



Unit 1:

1.1 Introduction

Introduction of Tool Engineering

(Introduction of Tool Engineering)

Tool engineering is a branch of engineering that deals with the design, development, and manufacturing of tools. It is a multidisciplinary field that involves the application of principles from various engineering disciplines such as mechanical, electrical, and computer engineering. The primary goal of tool engineering is to create tools that are efficient, reliable, and easy to use. This involves understanding the requirements of the user and designing a tool that meets those requirements. The design process typically involves the use of computer-aided design (CAD) software to create a 3D model of the tool. This model is then used to generate the manufacturing instructions for the tool. The manufacturing process typically involves the use of CNC machines to create the tool. Once the tool is manufactured, it is tested to ensure that it meets the required specifications. Tool engineering is a rapidly growing field due to the increasing demand for precision tools in various industries such as automotive, aerospace, and medical.

1.2 Importance of Tool Engineering

The importance of tool engineering lies in its ability to create tools that are essential for various industries. Tools are used in a wide range of applications, from simple tasks like drilling and cutting to complex tasks like manufacturing and assembly. The quality of the tools used in these applications can have a significant impact on the efficiency and safety of the process. For example, a poorly designed tool can lead to increased wear and tear, reduced productivity, and even accidents. On the other hand, a well-designed tool can improve the quality of the work, reduce the risk of accidents, and increase the overall efficiency of the process. Tool engineering also plays a crucial role in the development of new technologies. Many of the tools used in modern manufacturing and research are the result of advanced tool engineering techniques. For example, the development of high-speed cutting tools has enabled the manufacturing of complex parts that were previously impossible to produce. Similarly, the development of precision tools has enabled the manufacturing of micro-components that are essential for many modern technologies. In addition, tool engineering is also important for the maintenance and repair of tools. By understanding the principles of tool engineering, users can better understand how to use their tools correctly and how to maintain them to ensure their longevity.

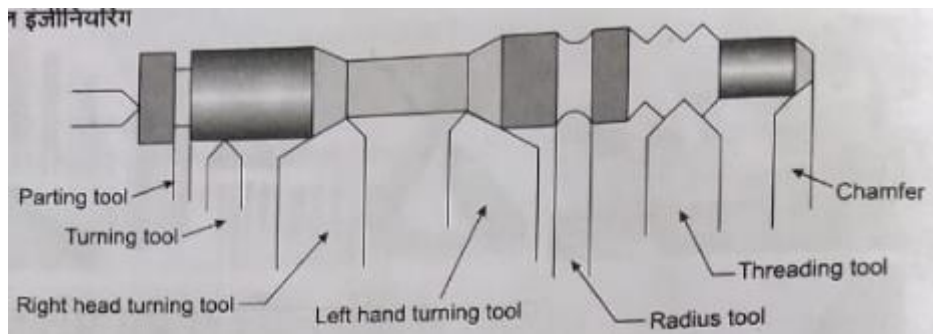
Importance of Tool Engineering

1. Tool engineering is a multidisciplinary field that involves the application of principles from various engineering disciplines such as mechanical, electrical, and computer engineering.
2. The primary goal of tool engineering is to create tools that are efficient, reliable, and easy to use.

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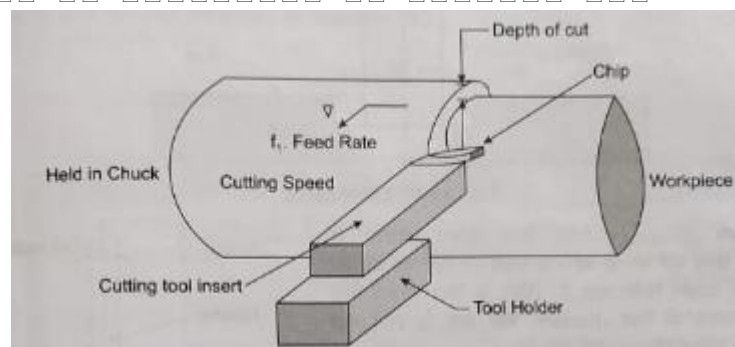
 (Depth of cut)
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2. (Turning) -
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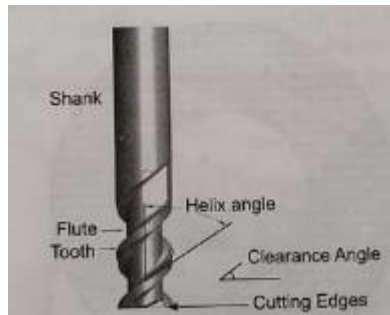


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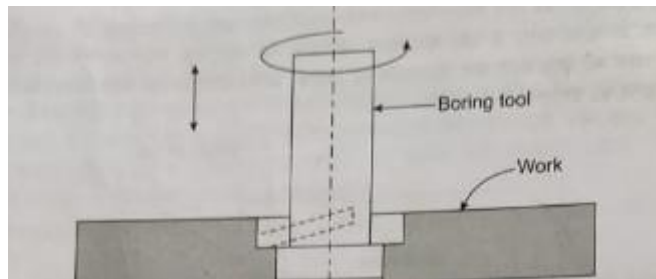
1.3: Lathe Turning

3. Drilling - Drilling is a process of creating a hole in a workpiece. The most common type of drill is the twist drill. The twist drill has two cutting edges and a helix angle. The cutting edge is the edge of the drill that does the cutting. The helix angle is the angle between the cutting edge and the axis of the drill. The clearance angle is the angle between the flank of the drill and the cutting edge. The cutting edges are the edges of the drill that do the cutting. The cutting edges are the edges of the drill that do the cutting.



1.4: Twist Drill

4. Boring - Boring is a process of creating a hole in a workpiece. The boring tool is used to create a hole in a workpiece. The boring tool is used to create a hole in a workpiece. The boring tool is used to create a hole in a workpiece. The boring tool is used to create a hole in a workpiece.



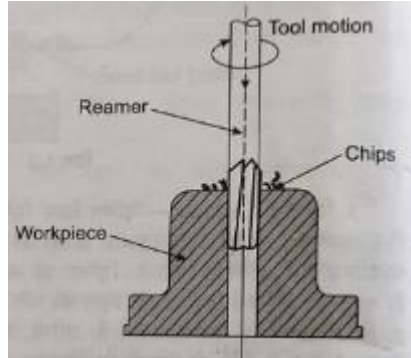
1.5: Boring

5. Reaming - Reaming is a process of creating a hole in a workpiece. The reamer is used to create a hole in a workpiece. The reamer is used to create a hole in a workpiece. The reamer is used to create a hole in a workpiece. The reamer is used to create a hole in a workpiece. The reamer is used to create a hole in a workpiece.

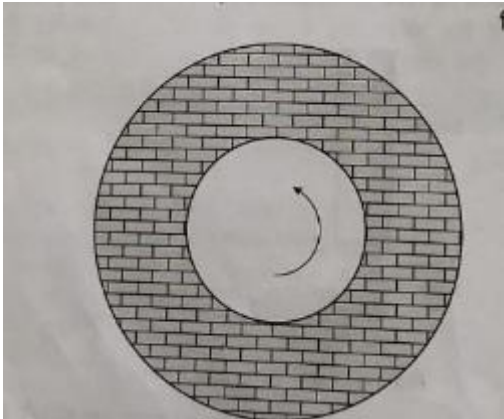
6. Tripping - Tripping is a process of creating a hole in a workpiece. The tripping tool is used to create a hole in a workpiece. The tripping tool is used to create a hole in a workpiece. The tripping tool is used to create a hole in a workpiece. The tripping tool is used to create a hole in a workpiece. The tripping tool is used to create a hole in a workpiece.

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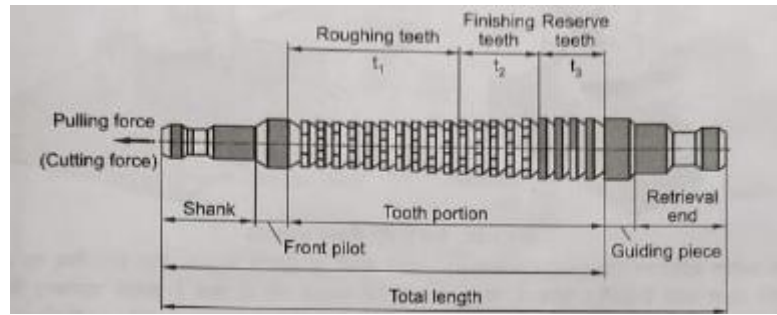


Figure 1.8: End mill

8. Milling (Milling) - The process of removing material from a workpiece by the action of a rotating cutter. The cutter is fed into the workpiece, and the rotation of the cutter removes the material. The process is used for a wide range of applications, including the production of flat surfaces, slots, and complex shapes. The cutting force is applied in the direction of the cutting motion.

- (a) Slab Milling
- (b) Face Milling

(a) Slab Milling - In slab milling, the cutter is a cylindrical tool that rotates about its axis. The workpiece is fed against the rotating cutter. The cutting force is applied in the direction of the cutting motion. The geometry of the chip is determined by the cutting speed, feed rate, and depth of cut. The cutting edge of the cutter is the primary cutting edge.

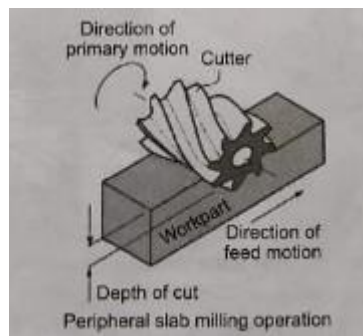


Figure 1.9: Slab Milling

(b) Face Milling - In face milling, the cutter is a cylindrical tool that rotates about its axis. The workpiece is fed against the rotating cutter. The cutting force is applied in the direction of the cutting motion. The geometry of the chip is determined by the cutting speed, feed rate, and depth of cut. The cutting edge of the cutter is the primary cutting edge.

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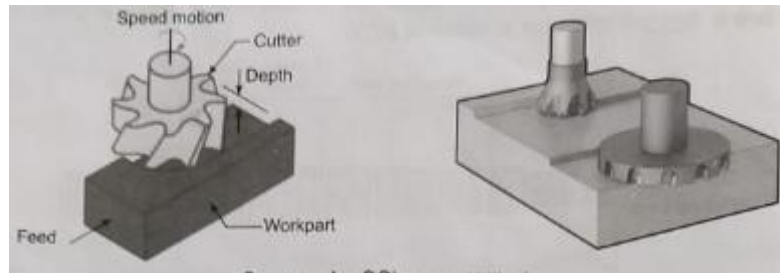


Figure 1.10: Face Milling (Face Milling)

9. **Shaping Operation** - Shaping operation is a process of removing metal from a workpiece by the reciprocating motion of a tool (ram) against a rotating workpiece. The ram moves forward to cut the metal and returns to its starting position. The cutting speed is low, and the tool life is short. This process is used for making straight surfaces, V-threads, and keyways. The ram is driven by a crank mechanism. The cutting is done on the forward stroke, and the return stroke is idle. The ram can be equipped with a quick return mechanism to reduce the return time. The cutting is done on a shaper machine. Figure 1.11 shows the shaper machine and the tools used in this operation.

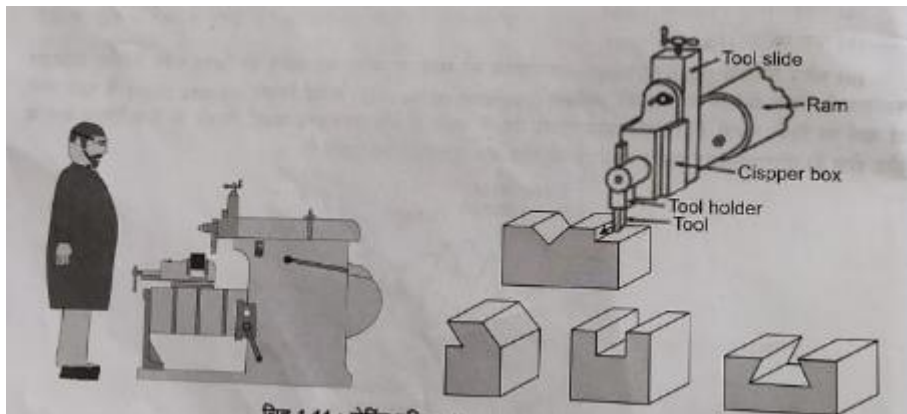


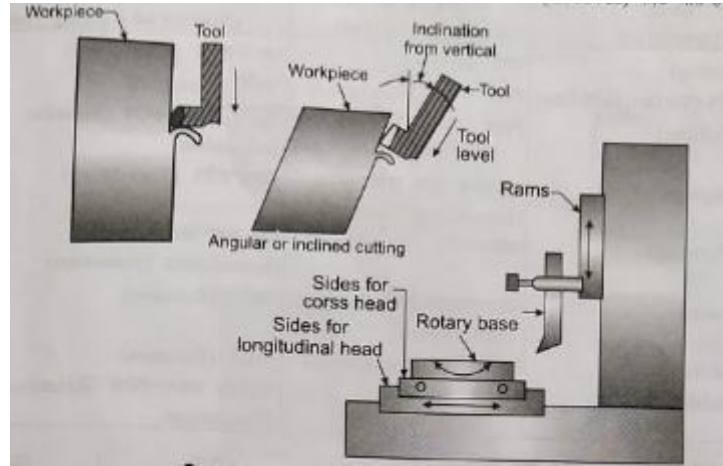
Figure 1.11: Shaping Operation (Shaping Operation)

10. **Planing Operation** - Planing operation is a process of removing metal from a workpiece by the reciprocating motion of a tool (planer) against a rotating workpiece. The planer moves forward to cut the metal and returns to its starting position. The cutting speed is low, and the tool life is short. This process is used for making straight surfaces, V-threads, and keyways. The planer is driven by a crank mechanism. The cutting is done on the forward stroke, and the return stroke is idle. The planer can be equipped with a quick return mechanism to reduce the return time. The cutting is done on a planer machine. Figure 1.11 shows the planer machine and the tools used in this operation.

11. **Slotting Operation** - Slotting operation is a process of removing metal from a workpiece by the reciprocating motion of a tool (slotter) against a rotating workpiece. The slotter moves forward to cut the metal and returns to its starting position. The cutting speed is low, and the tool life is short. This process is used for making straight surfaces, V-threads, and keyways. The slotter is driven by a crank mechanism. The cutting is done on the forward stroke, and the return stroke is idle. The slotter can be equipped with a quick return mechanism to reduce the return time. The cutting is done on a slotter machine. Figure 1.11 shows the slotter machine and the tools used in this operation.

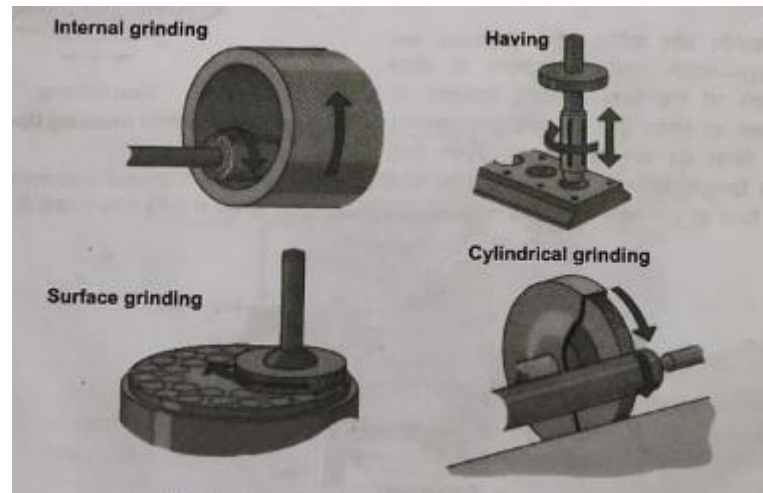
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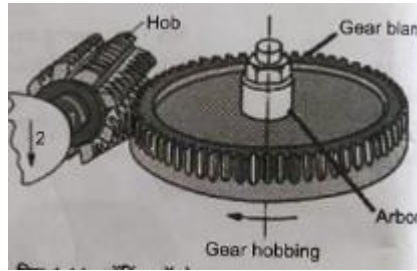


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13. □□□□□□ (Hobbing) - □□□□□□ □□ □□□ □□□ □□□□
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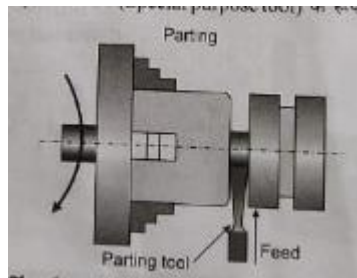


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1.14: Hobbing Operation

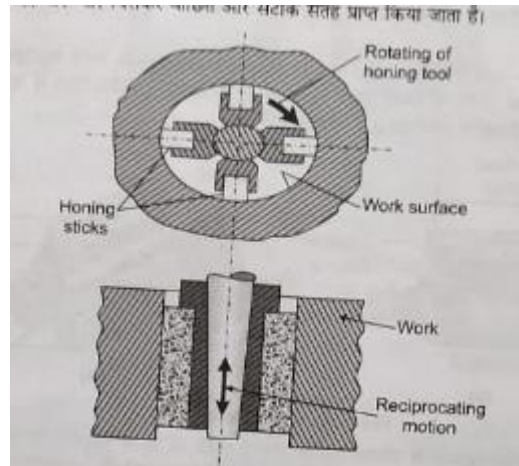
14. Forming and Parting Off - This operation is used to produce a smooth surface on a cylindrical workpiece. It is a finishing operation where the tool is fed radially into the workpiece. The tool is then drawn back across the surface. The tool used for this operation is called a parting tool. It is a special purpose tool used for cutting a groove or a groove of a certain depth on the surface of a workpiece.



1.15: Parting Operation

15. Honing - Honing is a finishing process used to produce a smooth surface on a cylindrical workpiece. It is a process where the workpiece is rotated and a honing tool is fed radially into the workpiece. The honing tool is then drawn back across the surface. The honing process produces a surface with a fine texture and a high degree of accuracy.

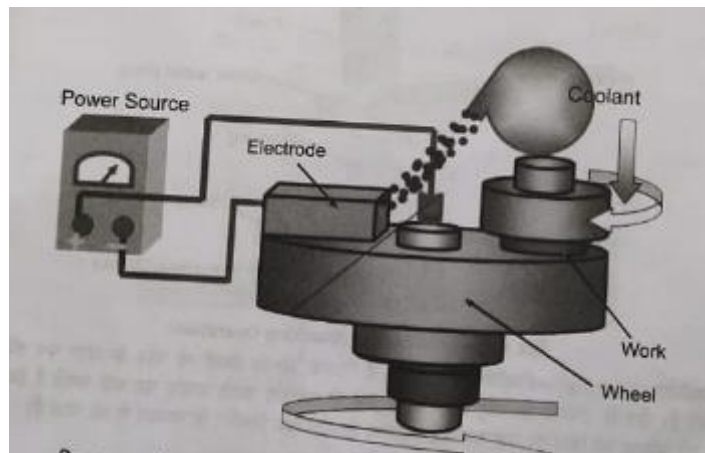
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1.16: Honing Operation

16. **(Lapping)** - **(Principle of Lapping Operation)**

Lapping is a process of finishing a workpiece by rubbing it against a lapping stone or a similar abrasive material. It is used to achieve a high degree of surface finish and dimensional accuracy. The process involves the use of a lapping tool, which is a flat, circular disc of abrasive material. The workpiece is held between two lapping tools, and the tools are rotated in opposite directions. The workpiece is reciprocated between the tools, and the abrasive material removes the surface irregularities, resulting in a smooth, flat surface.



1.17: Principle of Lapping Operation

17. **(Super finishing)** - **(Principle of Super finishing Operation)**

Super finishing is a process of finishing a workpiece by rubbing it against a super finishing stone or a similar abrasive material. It is used to achieve a high degree of surface finish and dimensional accuracy. The process involves the use of a super finishing tool, which is a flat, circular disc of abrasive material. The workpiece is held between two super finishing tools, and the tools are rotated in opposite directions. The workpiece is reciprocated between the tools, and the abrasive material removes the surface irregularities, resulting in a smooth, flat surface.

18. **(Super finishing)** - **(Principle of Super finishing Operation)**

Super finishing is a process of finishing a workpiece by rubbing it against a super finishing stone or a similar abrasive material. It is used to achieve a high degree of surface finish and dimensional accuracy. The process involves the use of a super finishing tool, which is a flat, circular disc of abrasive material. The workpiece is held between two super finishing tools, and the tools are rotated in opposite directions. The workpiece is reciprocated between the tools, and the abrasive material removes the surface irregularities, resulting in a smooth, flat surface.

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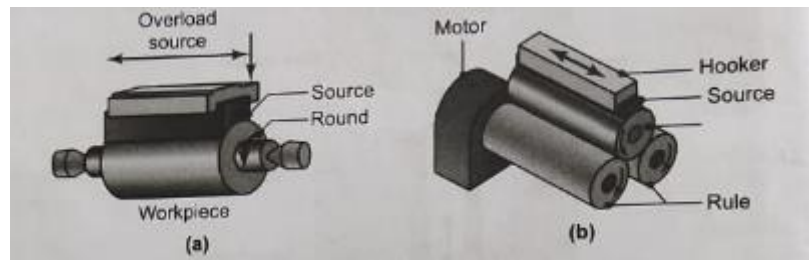


Figure 1.18: Lathe workholding methods

19. **Blanking** - A process of cutting a flat sheet metal piece into a desired shape using a punch and die. The process produces a blank (the desired shape) and scrap (the remaining material). The punch is a cylindrical tool that fits into a die cavity. The sheet metal piece is placed between the punch and the die. The punch is then pushed down, forcing the metal into the die cavity and creating a blank. The remaining material is scrap.

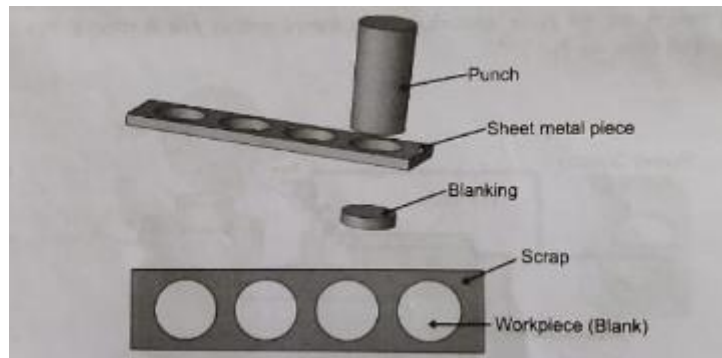


Figure 1.19: Blanking Operation

20. **Piercing** - A process of cutting a flat sheet metal piece into a desired shape using a punch and die. The process produces a part (the desired shape) and scrap (the remaining material). The punch is a cylindrical tool that fits into a die cavity. The sheet metal piece is placed between the punch and the die. The punch is then pushed down, forcing the metal into the die cavity and creating a part. The remaining material is scrap.

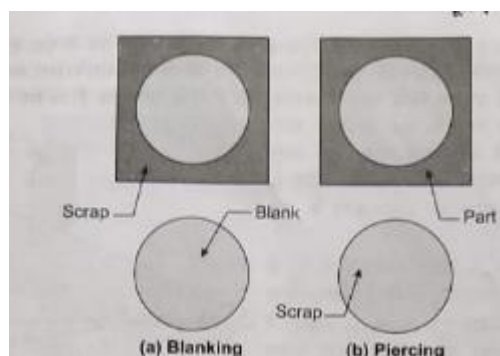


Figure 1.20: Comparison of blanking and piercing

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21. **Blanking** - **Blanking** is a process of cutting a flat sheet metal into a desired shape. In this process, the punch and die are used to cut the metal. The punch is a cylindrical tool that moves vertically through the metal. The die is a cavity that matches the shape of the punch. As the punch moves down, it pushes the metal into the die. The metal is then cut along the edges of the die, forming a blank. The blank is the desired shape, and the scrap is the remaining metal. The blanking process is used to produce a large number of identical parts.



Figure 1.21: Slitting, Trimming and Lancing

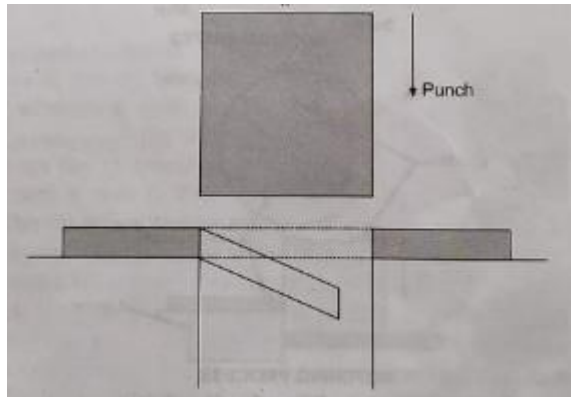


Figure 1.22: Blanking process

22. **Cutting off and Parting** - **Cutting off** is a process of cutting a long workpiece into shorter pieces. In this process, a circular cutting tool is used to cut the workpiece. The workpiece is fed into the cutting tool, and the tool rotates around the workpiece. The cutting tool is then moved along the length of the workpiece, cutting it into shorter pieces. **Parting** is a process of cutting a workpiece into two parts. In this process, a cutting tool is used to cut the workpiece. The workpiece is fed into the cutting tool, and the tool rotates around the workpiece. The cutting tool is then moved along the length of the workpiece, cutting it into two parts.

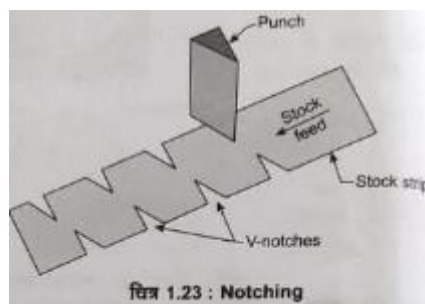
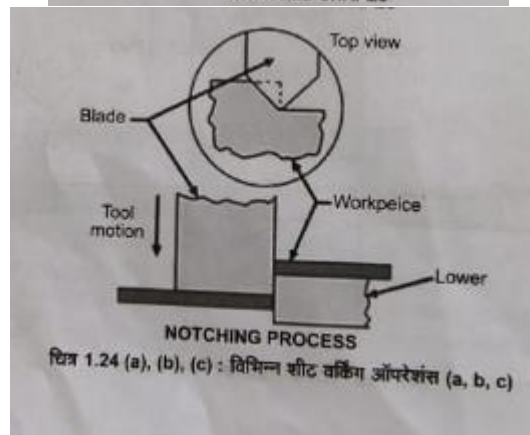
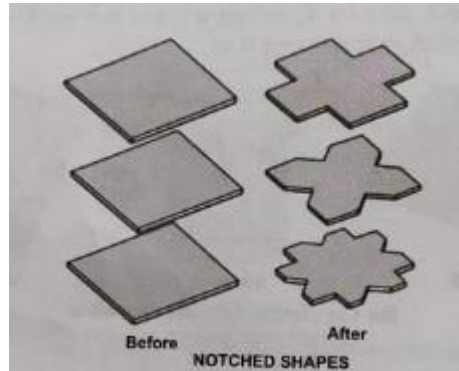


Figure 1.23: Notching

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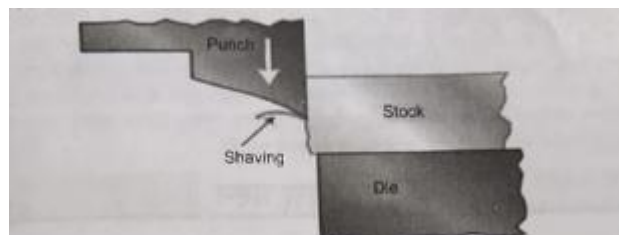
23. **Notching** - Notching is a process of cutting a notch or groove into a workpiece. It is a type of sheet metal working operation. In progressive die, the workpiece is fed through a series of dies, each performing a different operation. The final die in the sequence is the notching die, which cuts the notch into the workpiece. The notching die is a type of die that has a sharp edge and is used to cut a notch into a workpiece. The workpiece is fed through the die, and the notch is cut into the workpiece. The notching die is a type of die that has a sharp edge and is used to cut a notch into a workpiece.



चित्र 1.24 (a), (b), (c) : विभिन्न शीट वर्किंग ऑपरेशंस (a, b, c)

चित्र 1.24 (a), (b), (c) : विभिन्न शीट वर्किंग ऑपरेशंस (a, b, c)

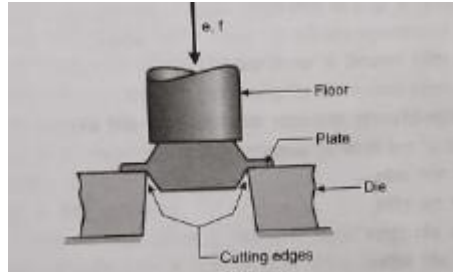
24. **Shaving** - Shaving is a process of removing a thin layer of metal from a workpiece. It is a type of sheet metal working operation. In shaving, the workpiece is fed through a die, and a thin layer of metal is removed from the workpiece. The shaving die is a type of die that has a sharp edge and is used to remove a thin layer of metal from a workpiece. The workpiece is fed through the die, and the shaving die removes a thin layer of metal from the workpiece. The shaving die is a type of die that has a sharp edge and is used to remove a thin layer of metal from a workpiece.



चित्र 1.25 शीट वर्किंग ऑपरेशंस में शैविंग ऑपरेशन

Unit 1:

25. **Trimming** - एक प्रकार का प्रक्रिया है, जिसमें एक बड़े आकार के ब्लैंक को एक छोटे आकार के ब्लैंक में बदलने के लिए एक डाय को उपयोग में लाया जाता है। इस प्रक्रिया में, डाय के कटिंग एज (cutting edges) द्वारा ब्लैंक के अतिरिक्त भाग हटाए जाते हैं।



चित्र 1.26: ट्रिमिंग प्रक्रिया

26. **Nibbling** - एक प्रकार का प्रक्रिया है, जिसमें एक बड़े आकार के ब्लैंक को एक छोटे आकार के ब्लैंक में बदलने के लिए एक डाय को उपयोग में लाया जाता है। इस प्रक्रिया में, डाय के कटिंग एज (cutting edges) द्वारा ब्लैंक के अतिरिक्त भाग हटाए जाते हैं।

(overlapping)



चित्र 1.27 : निबलिंग प्रक्रिया

चित्र 1.27: निबलिंग प्रक्रिया