



Department of Mechanical Engineering

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Subject: Metrology And Machines

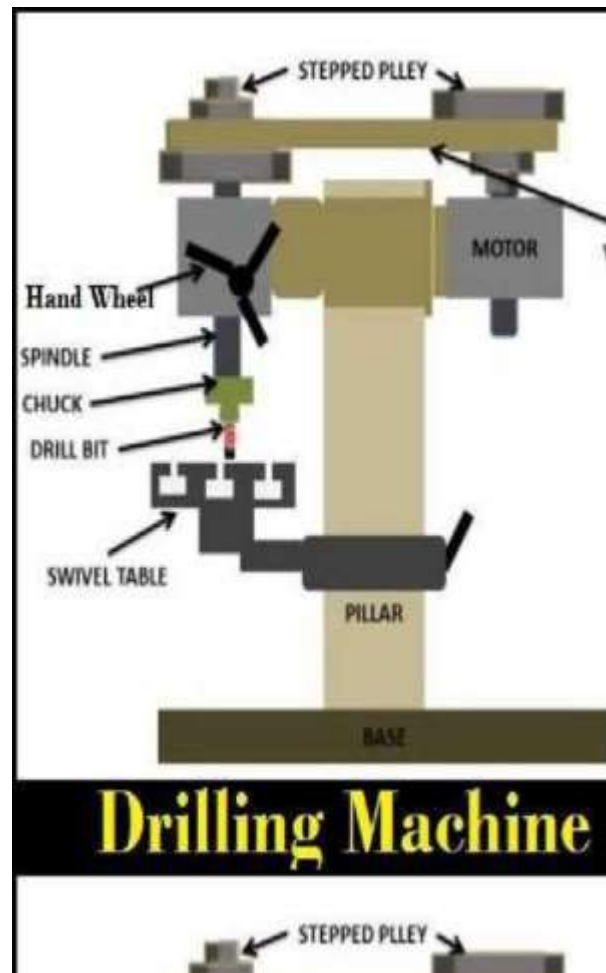
UNIT-2

UNIT 2

DRILLING BORING MACHINES

Introduction

boring machine, device for producing smooth and accurate holes in a workpiece by enlarging existing holes with a bore, which may bear a single cutting tip of steel, cemented carbide, or diamond or may be a small grinding wheel.



Drilling Machine

Drilling Machine: It is a machine which is used to drill the holes on the components or workpiece with the help of drill bits.

The drill bits are also called as Multi-point cutting tools which can have their rapid impact on the Material Removal Rate (MRR) i.e. a single point cutting tool (like the one used in a lathe machine) can remove the material slowly whereas, a multi-point cutting tool removes the material at a faster rate and thereby increases MRR.

2. Construction of Drilling Machine:

The parts are as follows.

1. Base (Bed): the base is made up of Cast Iron which has the capability of high compressive strength, good wear resistance and good absorbing capability (i.e. absorb the vibrations induced during working condition) and for these reasons, it acts as a base to the **drilling machine**.

2. Power Transmission system:

It consists of motor, stepped pulley, V-belt and the Spindle. The power transmission is explained in the working of the drilling machine.

5. Hand wheel

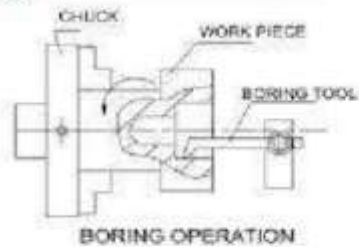
:the rotation of hand-wheel, the spindle moves up and down in the vertical direction in order to give the necessary amount of feed to the work.

2. **Swivel Table:** It is attached to the column which can hold the machine vice in the grips and thereby, the work piece is fixed in the machine vice to carry out the drilling operation.
3. **Column:** It is exactly placed at the center of the base which can act as a support for rotating the Swivel table and holding the power transmission system.

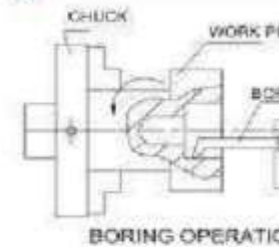
3. Working Principle of Drilling Machine:

- 1 When the power is given to the motor, the spindle rotates and thereby the stepped pulley attached to it also rotates.
- 2 On the other end, one more stepped pulley is attached and that is inverted to increase or decrease the speed of the rotational motion.
Now, a V-belt is placed in between the stepped pulleys so as to drive
- 3 the power transmission. Here a V-belt is used instead of a flat belt, in order to increase the power efficiency.
Now the drill bit also rotates
- 4 which was placed in the chuck and which was in connection with the spindle.
- 5 As the Pulleys rotates, the spindle also rotates which can rotate the drill bit.

Boring on lathe machine



Boring on lathe mach



principle of working boring

The boring process involves carefully placing the machine's head into the already drilled or cast hole. The device then starts to widen the hole by slowly scraping away portions of the inner wall. The boring tools are similar to those of lathes used in turning and milling machines

During manufacturing, materials must pass through a series of cutting processes that modify them till the end product is produced. Some parts may require holes in the material.

A typical technique to put these holes in the material is boring machining. Though other operations, like drilling, can create holes in a workpiece. CNC boring is the most suitable for making wide diameter holes with high dimensional accuracy.

In this article, we'd discuss extensively boring machining

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Every boring machine contains the following parts.

- **Chuck:** The clamp that firmly holds the material in place during boring.
- **Workpiece:** The material you intend to bore a hole into using the boring machine.
- **Boring :** The cutting tool that removes (scrapes) portions of the holes, resulting in a more expansive and precise hole.

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- 1 CNC Drilling Machine. ...
- 2 Drilling Machine. ...
- 3 Radial Drilling Machine. ...
- 4 Upright Drilling Machine.
...
- 5 Gang Drilling Machine. ...
- 6 Deep-Hole Drilling
Machine. ...
- 7 Multiple-Spindle Drilling
Machine. ...
- 8 Portable Drilling Machine.

Operations on a Drilling Machine:

Although drilling is the primary operation performed by this machine, a variety of similar operations are also done on holes using other tools. The following is a list of various drilling machine operations to create different types of holes.

Drilling

A cutting process that involves spinning a drill bit to create a circular hole in solid materials is known as drilling. The drill bit is typically a multi-point rotary cutting tool. The bit is pressed against the workpiece and rotated at speeds between several hundred and several thousand revolutions per minute. This causes the cutting edge to press against the workpiece, removing chips as the hole is drilled which is shown in the schematic diagram

Types of Boring Machines

- Horizontal Boring Machine (HBM)
 1. Table type HBM
 2. Planer type HBM
 3. Floor Type HBM
 4. Multiple Spindle HBM
- Vertical Boring Machine (VBM)
 1. Single Column VBM
 2. Double Column VBM

Types of

- Horizontal

 1. Table ty
 2. Planer ty
 3. Floor Typ
 4. Multiple S

- Vertical l

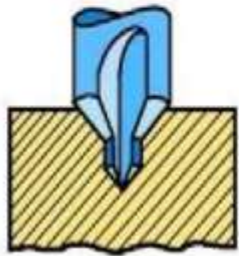
 1. Single C
 2. Double C

Types of Boring Machines

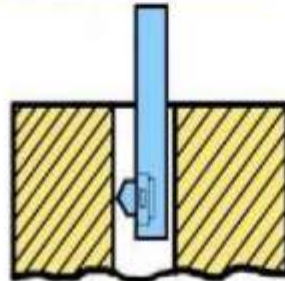
Types of

Drilling Operations

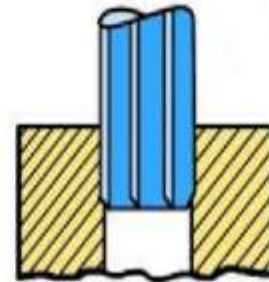
Drilling



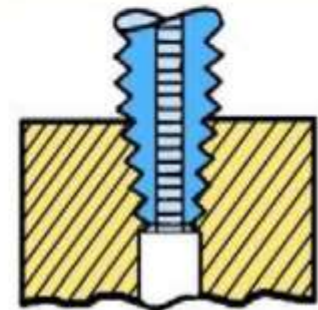
Boring



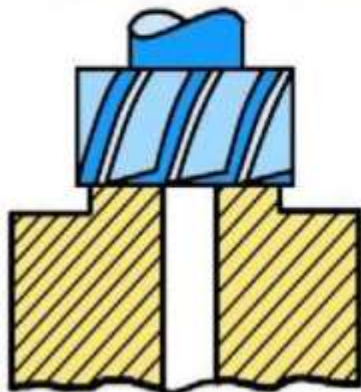
Reaming



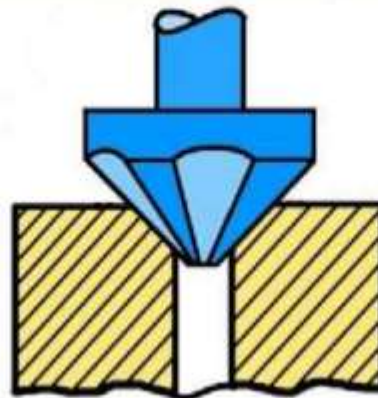
Tapping



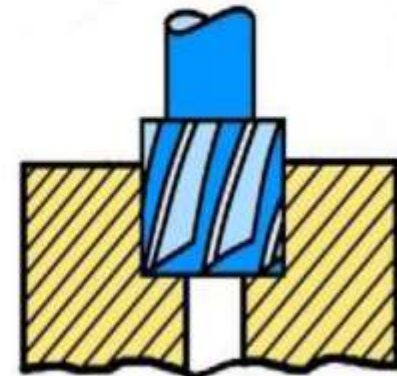
Spot Facing



Counter Sinking



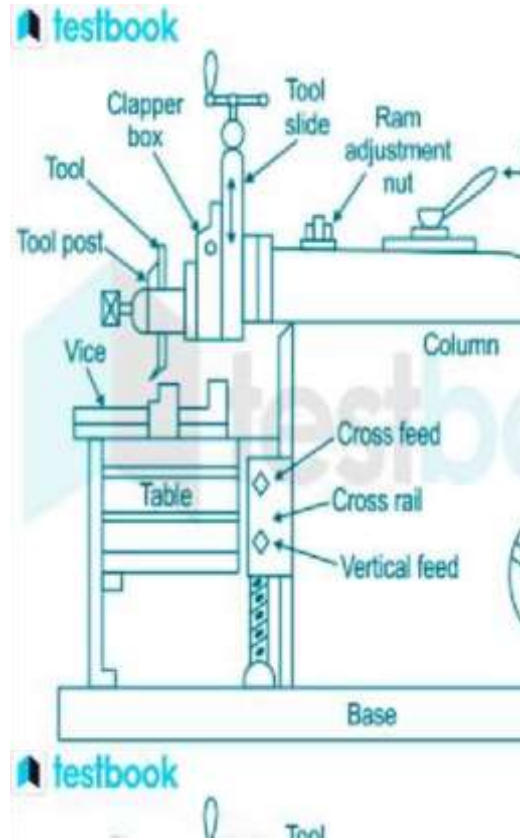
Counter Boring



Application:

- 1 Boring machines are commonly used in the manufacturing industry for several applications, including machining of engine blocks, connecting rods, and cylinders in the automotive industry. Additionally,
- 2 they are also used in the production of gears, pumps, and other industrial components.
- 3 These machines are essential for precision engineering, and they help to ensure that the final product meets the required specifications,
- 4 operation of a boring machine involves the use of a cutting tool to remove material from the workpiece.
- 5 cutting tool is mounted on a spindle, which rotates at high speed, while the workpiece remains stationary. The machine may be manually operated, but more advanced models are computer-controlled and can perform complex operations with high precision

Parts of Shaping Machine:



Base:

The base of the shaper holds all of the weight of the machine tool, and it is bolted to the shop floor. It is generally made of cast iron. It absorbs vibrations and other forces imparted during shaping operation.

Column:

The column is also made of cast iron in a box shape. It is set on the base of the shaper. It has precisely machined guideways on top that allow the ram to move back and forth. For the cross rail to move, there are guideways on the front vertical face. The ram-driving mechanism is inside the column. The base holds the column in place.

Table:

The table is one of the crucial components of the device which is mounted on the saddle. The elevating screw and crossfeed rod can be

Vice

Clamp or vice is mounted on the table to hold the workpiece firmly while the shaping process is in progress.

Crossrail

This part is fixed to the vertical guideways of the column. By turning an elevating screw, which enables the cross rail to glide on the vertical face of the column, the table can be elevated or lowered to meet the varying sizes of the task.

Saddle

It is fixed to the Crossrail securely on the top of the table. The rotation of the crossfeed screw causes the crosswise movement of the saddle which moves the table in the same direction.

Ram:

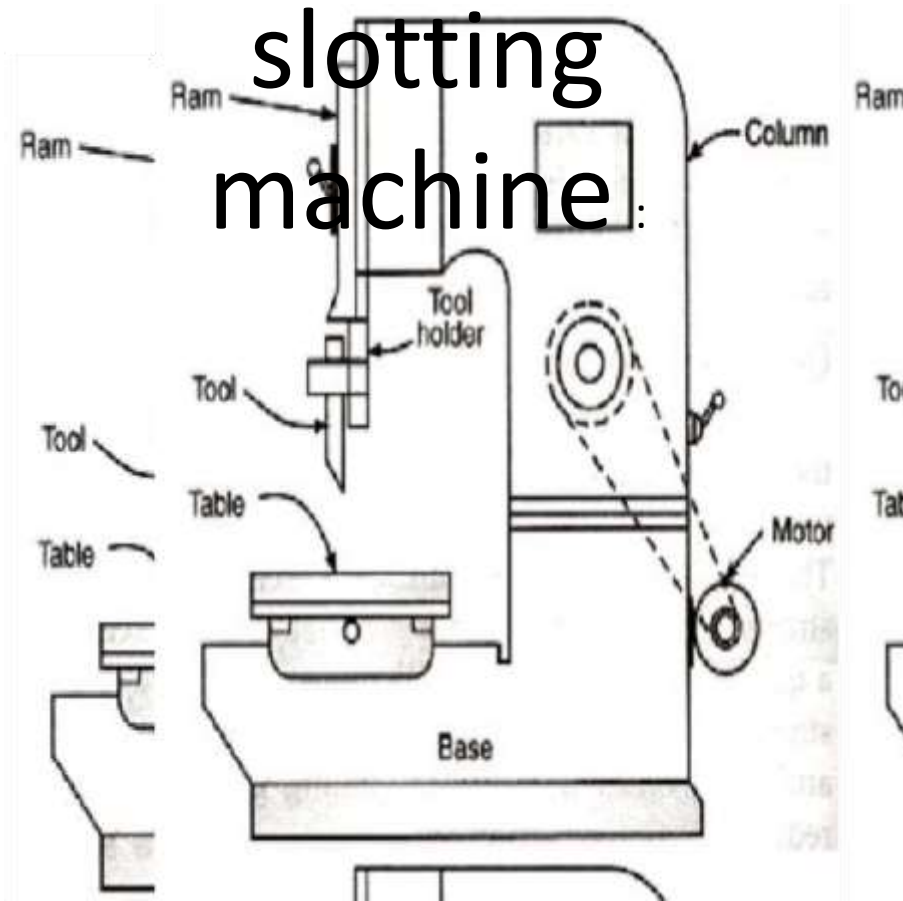
It is a component in the shaping machine that reciprocates using a quick return motion mechanism on the guideways at the top of the column while holding the tool in place. It contains a screwed shaft to adjust the working position.

Tool Head:

With the down-feed screw handle, the tool head secures the cutting tool and allows for both vertical and rotational movement. A tool head of shaping machine assembly has a vertical slide is made up of a swivel base with graduated degrees.

principle of

slotting machine:



Construction: The slotter can be considered as a vertical shaper and its main parts are:

1. Base, column and table
2. Ram and tool head assembly
3. Saddle and cross slide
4. Ram drive mechanism
and feed mechanism.

The base of the slotting machine is rigidly built to take up all the cutting forces. The front face of the vertical column has guide ways for Tool the reciprocating ram.

The ram supports the tool head to which the tool is attached. The workpiece is mounted on the table which can be given longitudinal, cross and rotary feed motion.

The slotting machine is used for cutting grooves, keys and slots of various shapes making regular and irregular surfaces both internal and external cutting internal and external gears and profiles

The slotter machine can be used on any type of work where vertical tool movement is considered essential and advantageous.

The different types of slotting machines are:

1. **Punch slotter:** a heavy duty rigid machine designed for removing large amount of metal from large forgings or castings
2. **Tool room slotter:** a heavy machine which is designed to operate at high speeds. This machine takes light cuts and gives accurate finishing.
3. **Production slotter:** a heavy duty slotter consisting of heavy cast base and heavy frame, and is generally made in two parts.

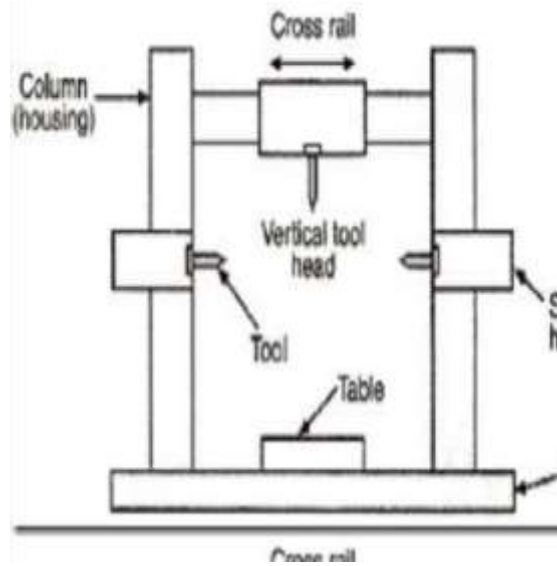
principles of working planing machine:

Operations of planer machine: The planer is used for

1. Planing flat horizontal, vertical and curved surface
2. Planing at an angle and machining dovetail
3. Planing slots and groove

Construction: The main parts of the double Housing Planer machine is Bed and table, Housings, Cross rail, , Tool heads, Driving and feed mechanism.

1 bed and table: The bed is a long heavy base and table made of cast iron. Its top surface is flat and machined accurately. The flat top surface has slots in which the workpiece can be securely clamped. The workpiece needs rigid fixing so that it does not shift out of its position. The standard clamping devices used on planer machine are: Heavy duty vice, T-holders and clamps, angle plate, planer jack, step blocks and stop. The table movement may be actuated by a variable speed drive through a rack and pinion arrangement, or a hydraulic system.



Cross rail: The cross rail is a horizontal member supported on the machined ways of the upright columns. Guide ways are provided on vertical face of each column and that enables up and vertical movement of the cross rail. The vertical movement of the cross rail allows to accommodate workpiece of different heights. Since the cross rail is supported at both the ends, this type of planer machine is rigid in construction.

Tool heads: Generally two tool heads are mounted in the horizontal cross rail and one on each of the vertical housing. Tool heads may be swiveled so that angular cuts can be made.

Driving and feed mechanism: The tool heads may be fed either by hand or by power in crosswise or vertical **direction. The motor drive is usually** at one side of the planer near the centre and drive mechanism is located under the table.

The size of the planer is specified by the maximum length of the stroke, and also by the size of the largest rectangular **solid that can be**

- Spindle Speed - N
 - v = cutting speed
 - D_o = outer diameter

$$N = \frac{v}{\pi D_o}$$

(rpm)

- Feed Rate - f_r
 - f = feed per rev

$$f_r = N f$$

(mm/min -or- in/min)

- Depth of Cut - d
 - D_o = outer diameter
 - D_f = final diameter

$$d = \frac{D_o - D_f}{2}$$

(mm/rev -or- in/rev)

- Machining Time - T_m
 - L = length of cut

$$T_m = \frac{L}{f_r}$$

(min)

- Mat'l Removal Rate - MRR

(mm³/min -or- in³/min)

If
$$K = \frac{\text{Time for return stroke}}{\text{Time forward stroke}}$$

Then cutting speed is given by

$$S = \frac{L(1+K)}{1,000} \times N \text{ m/min}$$

Now time taken by cutting stroke = $\frac{L}{S \times 1,000}$

Now time taken by return stroke = $\frac{L}{S \times 1,000} \times K$

The total time for one cut (one cutting stroke and one return stroke)

$$T = \frac{L}{S \times 1,000} + \frac{LK}{S \times 1,000} = \frac{L(1+K)}{1,000 \times S}$$

Now if $W = \text{Width of job in mm}$
 $f = \text{feed per stroke}$

Then number of strokes required to complete one pass on full width = $\frac{W}{f}$

Total time for completing one cut = $\frac{L(1+K)}{1,000 S} \times \frac{W}{f}$

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Then number of strokes required to complete one pass on full width = $\frac{W}{f}$

Total time for completing one cut = $\frac{L(1+K)}{1,000 S} \times \frac{W}{f}$

Machining Time

Let

L = length of ram stroke, mm
 B = breadth of job, mm
 f = feed in mm/double stroke
 m = ratio of return time to cutting time
 v = cutting speed, m/min

We know from Eqn. (6.85) that

$$\text{Time taken in completing one double stroke} = \frac{L}{1000 \cdot v} (1 + m)$$

$$\text{Total number of double strokes required to complete the work} = \frac{B}{f}$$

$$\text{Hence, time taken to complete machining} = \frac{L \cdot B \cdot (1 + m)}{1000 \cdot f \cdot v}$$

Metal removal rate (MRR)

$$\text{MRR} = f \cdot v \cdot \pi \cdot L (1 + m), \text{ mm}^3/\text{min}$$

Machining Time

Principle and Working of MILLING MACHINE:

Working Principle:

The workpiece is holding on the worktable of the machine. The table movement controls the feed of workpiece against the rotating cutter. The cutter is mounted on a spindle or arbor and revolves at high speed. Except for rotation the cutter has no other motion. As the workpiece advances, the cutter teeth remove the metal from the surface of workpiece and the desired shape is produced.

