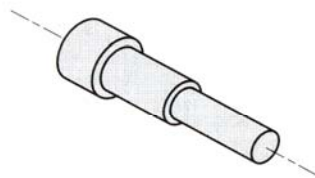


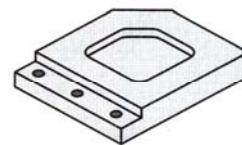
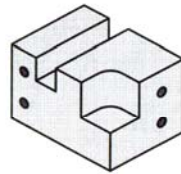
# Machining Operations and Machine Tools

Dr. Pulak M. Pandey

<http://paniit.iitd.ac.in/~pmpandey>



(a)

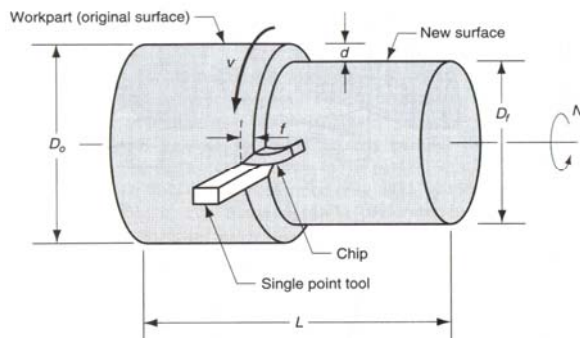


(b)

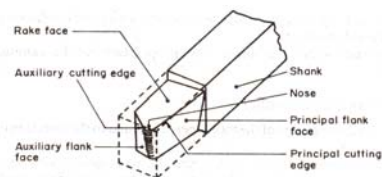
Machined parts are classified as (a) rotational, or (b) nonrotational, shown here by block and flat parts.

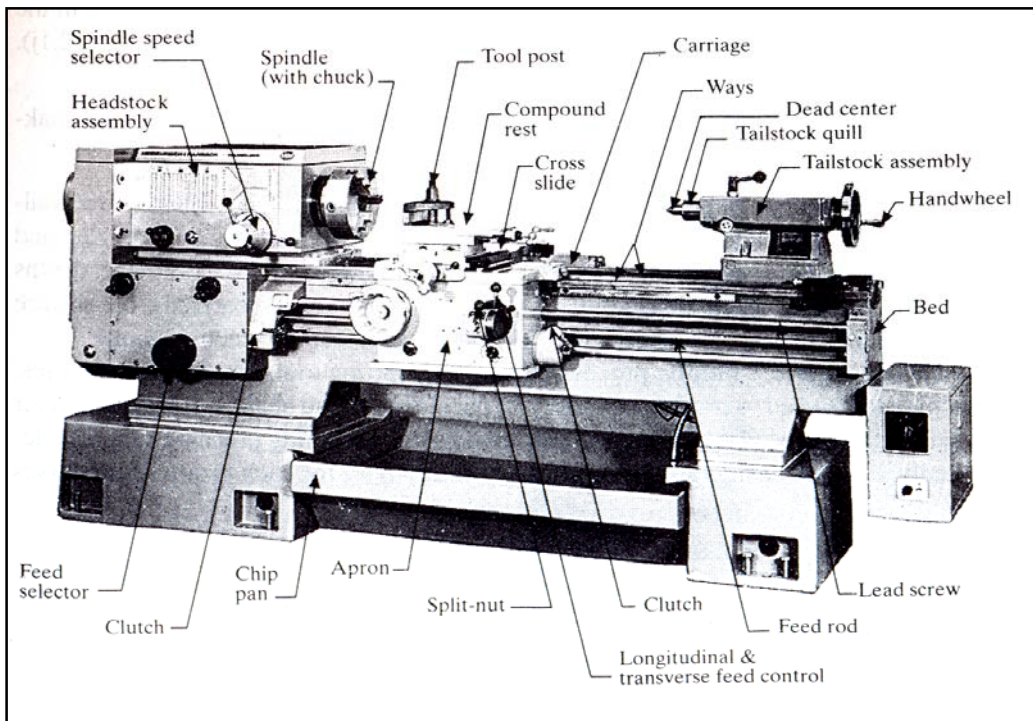
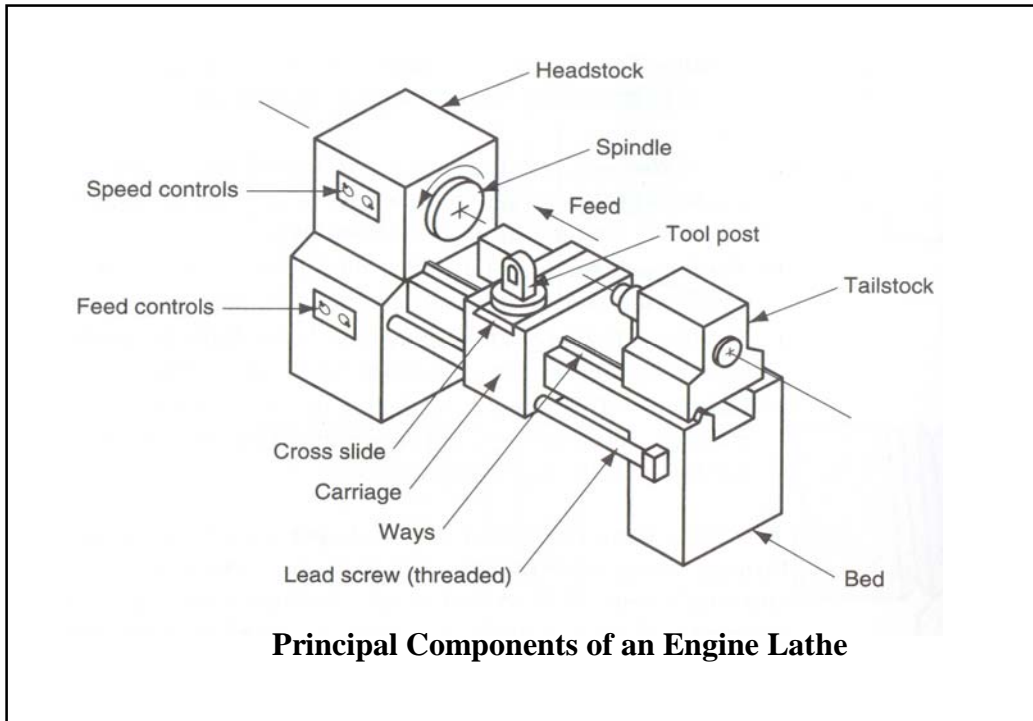
## Manufacturing of Rotational Parts

Turning operation



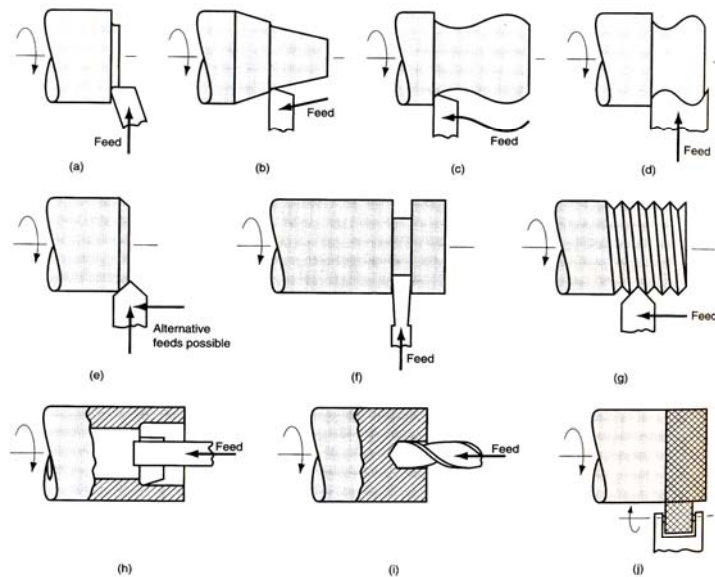
Turning tool





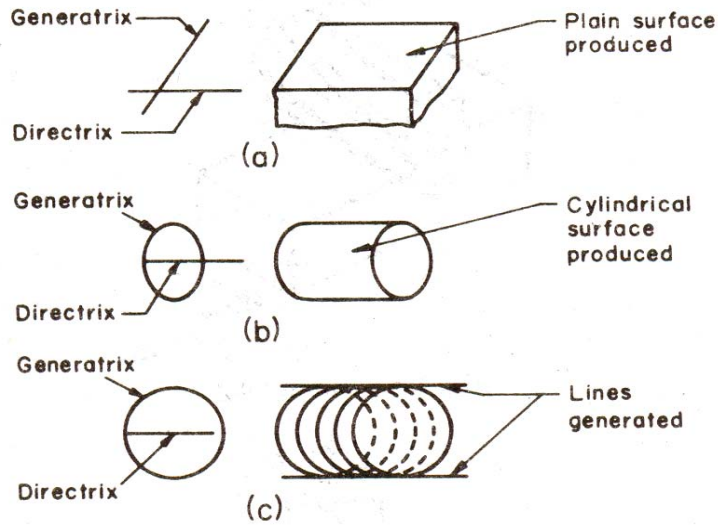
## Various types of Lathe Machine Tools

- Engine lathe
- Tool room lathe
- Speed lathe
- Turret lathe
- Chucking lathe
- Automatic screw machine or a bar machine
- Numerically controlled lathe

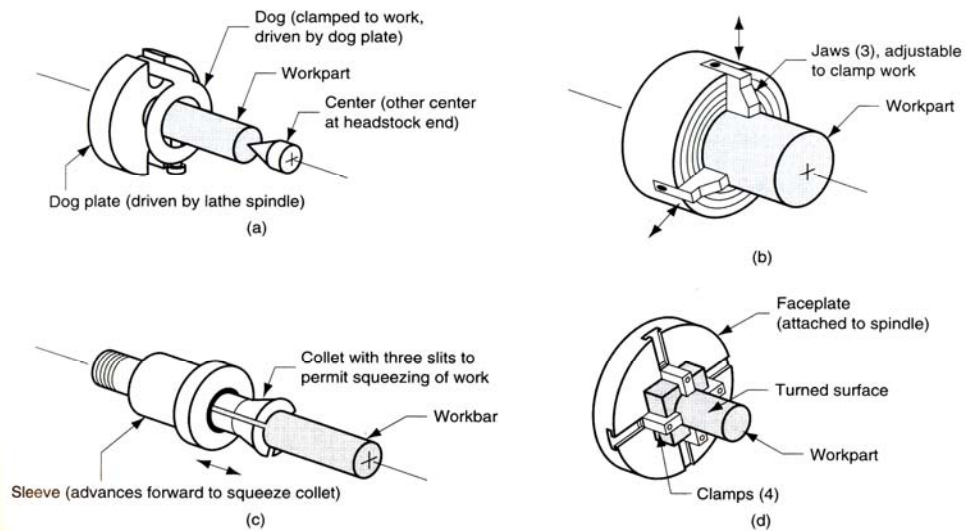


Machining operations other than turning that are performed on a lathe: (a) facing, (b) taper turning, (c) contour turning, (d) form turning, (e) chamfering, (f) cutoff, (g) threading, (h) boring, (i) drilling, and (j) knurling.

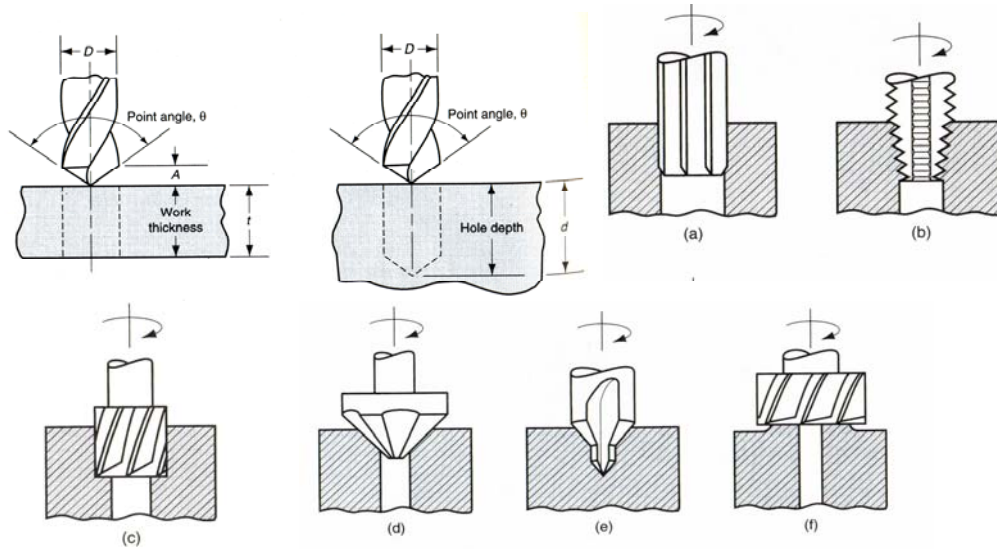
## Concept of generatrix and directrix



## Workholding Methods in Lathe

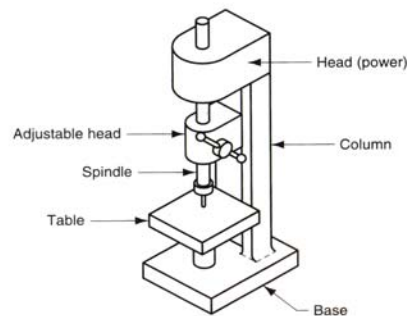


## Drilling Operation



(a) Reaming (b) Taping (c) Counter-boring (d) Countersinking (e) Centerdrilling (f) spot facing

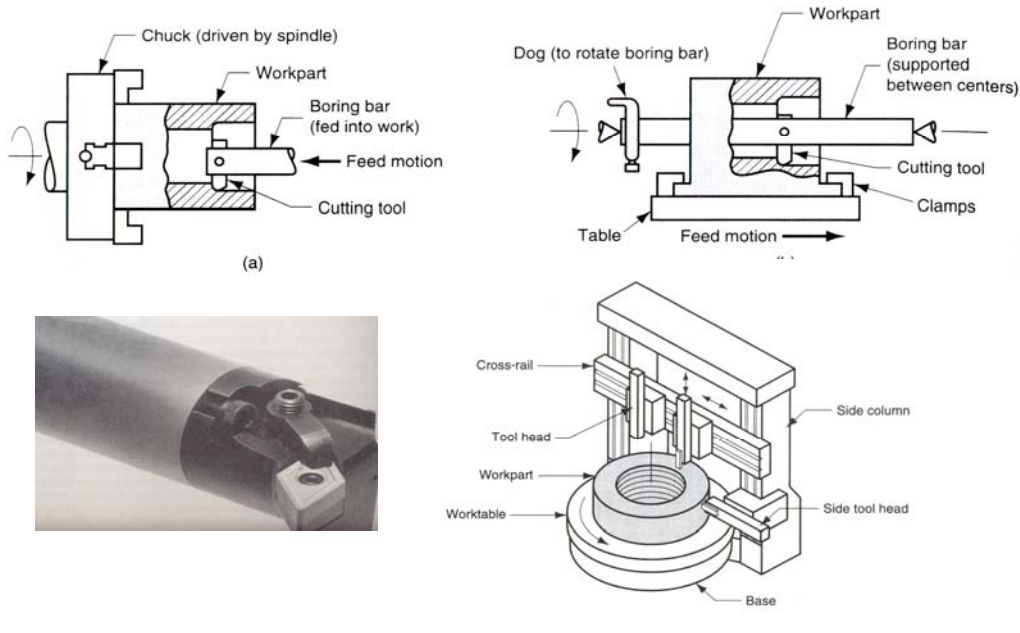
## Drill Presses



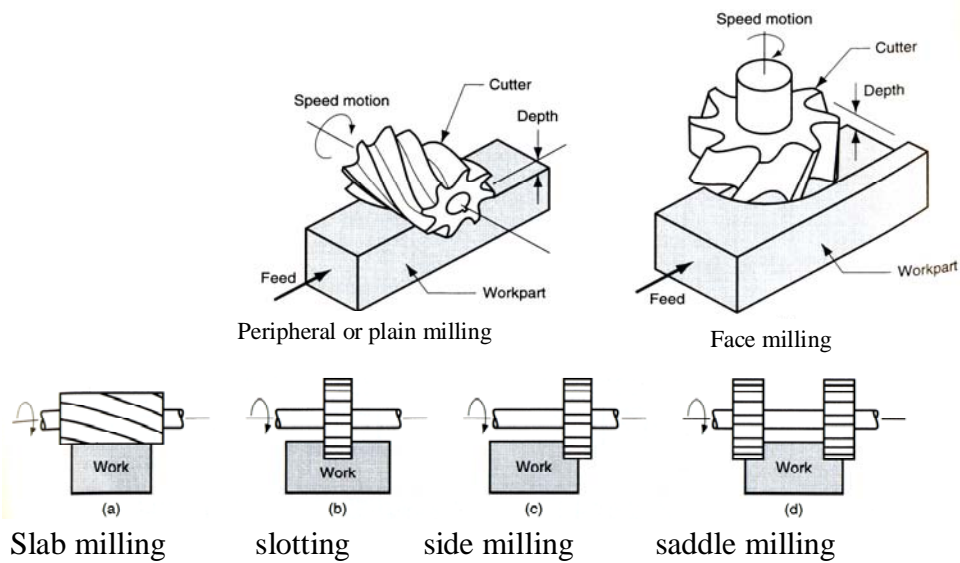
Upright drill press

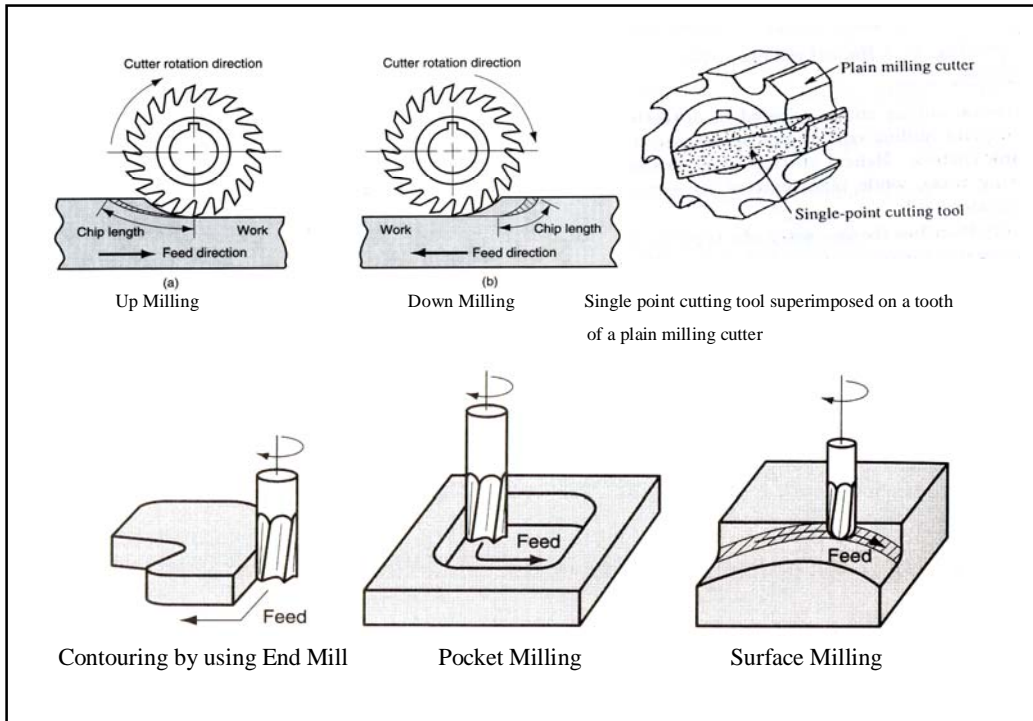
- Upright drill press
- Bench drill press
- Radial drill press
- Gang drill press
- Multiple spindle drill press
- Numerical control drill press

## Boring Operation

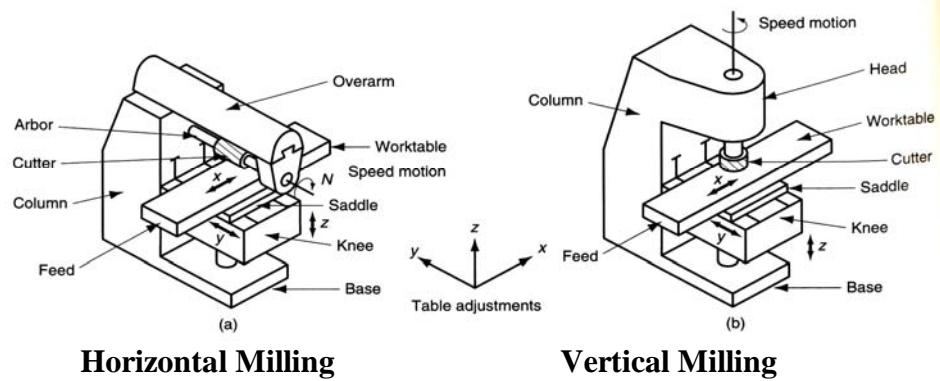


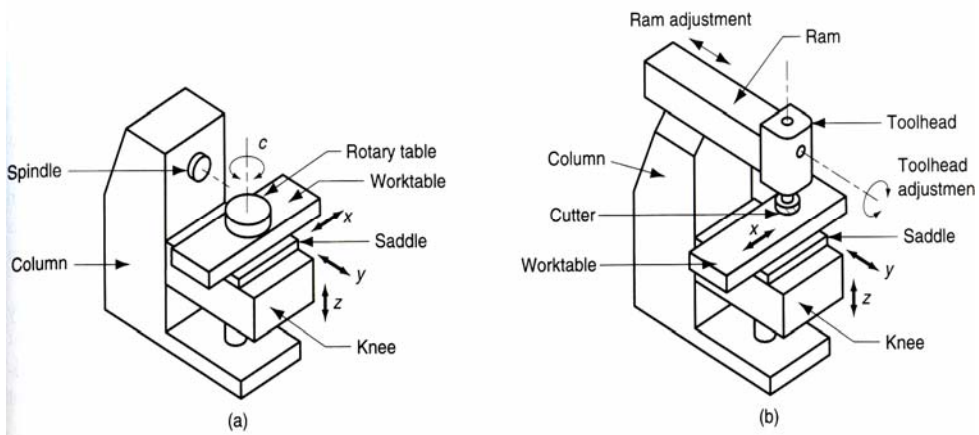
## Milling Operation





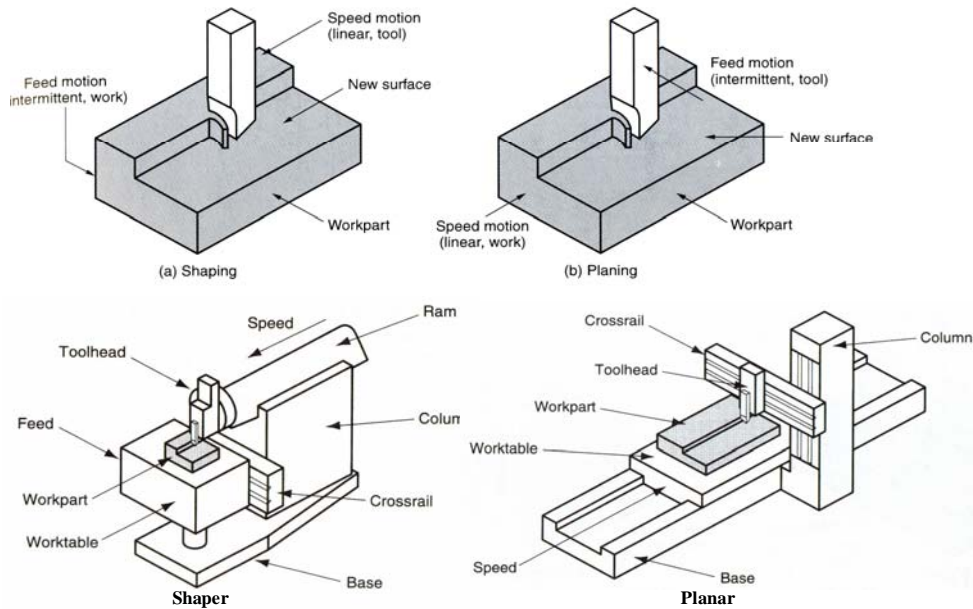
## Milling Machines





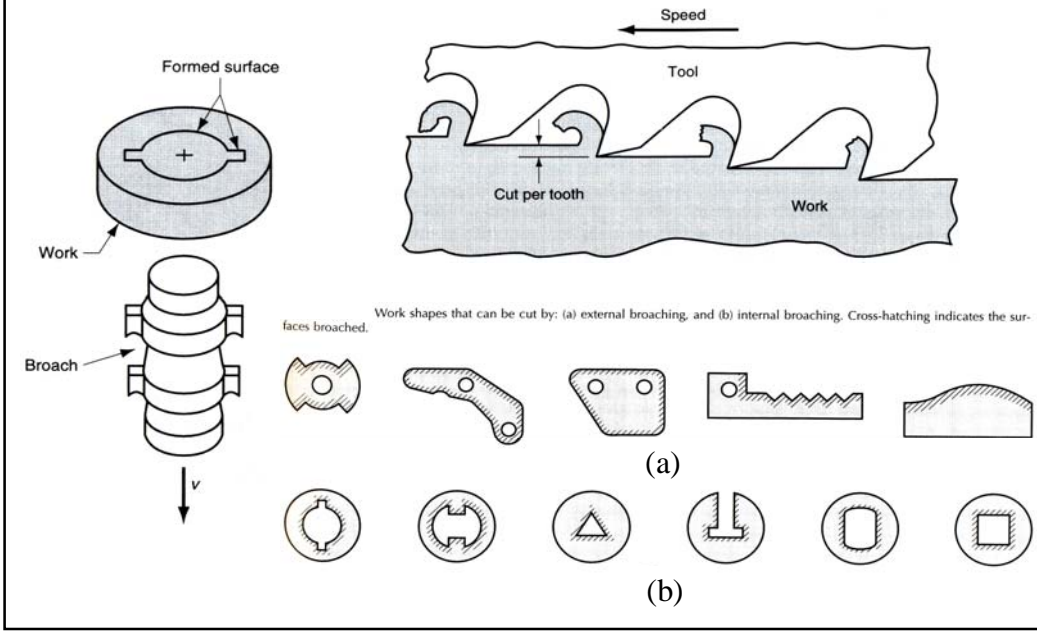
**Special types of Knee-and-column milling machines**  
**(a) universal-overarm, arbor, and cutter are omitted for clarity**  
**(b) ram type**

## Shaping, Slotting and Planing

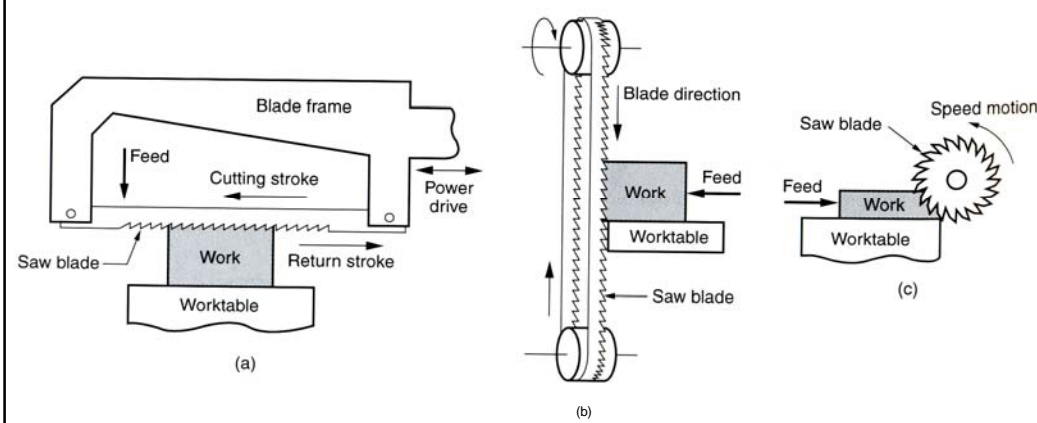




# Broaching

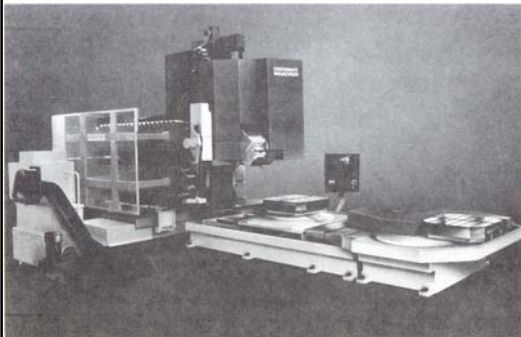
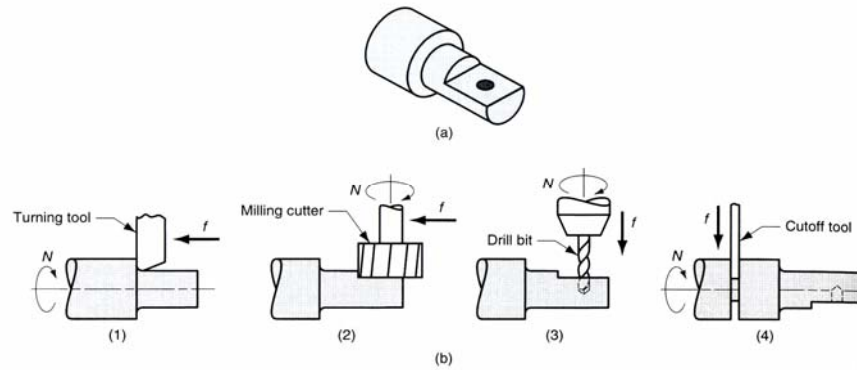


# Sawing



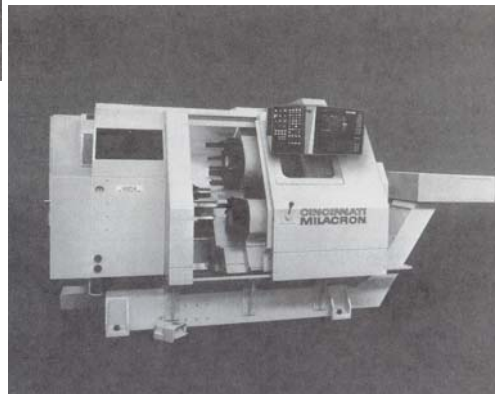
## Machining centers and Turning centers

- Automatic tool changing
- Pallet shuttles
- Automatic workpart positioning



**Universal machining center**

**CNC 4-axis turning center**



## Comparison of Machining Processes

Process	Advantages	Limitations
Turning	<ul style="list-style-type: none"> <li>• All types of materials can be turned.</li> <li>• Most versatile machine capable of producing external and internal circular profiles and flat surfaces.</li> <li>• Low tooling cost.</li> <li>• Large components can be turned.</li> </ul>	<ul style="list-style-type: none"> <li>• Requires skilled labour.</li> <li>• Low production rate.</li> <li>• Close tolerances and fine finish cannot be achieved.</li> </ul>
Boring	<ul style="list-style-type: none"> <li>• All types of materials can be bored.</li> <li>• Variety of internal circular profiles can be obtained.</li> <li>• Low tooling cost.</li> <li>• Large components can be bored.</li> <li>• Provides better dimensional control and surface finish.</li> </ul>	<ul style="list-style-type: none"> <li>• Requires skilled labour.</li> <li>• Low production rate.</li> <li>• Suitable for internal profiles only.</li> <li>• Stiffness of boring bar is an important consideration.</li> </ul>
Shaping	<ul style="list-style-type: none"> <li>• Suitable for producing flat and contour profiles on small workpieces.</li> <li>• Suitable for low production rate.</li> <li>• Low tooling and equipment cost.</li> </ul>	<ul style="list-style-type: none"> <li>• Requires skilled labour.</li> <li>• Large size workpieces cannot be used.</li> <li>• Only simple profiles can be obtained.</li> <li>• Close tolerance and fine finish cannot be obtained.</li> </ul>

Planing	<ul style="list-style-type: none"> <li>• Suitable for producing flat and contour profiles on large workpieces.</li> <li>• Suitable for low production rate.</li> <li>• Low tooling cost.</li> </ul>	<ul style="list-style-type: none"> <li>• Requires skilled labour.</li> <li>• Only simple profiles can be obtained.</li> <li>• Close tolerance and fine finish cannot be obtained.</li> </ul>
Milling	<ul style="list-style-type: none"> <li>• Variety of shapes including flats, slots and contours can be obtained.</li> <li>• Versatile operation with wide variety of toolings and attachments.</li> <li>• Suitable for low and medium production rate.</li> <li>• Better dimensional control and surface finish.</li> </ul>	<ul style="list-style-type: none"> <li>• Requires skilled labour.</li> <li>• Tooling relatively more expensive.</li> </ul>
Drilling	<ul style="list-style-type: none"> <li>• Inexpensive tooling and equipment.</li> <li>• Most suitable for producing round holes of various sizes.</li> <li>• High production rate.</li> <li>• Machine can be used for reaming and tapping.</li> </ul>	<ul style="list-style-type: none"> <li>• Requires semi-skilled labour.</li> <li>• Basically a rough machining operation.</li> </ul>