

# Calculation, design and manufacture of planer milling machine on long PE plastic pipes

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**ABSTRACT:** This paper presents the results of the process of calculation, designing and manufacturing a planer milling machine on long PE plastic pipes, this machine can be easily moved to area where the workpieces need to be manufactured. The parameters calculated during the design process include: speed chain, feed chain and whole the kinematic diagram of this planer milling machine. The biggest difficulty in the process of planing plastic pipes on the planer milling machine is the problem of part deformation during the clamping process. In this article, the author has solved that problem.

**KEYWORDS:** Milling machine; Planer milling machine; Cutting Process; Plastic pipe.

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## I. INTRODUCTION

A planer is a type of metalworking machine tool that uses linear relative motion between the workpiece and a single-point cutting tool to cut the work piece. A planer is similar to a shaper, but larger, and with workpiece moving, whereas in a shaper the cutting tool moves. [1]

A Planer Machine is a robust machine used to remove material from workpieces to achieve flat and smooth surfaces with high precision. These machines are widely utilised in workshops and manufacturing industries for shaping metals, woodworking, and producing large and heavy components such as steel plates, machine beds, and industrial moulds. With its ability to handle substantial workpieces and deliver accurate results, the planer machine remains an indispensable asset in modern machining processes. The planer is a machine tool designed to create precise flat surfaces and cut slots with efficiency. It shares similarities with the shaper machine, but its larger size sets it apart. In the planer, the workpiece slots move between points during operation, whereas the workpiece slots remain stationary in the shaper. The planer employs a single-point cutting tool. The credit for inventing the planer goes to General Bentham, making it a significant and indispensable machine tool in the manufacturing process. [2]

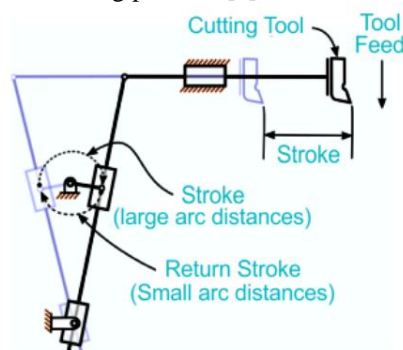


Fig 1: Planer machine

In a Planer Machine, the workpiece is securely fixed to the machine table, while a single-point cutting tool is appropriately held in the tool post attached to the reciprocating ram. The reciprocating motion of the ram is achieved through a quick return motion mechanism, ensuring smooth back-and-forth movement. During the forward stroke of the ram, the cutting tool engages with the material, removing the material to shape the workpiece. However, during the return stroke, there is no cutting action, and this stroke is known as the idle stroke. The idle stroke allows the cutting tool to reposition for the next pass without cutting into the material,

preventing unnecessary wear and facilitating efficient machining. Planer machines are known for handling large workpieces and producing accurate flat surfaces and slots. [2]

The second problem is about the clamping of PE plastic pipe products. The nature of PE plastic pipes is very soft and easily deformed when subjected to impact force. Therefore, clamping is a very difficult problem in mechanical processing. In this article, the author introduces a clamping method that causes little deformation of the part and does not change much the geometric shape of the PE plastic pipe.

The design and manufacturing of this machine has never been done before in the world. Therefore, the author faced many difficulties in the design and manufacturing process.

## **II. CALCULATION AND DESIGN PROCESS**

### **1. Theoretical basis for design**

The various components of a Planer Machine are discussed below:

- Bed: The bed serves as the sturdy foundation on which all other machine parts are mounted. It is designed to be large and heavy to provide stability and support during machining operations.
- Column / Housing: The columns, also known as uprights, are rigid box-like vertical structures positioned on each side of the bed and firmly attached to it. These housings accommodate pulleys and gears, essential for power transmission within the machine.
- Table: The table supports the workpiece and moves reciprocally along the bed's ways. It is crafted from high-quality cast iron for strength and durability. The upper surface of the table is meticulously finished and accurately machined to hold the workpiece securely during the planer operation.
- Cross Rail: The cross rail features tool holders where cutting tools, such as single-point cutting tools, can be fixed. It is connected between the two housings and provides additional support to them, ensuring stability during cutting processes.
- Tool Head: The tool head is responsible for holding and securing the cutting tools in place, enabling precise machining operations. It plays a pivotal role in shaping the workpiece as the planer moves back and forth. [2]

Types of Planer Machines:

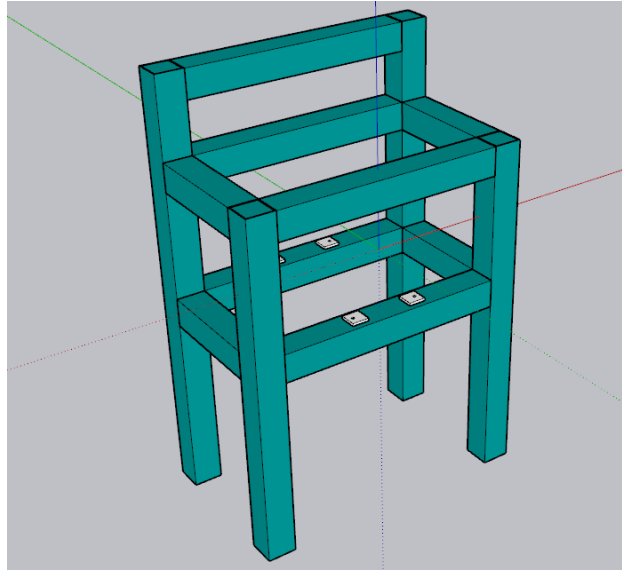
- Standard or Double Housing Planer Machine
- Open side Planer Machine
- Pit Planer Machine
- Edge or Plate-type Planer
- Divided Table Planer

Applications of Planer machine

- Excellent Flat Surface Generation
- Efficient Material Removal
- Versatility in Cutting Slots slots and grooves
- Angled Cutting Capabilities
- Handling Large Workpieces
- Improved Accuracy
- Stable and Rigid Construction

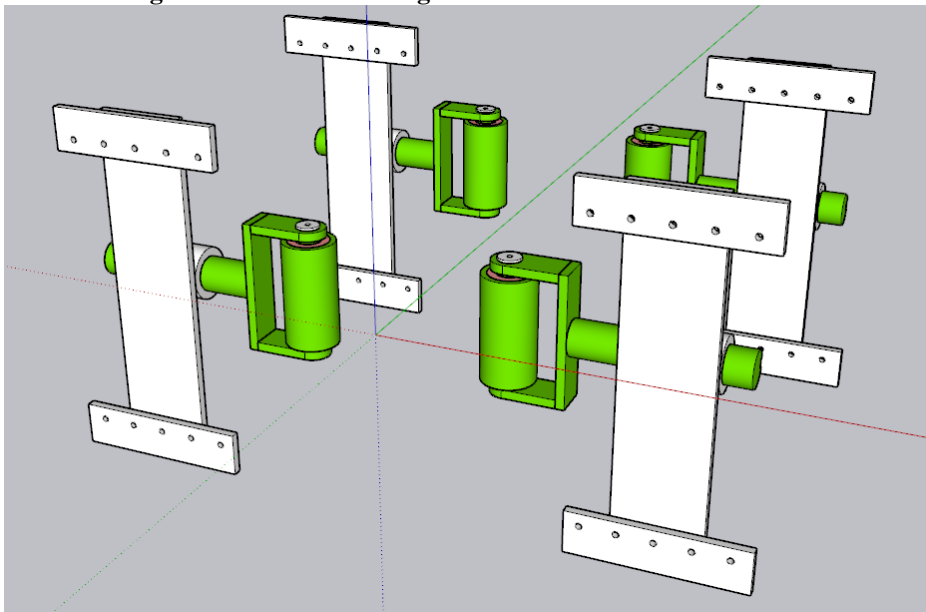
### **2. Design process**

#### **a. Machine frame design**



**Fig 2: Machine frame**

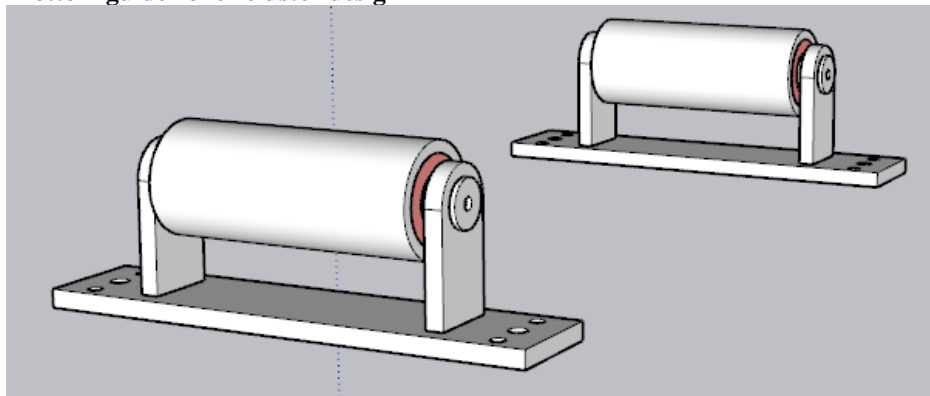
**b. Double side guide roller cluster design**



**Fig 3: Double side guide roller**

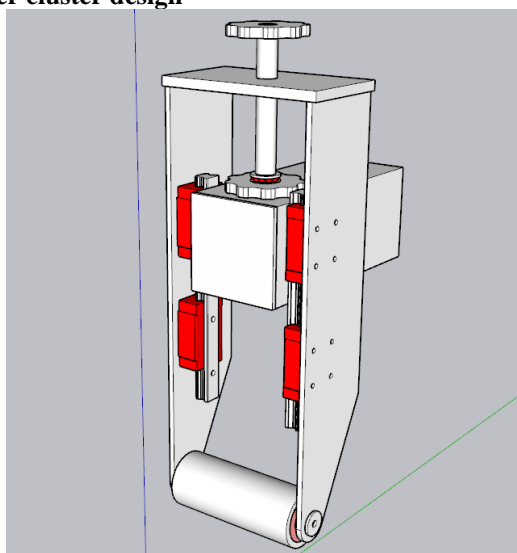
The structure of the 2-side clamping roller set includes 4 rollers mounted on 4 slide rails as shown in the Fig 3. The adjustment of the rollers is done before machining. This fixture can be used to clamp many different pipe sizes. The adjustment process is very easy with just simple operations.

**c. Bottom guide roller cluster design**



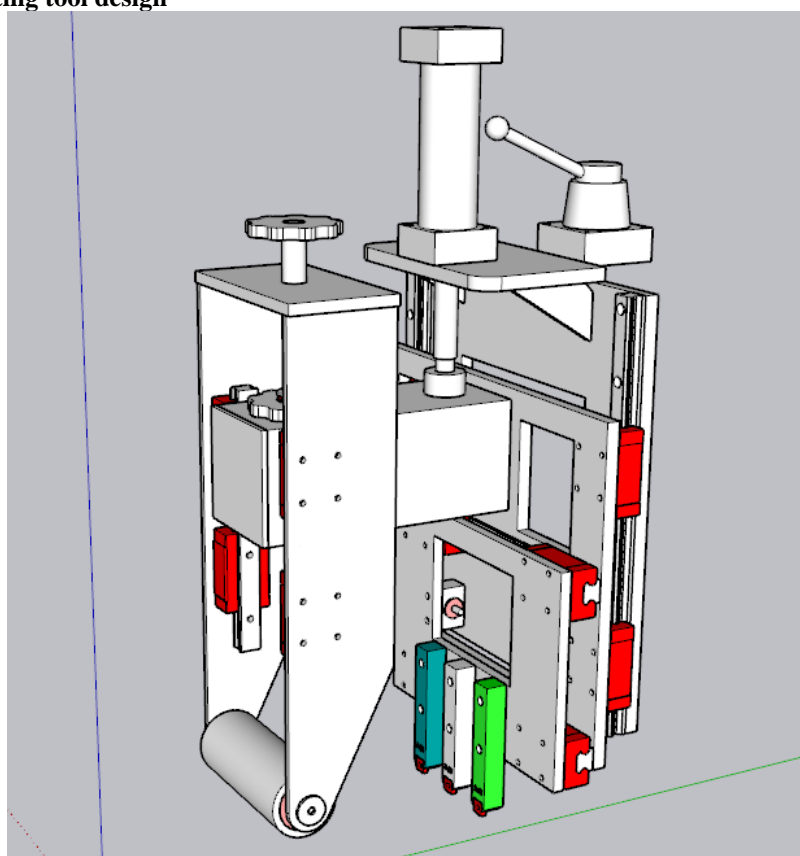
**Fig 4: Bottom guide roller**

**d. Upper guide roller cluster design**



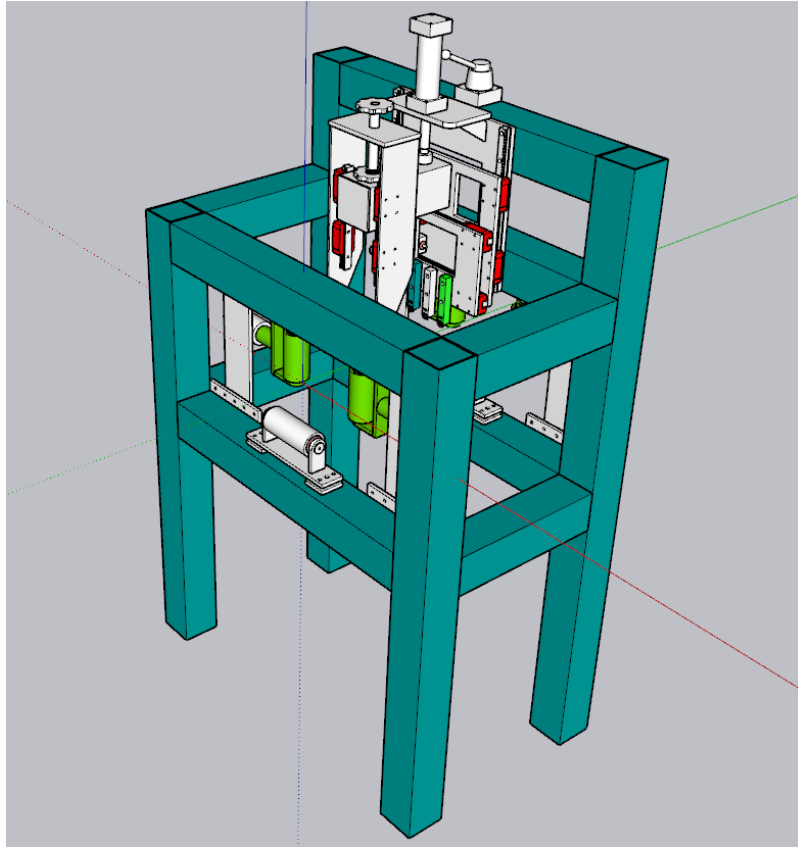
**Fig 5: Upper guide roller**

**e. Cutting tool design**



**Fig 6: Cutting tool**

**f. Complete assembly**



**Fig 7: The whole machine**

### **III. MANUFACTURE OF PLANER MILLING MACHINE ON LONG PE PLASTIC PIPES**

Below are some actual pictures of the planer milling machine for milling long PE plastic pipes. The author has completed the machine with all the designed features.



**Fig 8: The guide roller cluster**



**Fig 9: The cutting tools**



**Fig 10: The whole machine**

And above is the result after the process of research, calculation, design and manufacturing. The product created is a planer milling machine for milling long PE plastic pipes. This machine has been applied immediately to practical production. Specifically, it has participated in the PE plastic pipe production line. The product serves many manufacturing industries in society.

#### **IV. CONCLUSION**

In the article, the author has solved the most difficult problems in the design. That is the problem of clamping plastic pipe parts with very low rigidity. The author's fixture system ensures enough clamping force but does not deform the workpiece. The key point is that the author knows how to connect the kinematics of the upper roller system to the cutting tool system. This helps to ensure that the cutting depth is always fixed when the size of the part changes.

As a result, the author has successfully created a planer milling machine for milling long PE plastic pipes.

#### **ACKNOWLEDGMENT**

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#### **REFERENCES**

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