Junior Cert Engineering Grinds – Week 6

Topic: Drilling & Cutting Speeds

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Education is the key to success

Junior Cert
Engineering
Grinds

Week 6:
Drilling & Cutting Speeds

Sound & Visual Check

"I am now talking…."

"If you **cannot** hear me or see my screen please say "Cannot hear/see you" on the chat.

"If some of you can't hear me, please restart your computer and join the class again."

Junior Cert
Engineering
Grinds

Week 6:
Drilling & Cutting Speeds

Lesson Overview:

By the end of this lesson you should:

- **Understand** how the pillar drill works and how to calculate cutting speeds
- **Identify** each part of the pillar drill
- **Define** the function of each part of the pillar drill
- **Know** the difference between different types of holes
- **Have** a better understanding of the Pillar Drill, its parts, safety and uses of it

- # The Pillar Drill

Allows to drill, ream, counter-bore, countersink and tap holes

- **The Pillar Drill**

How does it work???

How does it work???

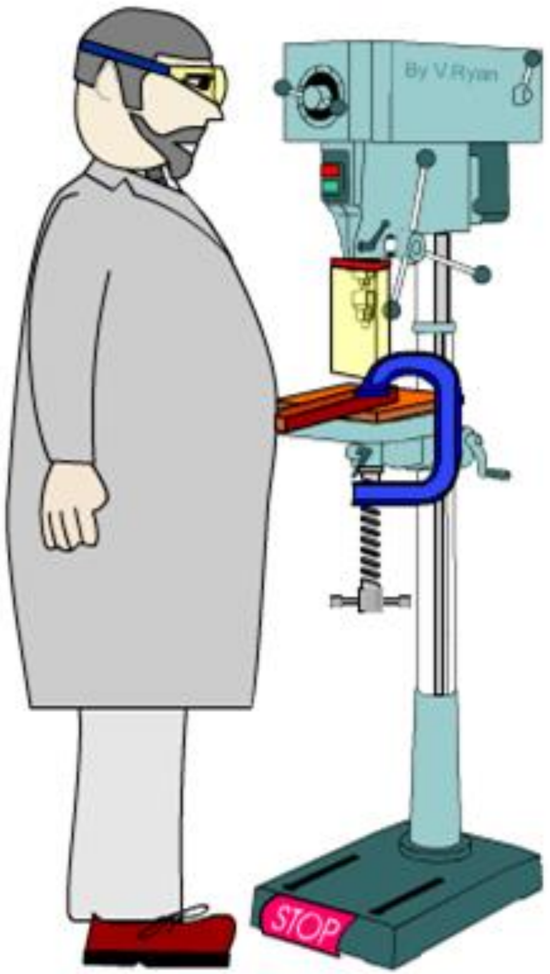
- Motor turns on and turns the back spindle (rotation)
- Belt carries the motion across to the chuck spindle
    - This causes the chuck to rotate (drill bit)
- ***Rack and Pinion Mechanism*** allows chuck to move up and down (Manual Feed Lever)

- **The Pillar Drill**

SAFETY!

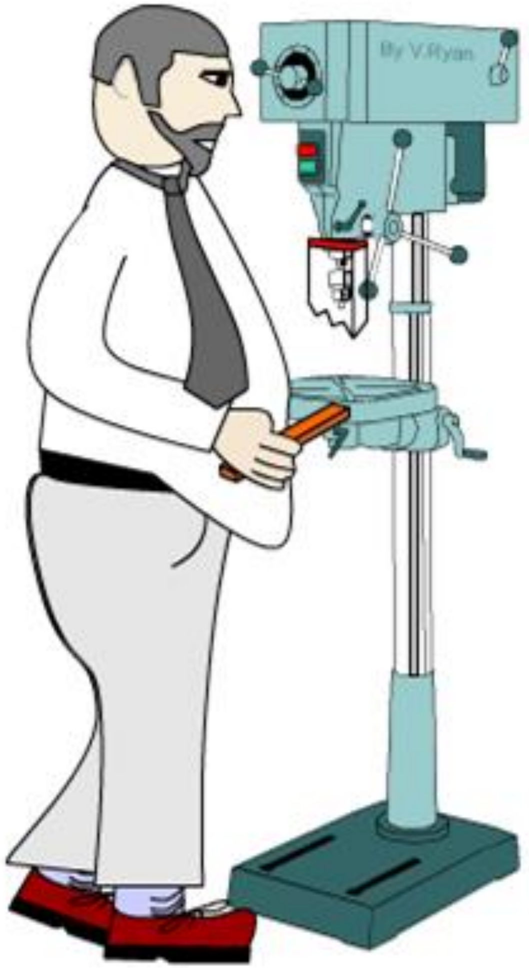
ED 1

SENSIBLE ED THE HANDY MAN
IS READY
TO OPERATE THE DRILL

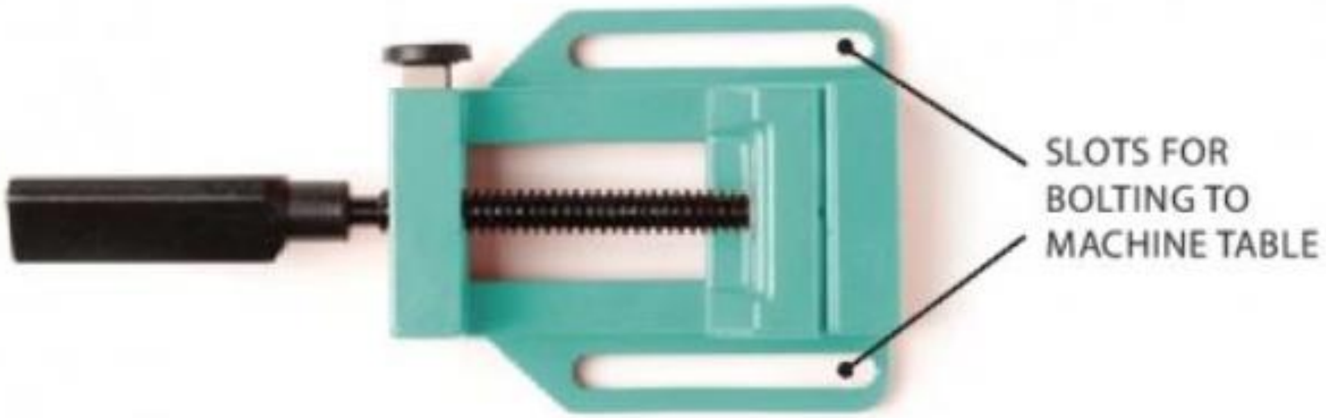


ED 2

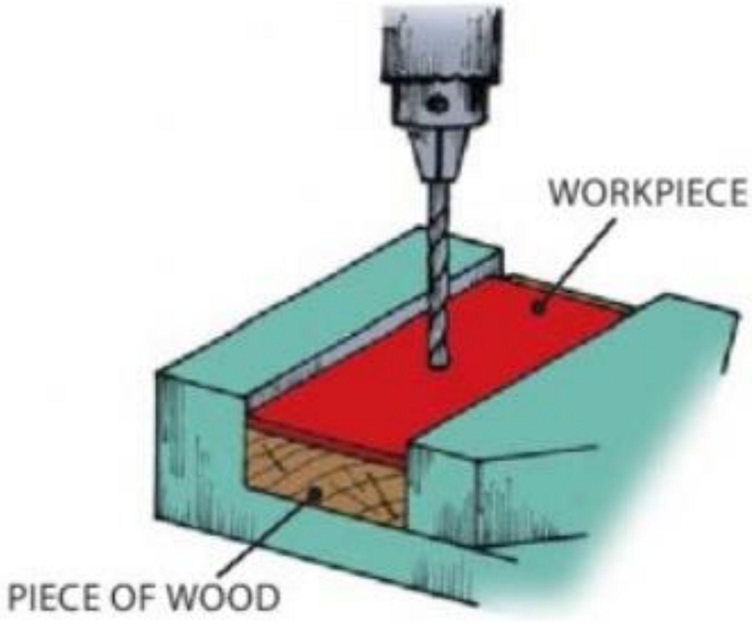
ED IS NOT READY TO
USE THE DRILL SAFELY



Holding the Work for Drilling

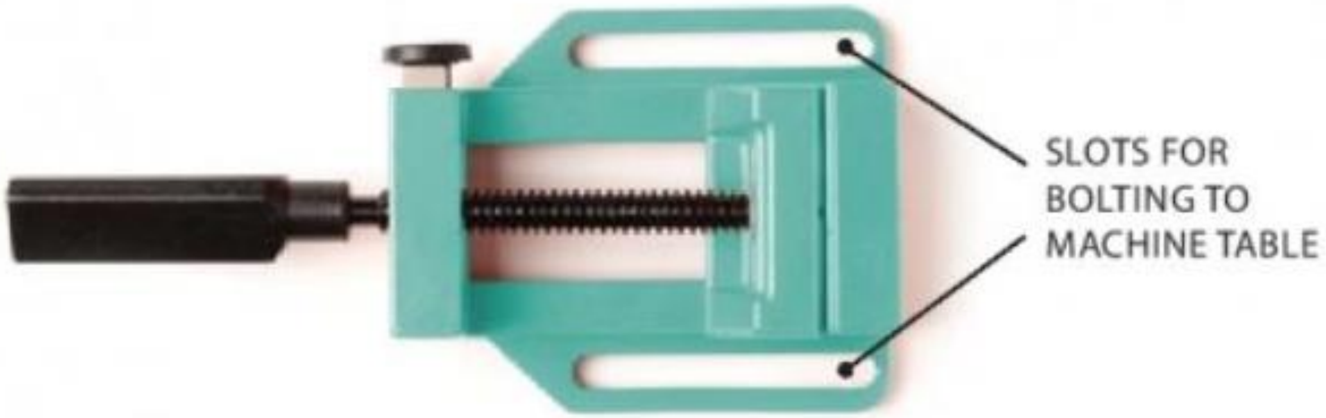


Machine vice

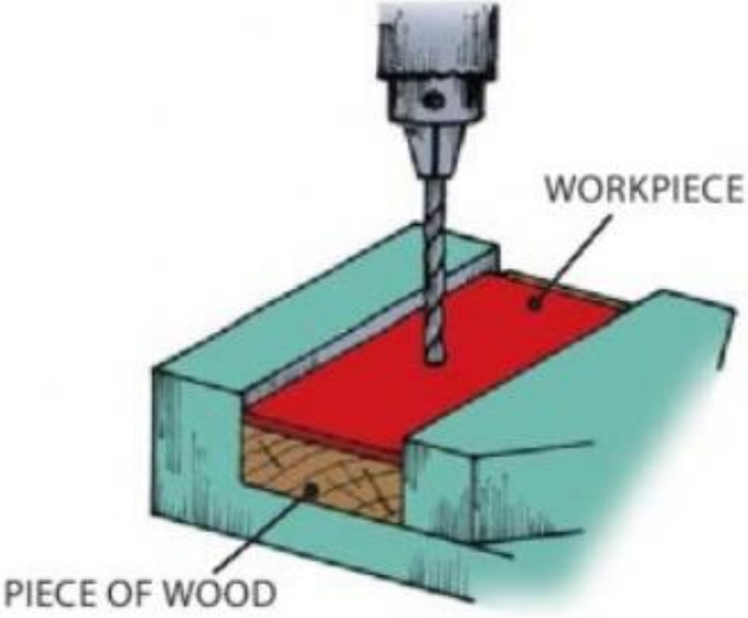


Holding the Work for Drilling

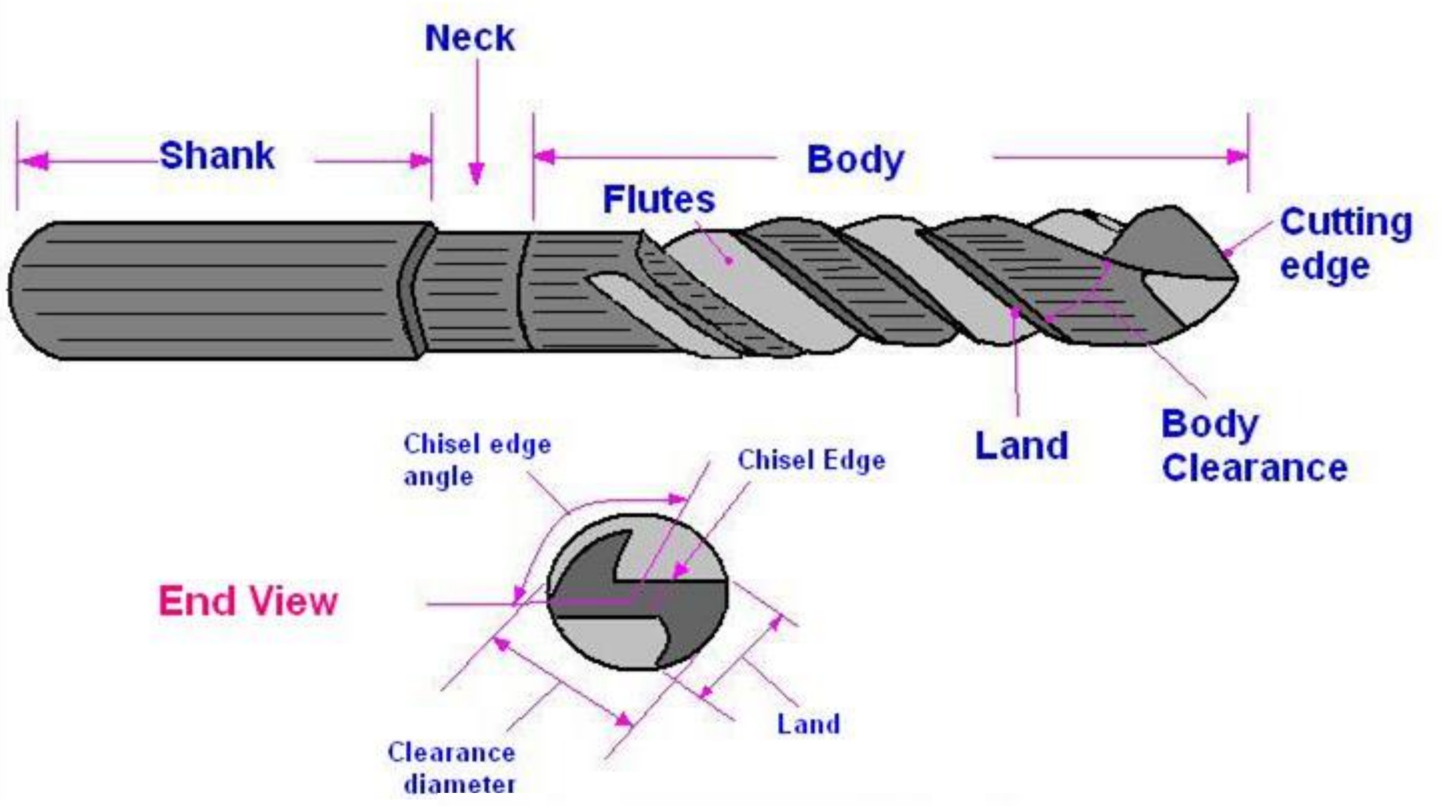
- Ensure that your piece is even and level in the vice!!
    - How? Make sure the **drill bit** and **material** make a **right angle/inverted T shape** when secured.



Machine vice



Parts of Twist Drill



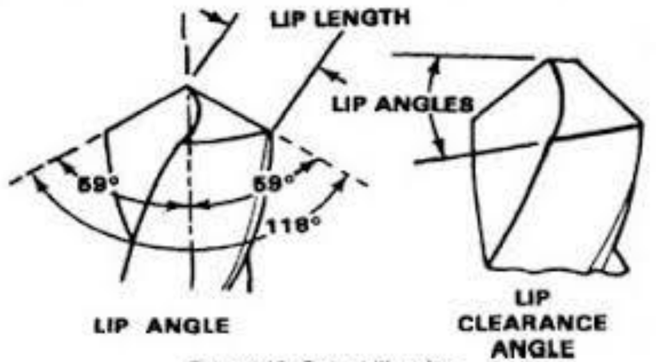
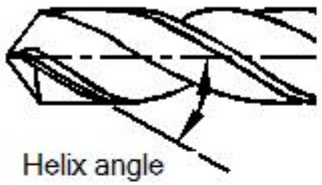


Figure 4-13. Twist drill angles.

- Made of HSS (High Speed Steel)
- Bits up to 13mm have parallel shanks, after that they are tapered
- Parallel Shank – Chuck
- Tapered Shank – Taper Bore of Spindle
- Flutes – Provide cutting lips, allow swarf to escape and allows cutting fluid to reach cutting edges.
- Body Clearance – Reduces Friction – slightly smaller than diameter of bit
- Std Drills Point Angle = 118°, Lip clearance = 12°



- **Slow Helix** – Reduced rake angle, *brass and bronze*
- **Quick/High Helix** – Increased rake angle, softer materials (*copper and aluminium*)

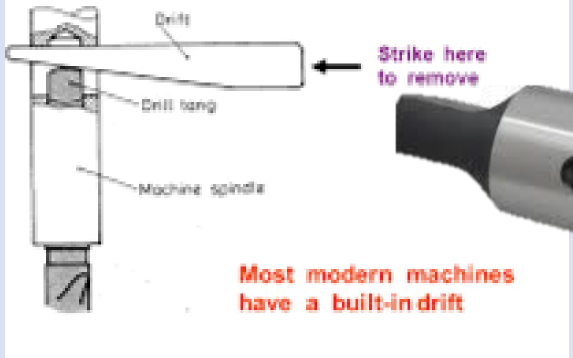
Used to finish holes – smoother finish

<u>Drill Grinding</u>

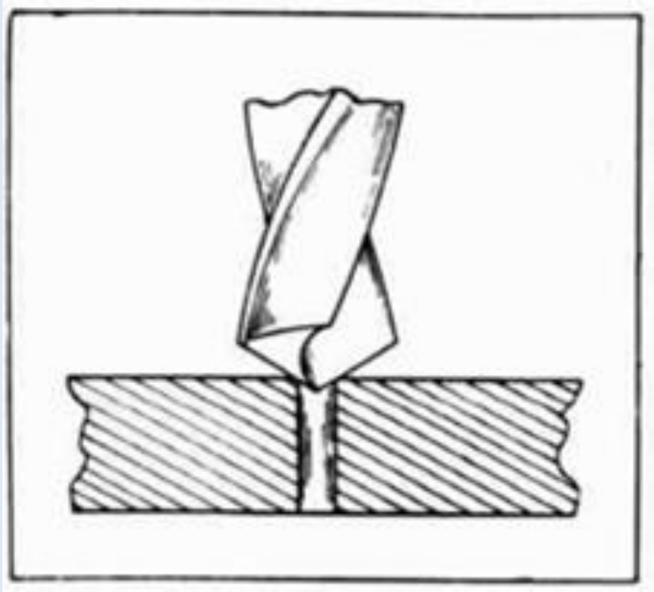
- Tools must be re-ground if the lips become blunt/chipped/land becomes worn away towards the point.
- Both lips must be at the same angle to the drill axis.

<u>Drill Drift</u>

- Used for removing tools (reamers/morse taper sleeves)

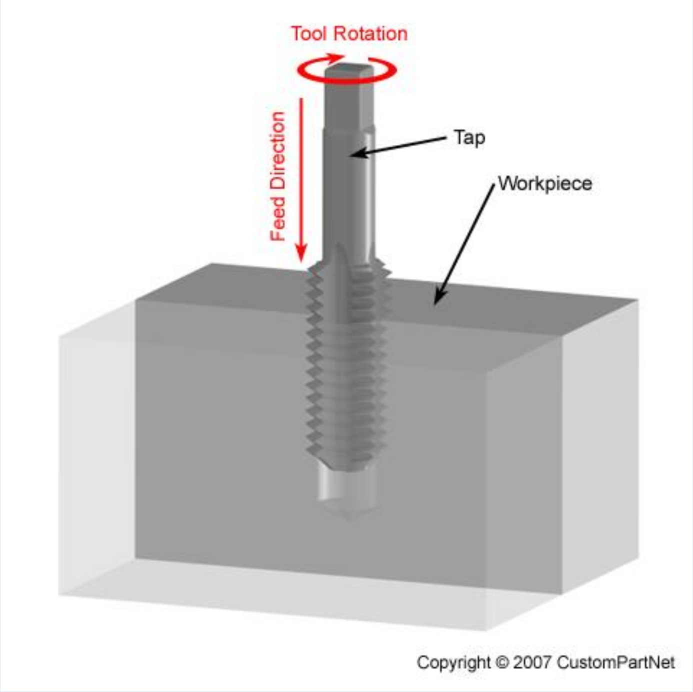


PILOT HOLE



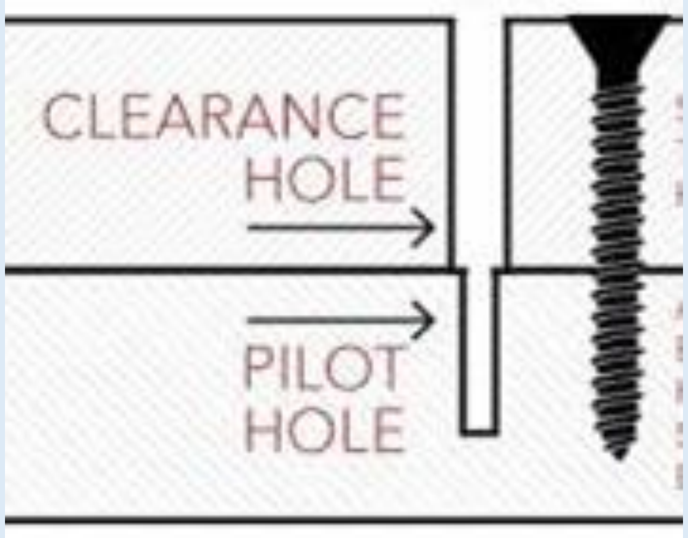
- Smaller hole drilled 1st
- Keeps large drill bit central
- Chisel edge of drill bit does not have to do any cutting

TAPPING SIZE HOLE



- Drilled prior to cutting an internal thread
- Must be smaller than the tapping tool (.5 smaller)

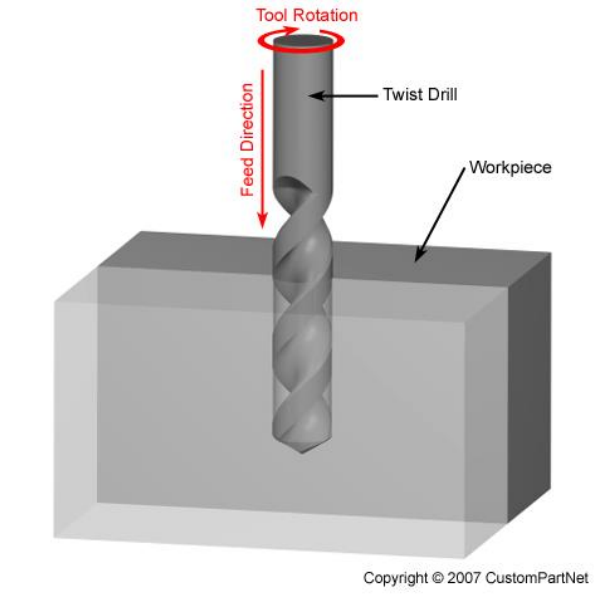
CLEARANCE HOLE



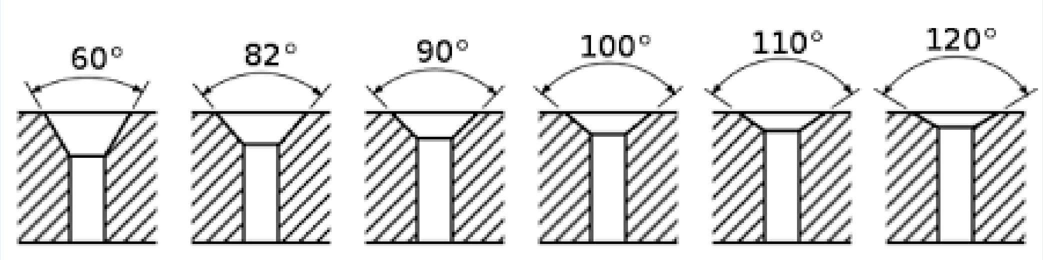
- Screw passes freely through pilot hole
- Grips onto edges of pilot hole
- Head of the screw pulls the 2 pieces of material together

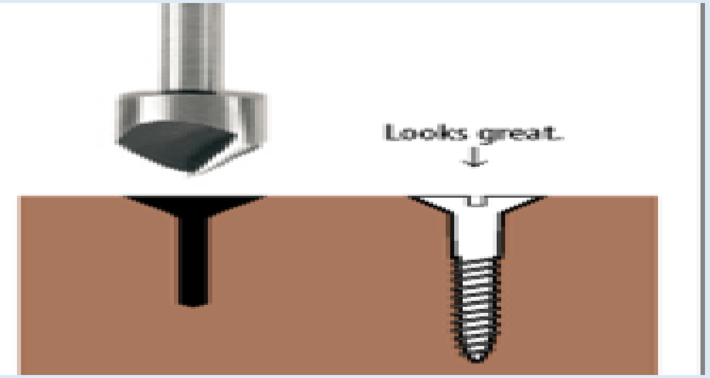
COUNTERSINKING HOLES

BLIND HOLE



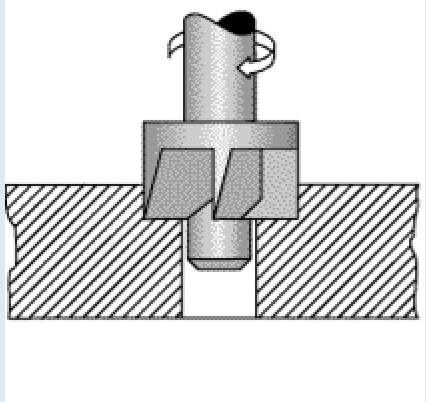
- Does not go all the way through a part
- Can be tapped to allow a screw to be used without a nut





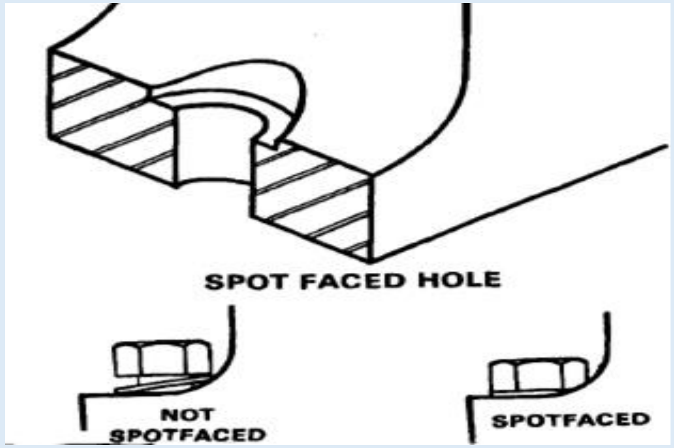
- Enlarging the mouths of the holes to accommodate the heads of csk head screws and rivets.
- Point angles of : 60°/90°
- A twist drill can be used, but the point angle must be ground to the required angle.

COUNTERBORING HOLES



- Enlarging the top of previously drilled hole to accommodate flathead/cheesehead screws.
- Counterboring bit has a pilot on the end to guide it straight into the existing hole.

SPOT FACING



- Machining of rough/uneven surfaces surrounding holes – provide a flat seating.

CUTTING FLUIDS

Coolants/cutting lubricants

- **Why are they used??**
  - Cutting tool lasts longer
  - Machining can be carried out at a greater speed
  - Better surface finish
  - Keeps everything cool
  - Reduces friction

SPINDLE SPEED

- **<u>REVOLUTIONS PER MIN</u>**
  - **<u>Depends on:</u>**
  - Size of the drill bit
  - Type of material being drilled
    - Softer=Higher Speed
  - HSS or HCS? HSS @ higher temp- retain hardness
  - Use of coolant

CUTTING SPEEDS

$$N = \frac{S \times 1000}{\pi \times D}$$

N *= Spindle Speed in rev/min*
S *= Cutting Speed in metres/min*
D *= Diameter of drill bit*

(b) A 15 mm diameter bar is to be turned on the lathe. The material has a surface cutting speed of 126 m/min. Using the given formula, calculate the speed in RPM. (Take π as 3)

$$N = \frac{S \times 1000}{\pi \times D}$$

Using the formula below, answer the following questions. (Round up answers if a decimal place is given)

$$\frac{\textbf{S X 1000}}{\boldsymbol{\pi}\ \textbf{X D}}$$

A 15mm diameter bar is to be turned on the lathe. The material has a surface cutting speed of 126m/min. Using the given formula, calculate the speed in RPM and take π as 3.

Using the formula below, answer the following questions. (Round up answers if a decimal place is given)

$$\frac{S \times 1000}{\pi \times D}$$

A 15mm diameter bar is to be turned on the lathe. The material has a surface cutting speed of 126m/min. Using the given formula, calculate the speed in RPM and take π as 3.

Using the formula below, answer the following questions. (Round up answers if a decimal place is given)

$$\frac{S \times 1000}{\pi \times D}$$

A 15mm diameter bar is to be turned on the lathe. The material has a surface cutting speed of 126m/min. Using the given formula, calculate the speed in RPM and take π as 3.

$$\frac{126 \times 1000}{3 \times 15} = \frac{126000}{45} = 2800 \text{ RPM}$$

Using the formula below, answer the following questions. (Round up answers if a decimal place is given)

$$\frac{\mathbf{S \times 1000}}{\mathbf{\Pi \times D}}$$

A 12mm hole is drilled in a material which has the surface cutting speed of 72m/min.

Calculate the speed in RPM and take π as 3.

Using the formula below, answer the following questions. (Round up answers if a decimal place is given)

$$\frac{S \times 1000}{\pi \times D}$$

A 12mm hole is drilled in a material which has the surface cutting speed of 72m/min.

Calculate the speed in RPM and take π as 3.

Using the formula below, answer the following questions. (Round up answers if a decimal place is given)

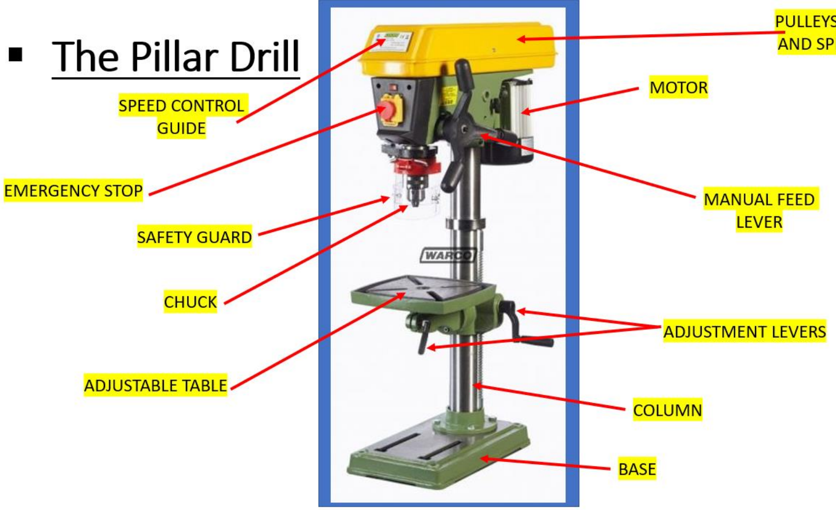
$$\frac{S \times 1000}{\pi \times D}$$

A 12mm hole is drilled in a material which has the surface cutting speed of 72m/min.
Calculate the speed in RPM and take π as 3.

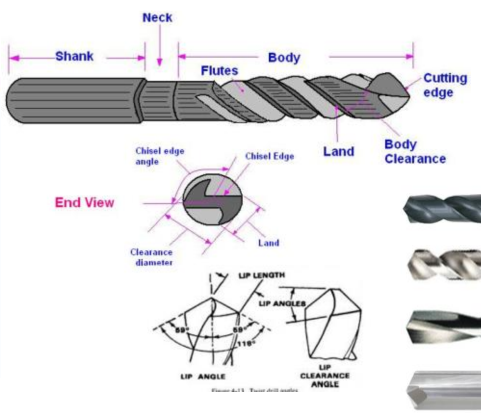
$$\frac{72 \times 1000}{3 \times 12} = \frac{72000}{36} = 2000 \text{ RPM}$$


SUMMARY

The Pillar Drill

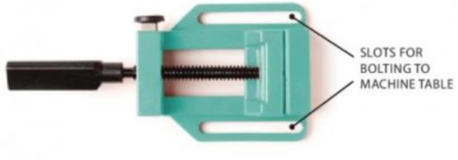


How does it work???

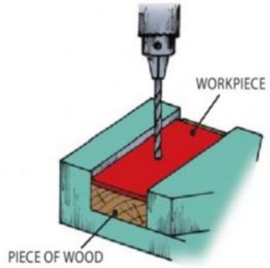


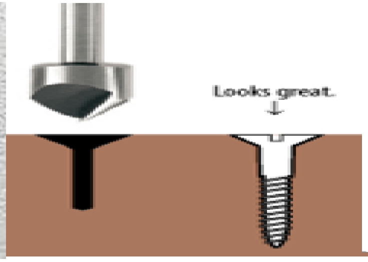
The Pillar Drill

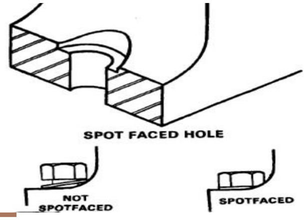
SAFETY!



Machine vice







CUTTING FLUIDS

Coolants/cutting lubricants

- **Why are they used??**
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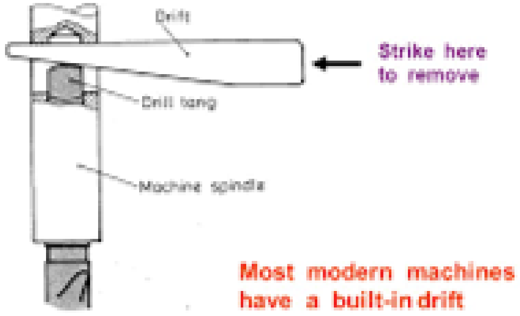
CUTTING SPEEDS

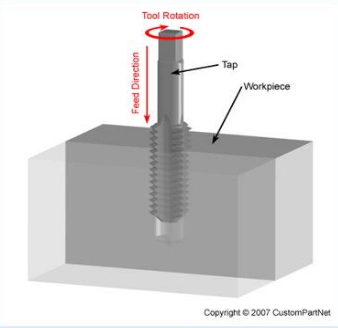
$$N = \frac{S \times 1000}{\pi \times D}$$

N *= Spindle Speed in rev/min*
S *= Cutting Speed in metres/min*
D *= Diameter of drill bit*

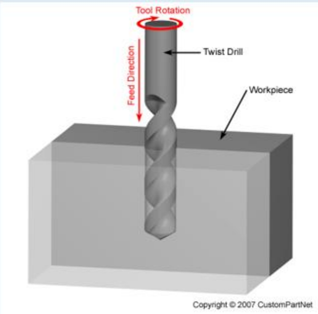


Most modern machines have a built-in drift

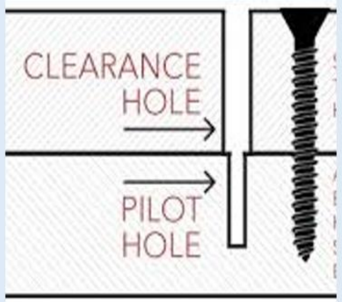
TAPPING SIZE HOLE



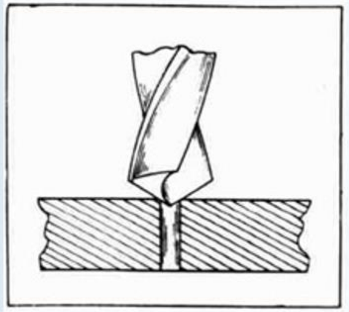
BLIND HOLE



CLEARANCE HOLE



PILOT HOLE



I must do some revision
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Question 3 **20 Marks**

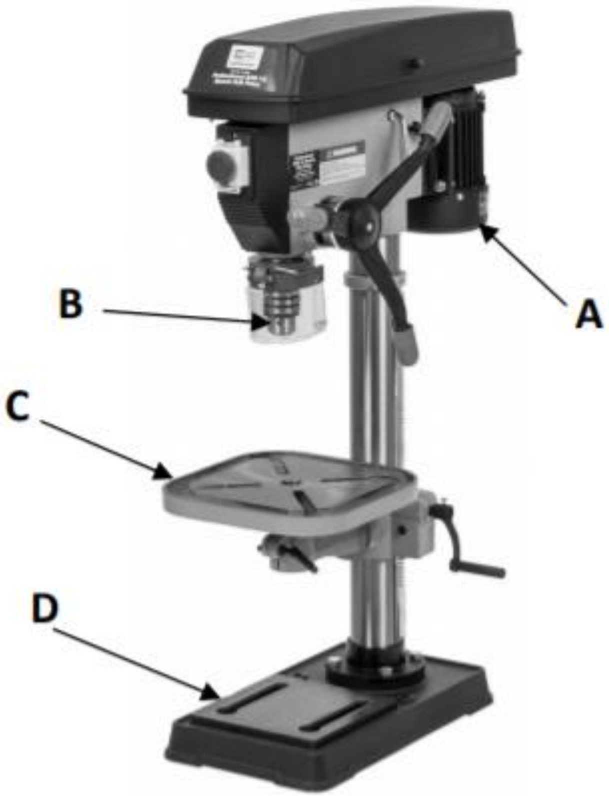
(a) **(i)** Name parts **A**, **B**, **C** and **D** of the pillar drilling machine shown.

(ii) Name and describe a suitable mechanism used to adjust the height of part **C**.

(iii) Identify **any two** integrated safety features on the pillar drilling machine shown.

(iv) Name an alloy steel used to make drill bits and explain why this material is suitable for drill bits.

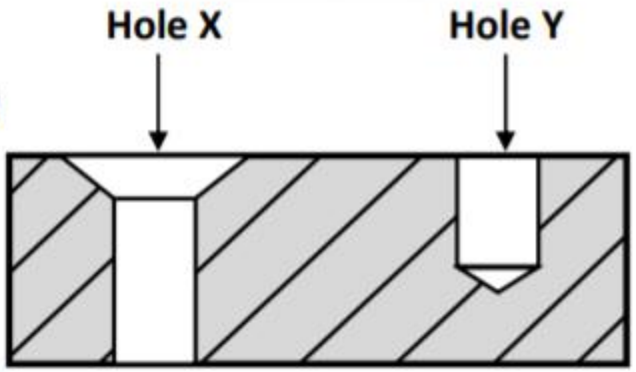
(10 marks)



(b) A Ø16 mm hole is to be drilled in a material which has a surface cutting speed of 120 m/min. Using the given formula, calculate the speed in RPM. (Take π as 3).

$$N = \frac{S \times 1000}{\pi \times D}$$

(4 marks)



(c) **(i)** Name **each** of drilled holes **X** and **Y** shown opposite.

(ii) Describe the stages required to fully thread hole **Y** using M4 taps.

(6 marks)

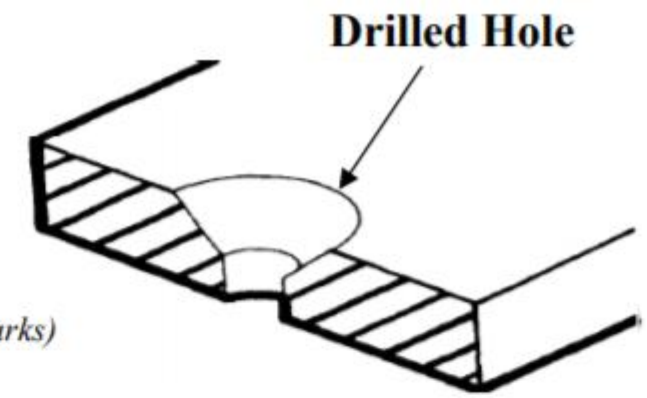
Question 3 **20 Marks**

(a) **(i)** Explain the meaning of the term *spindle speed* in relation to the drilling machine.

(ii) Outline **any two** reasons why the spindle speed of a drilling machine may need to be changed.

(iii) Identify the type of drilled hole shown opposite.

(iv) Explain the purpose of the morse taper sleeve shown. *(10 marks)*



Sectional View of Drilled Hole

(b) A 15 mm diameter bar is to be turned on the lathe. The material has a surface cutting speed of 126 m/min. Using the given formula, calculate the speed in RPM. (Take π as 3)

$$N = \frac{S \times 1000}{\pi \times D}$$

(4 marks)

Morse Taper Sleeve

(c) Select **any two** of the following and explain the difference between the terms:

(i) Chuck Key and Allen Key;

(ii) Drill Gauge and Feeler Gauge;

(iii) Pilot hole and Blind hole. *(6 marks)*

Any questions

Next Week's Lesson:

Junior Cert Engineering Grinds – Week 7

Topic:

Thread Cutting

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