor surface finish.

***Key Words*:** Pantograph, Parallelogram, Four Bar Mechanism and AutoCAD, etc.

## 1. INTRODUCTION

The pantograph is one of the most fascinating engineering equipment mechanisms ever created, and every engineering shop should have one in some configuration. One of its tasks is to engrave lines in two dimensions. More advanced versions also work in two dimensions and can duplicate complex two-dimensional designs and engineering components, enlarging or contracting them as needed. A pantograph is a straightforward yet effective equipment that can increase the variety of crafts and artwork. Depending on how the components are measured and put together, we can scale the images using a pantograph. As part of the "algorithm" for producing the final copy, the pantograph determines the separations between its pivot points and resizes the image. In the analogy, the pantograph would create a copy that was smaller than the original. By adjusting the lengths between the pivot points, the pantograph's percentage of expansion could be determined.

In the current technological environment, workers shape and cut objects using hand-operated instruments, requiring human labour. Most workers are elderly and unable to exert themselves. If the wooden substance has a huge surface area, using a hand tool will take the entire day. Typically, single operation machines are the automatic ones. The available multifunctional machines are high costly.

"Design and Fabrication of Precise Wood Engraving Machine" is the project's official title. To minimise worker effort, we'll strive to run the router using alternative energy sources. A new technology called the PRECISE WOOD ENGRAVING MACHINE enables routers to be driven by electricity and only require a little amount of power for the drilling or shaping processes. For the final model, we will design in 3D parametric software (solid works/Autocad), and then construct an actual prototype that will function more quickly and with less effort. We are going to use a handle to let us move the router in any direction.

## 2. LITERATURE REVIEW

**Syed shahnawaz et al. (2017) [1]:** In this paper study presents the design, analysis and fabrication of "MULTIPURPOSE MECHANICAL MACHINE". This mechanical machine is designed to perform multi operations specially drilling, cutting and grinding. The machine is designed to perform all the Operations at same time with desired speed. There model of the multi operational machine may be used in industries and domestic operation which can perform mechanical operation like drilling, cutting & grinding of a thin metallic as well as wooden model or body. In this study literature review and problem identification is performed.

**R. Robert Henty et al. (2016) [2]:** There are many ways to cut metals, but all these ways take more time our aim is to reduce the cutting time by "DESIGN AND FABRICATION OF A MULTI PURPOSE SCOTCH YOKE MECHANISM" and increasing the number of productivity. By this method six operations can be performing. There are four cutting, drilling and grinding at the same time by using the bevel gear attachment. The time required to cut four works by power hacksaw multi metal cutter is the time taken by other methods to cut a two work. This method reduces human effort and saves the metal cutting time. Apart from other methods this method

can be used in places were to cut more work at low cost. If we want to drilling or surface finishing work it is also possible. The sawing machine is faster and easier than hand sawing and is used principally to produce an accurate square or mitered cut on the work piece.

**Krishnappa R, et al. (2017) [4]:** This paper presents the concept of Multi-Function Operating Machine mainly carried out for production based industries. Industries are basically meant for Production of useful goods and services at low production cost, machinery cost and low inventory cost. They have developed a conceptual model of a machine which would be capable of performing different operation simultaneously, and it should be economically efficient .In this machine they are actually giving drive to the main shaft to which scotch yoke mechanism is directly attached, scotch yoke mechanism is used for sawing operation. On the main shaft they have use bevel gear system for power transmission at two locations. Through bevel gear we will give drive to drilling centre and grinding centre. The model facilitate us to get the operation performed at different working centre simultaneously as it is getting drive from single power source. Objective of this model are conservation of electricity (power supply), reduction in cost associated with power usage, increase in productivity, reduced Floor space.

**Yashraj V Patil et al (2018) [5]:** This paper deals with fabrication of multi-purpose tooling machine. This machine is based on the mechanism of belt drive with pulleys, bevel gears, and scotch yoke. The various machining process in manufacturing industries are carried out by separate machining machine. It requires more space requirement and time with high expenses. But the fabrication of multi-purpose tooling machine, which contains five operations in a single machine. The operations are namely drilling, shaping, cutting, buffing and grinding. It is a new concept specially meant to reduce the work time and save the cost. This machine can perform multi-purpose operation at the same time with required speed and this machine is automatic which is operated by motor which is run with the help of electric power supply.

**S.S. Kulkarni, et al.(2018) [6]:** This paper presents the concept of Multi-Function Operating Machine mainly carried out for production based industries. Industries are basically meant for Production of useful goods and services at low production cost, machinery cost and low inventory cost.

## 3. WORKING PRINCIPLE

The working principle of a pantograph wood engraver is primarily based on a four bar mechanism in which one link is fixed and the other links are pivoted and move in accordance with the movement of the stylus, as seen in Fig. 1. Figure: Point P1 is the stylus point, Point P2 is the cutting point, and Points A, C, D, and E are pivot points. Point B is fixed.

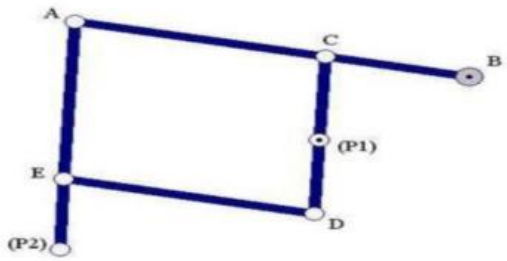



**Fig-1:** Four Bar Mechanism

## 4. DESIGN AND CALCULATIONS

### *A. DESIGN*

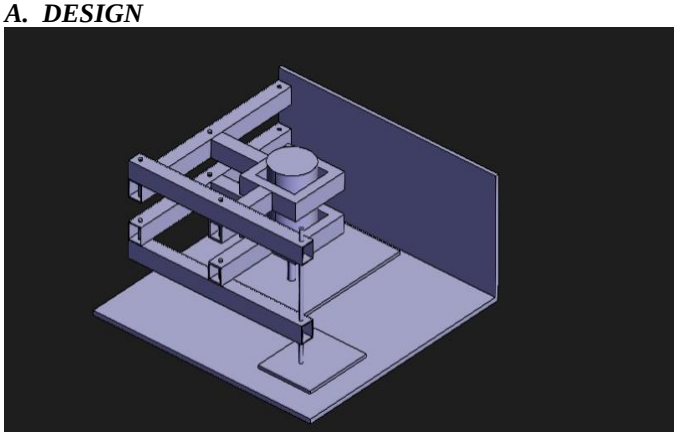


**Fig-2: Design**

### *B. CALCULATIONS*

**Design of Frame**

The Frame fabricated for our project which is made up of M.S.It is welded accordingly for arrangement of the system components. The Frame along with dimension is shown in figure below:

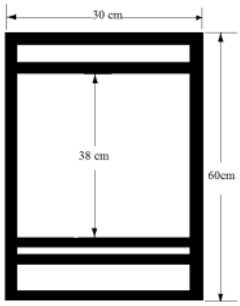



**Fig-3: Design of Frame**

Frame Specification:

- Size of Frame: 1000 x 350 mm
- Material of Frame: Mild Steel
- Unloaded Weight of Frame: 2.65 kg o
- Loaded weight of frame: 9.7 kg

**Force Calculation**

By lever principal: 32 × 1.9 = 8 x A 60.8 ÷ 8 = A
A = 7.6 kg A = 74.556 N.
Applying Pascals law:

i.e., "Pressure exerted on a confined liquid is transmitted undiminished in all directions and acts at right angles with equal force on all areas of the container".

P = F ÷ A

P = 74.556 † [(π/4) × (12.7)2]

P = 0.588 N/mm2

Cantilever Beams are members that are supported from a single point only; typically with a Fixed Support. In order to ensure the structure is static, the support must be fixed; meaning it is able to support forces and moments in all directions.

Sample Cantilever Beam equations can be calculated from the following formulae, where:

Bending stress formula

$$\sigma = \frac{My}{I}$$

Where , σ = bending stress

M = bending moment (which is calculated by multiplying a force by the distance between the point of interest and the force),

y= The distance from the neutral axis

I= Moment of inertia.

1.Cantilever Beams at square section

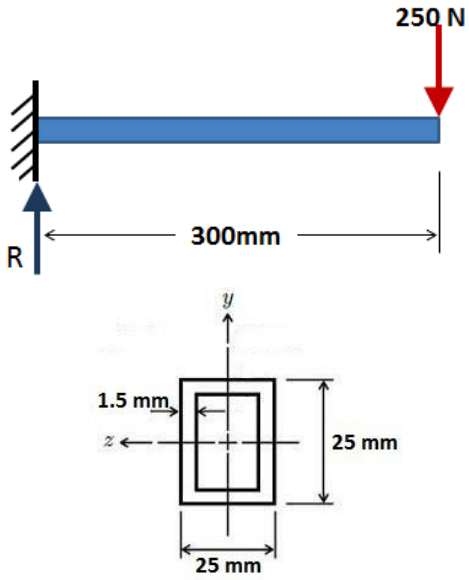



**Fig-4:** Cantilever Beams at square section

Load(W) = 250N

Member Length(L) =300 mm

Thickness(T) = 1.5 mm

The distance from the neutral axis (y) =12.5 mm

Width (B) = 25 mm

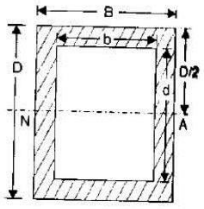
Depth (D) = 25 mm

For Circular hollow section

$$I = \frac{BD^3}{12} - \frac{bd^3}{12}$$

$$y_{max} = \left(\frac{D}{2}\right)$$

$$Z = \frac{1}{6D}[BD^3 - bd^3]$$




$$I = \frac{25 * 25^3}{12} - \frac{22.5 * 22.5^3}{12}$$

$$I = 390625 - 256289.0625$$

I=11419.6614

Y=12.5 mm

MA -250*300 =0

MA= 75000 N.mm

$$\sigma = \frac{My}{I}$$

$$\sigma = \frac{75000 * 12.5}{11419.6614}$$

$$\sigma = 82.09 \text{ N/mm2}$$

## 5. RESULTS AND DISCUSSIONS

This machine is suitable for small and medium-sized businesses. This machine is primarily employed in sectors that focus on wood fabrication. The materials can be removed in any shape, such as ovals, rectangles, ellipses, squares, circles, pentagons, and hexagons. This machine is used to direct the cutting tools. This machine is used to reproduce maps and plans at either a larger or smaller scale.

## 6. CONCLUSIONS

Even though the pantograph is an antique mechanism, it still works today. It can be put to lots of good use. In order to engrave paper on materials like wood, we employ a pantograph, which is a parallelogram linkage. Compared to other complex engraving machines, our kind of pantograph engraving machine is lightweight, portable, and simple enough for non-experts to operate. We created a safe method for the engraving machine, so there are no issues with manufacturing either.

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