Lecture: Introduction to Manufacturing Processes
Sub: Mfg. Processes
(PCC-ME303)
5th Semester, ME
Under AKU Patna

Lecture By:
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PCC-ME 303	Manufacturing Processes	3L:0T:3P	4.5 Credits

Objectives:

To motivate and challenge students to understand and develop an appreciation of the processes in correlation with material properties which change the shape, size and form of the raw materials into the desirable product by conventional or unconventional manufacturing methods

Contents:

Module:1

Conventional Manufacturing processes: Casting and Moulding: Metal casting processes and equipment, Heat transfer and solidification, shrinkage, riser design, casting defects and residual stresses.

(Lectures6)

Module:2

Introduction to bulk and sheet metal forming, plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk forming (forging, rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending) principles of powder metallurgy.

(Lectures6)

Module:3

Metal cutting: Single and multi-point cutting; Orthogonal cutting, various force components: Chip formation, Tool wear and tool life, Surface finish and integrity, Machinability, Cutting tool materials, Cutting fluids, Coating; Turning, Drilling, Milling and finishing processes, Introduction to CNC machining. **(Lectures8)**

Module:4

Joining/fastening processes: Physics of welding, brazing and soldering; design considerations in welding, Solid and liquid state joining processes; Adhesive bonding.

Additive manufacturing: Rapid prototyping and rapid tooling **(Lectures5)**

Module:5

Machine Tools:

(a) Lathe : Principle, types, operations, turret/capstan, semi/automatic, Tool layout.

(b) Shaper, slotted, planer, operation, drive.

(c) Milling, Milling cutter, up & down milling, dividing head indexing, Max chip thickness, power required.

(d) Drilling and boring, reaming tools, Geometry of twist drill, Grinding, Grinding wheel, Abrasive, cutting action, grinding wheel specification, Grinding wheel wear, alterations, wear, fracture wear, dressing and trimming. Max chip thickness and guest criteria, Flat and cylindrical grinding, Centerless grinding, Super finishing, Honing lapping, Polishing

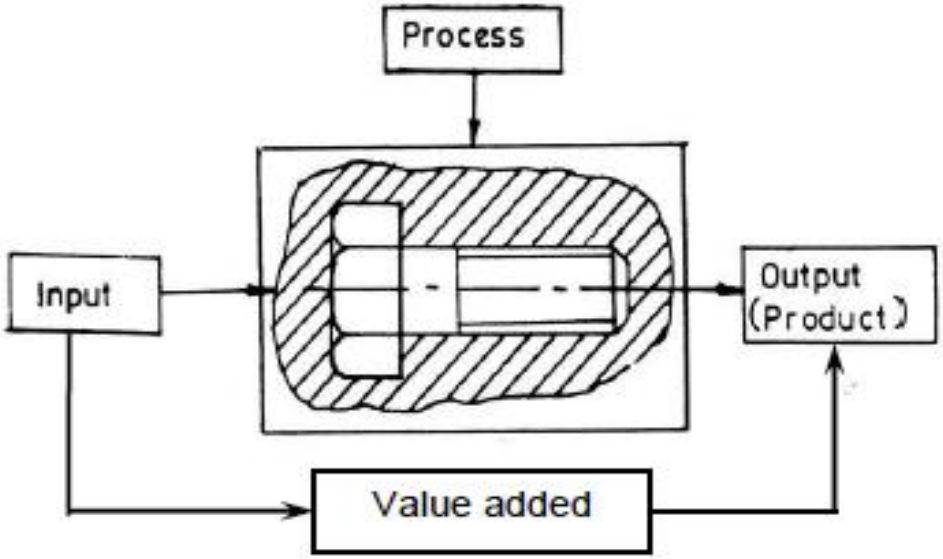
(Lectures15)

Course Outcomes:

Upon completion of this course, students will be able to understand the different conventional and unconventional manufacturing methods employed for making different products

Manufacturing – Need and concept

- Production or manufacturing can be simply defined as value addition processes by which raw materials of low utility and value due to its inadequate material properties and poor or irregular size, shape and finish are converted into high utility and valued products with definite dimensions, forms and finish imparting some functional ability.



5 ‘M’

- Materials
- Machine
- Money
- Men
- Manufacturing Process

MANUFACTURING: IMPORTANCE

- Manufacturing ⟹ backbone of any industrialized nation.
- Related to the economic health of a country.
- Higher the level of manufacturing activity :higher the standard of living(Japan, U.K, China, etc.)
- Machine Tools: (ex- Lathe m/c, presses, milling m/c etc)

Production Engineering covers two domains:

- (a) Production or Manufacturing Processes
- (b) Production Management

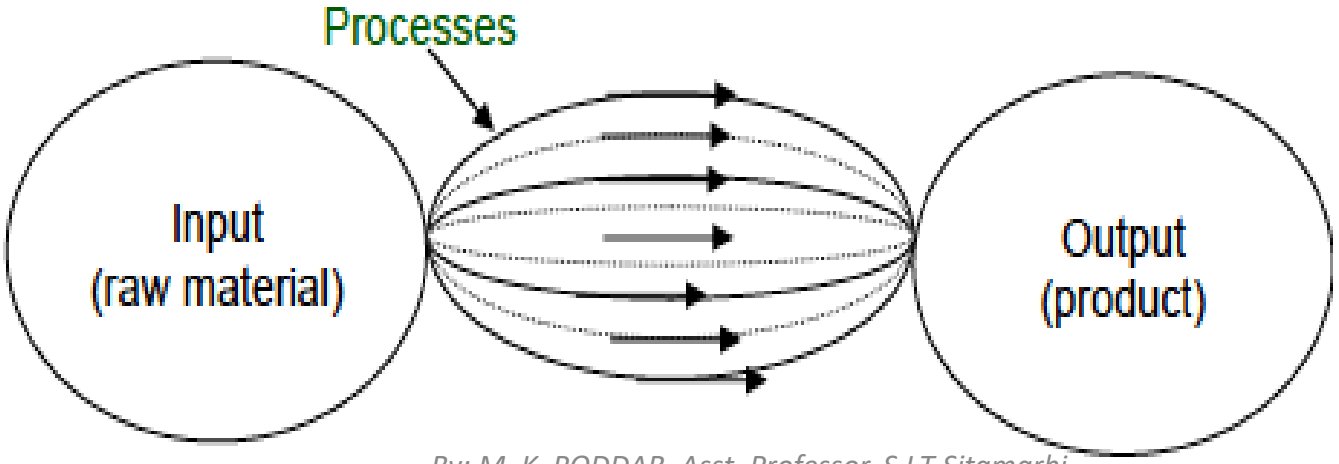
Manufacturing Processes

This refers to science and technology of manufacturing products effectively, efficiently, economically and environment-friendly through

- Application of any existing manufacturing process and system
- Proper selection of input materials, tools, machines and environments.
- Improvement of the existing materials and processes
- Development of new materials, systems, processes and techniques

Production Management

This is also equally important and essential in the manufacturing world. It mainly refers to planning, coordination and control of the entire manufacturing in most profitable way with maximum satisfaction to the customers by best utilization of the available resources like man, machine, materials and money.



Classification of Manufacturing Process

A. Foundry Process

B. Forming or Metal Forming process

C. Conventional metal cutting process

D. Non-conventional metal cutting process

E. Metal finishing process

F. Joining & Assembly process

G. Metal Coating process

H. Regenerative manufacturing

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Casting and Foundry Processes

- In one step raw materials are transformed into a desirable shape
- Parts require finishing processes

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Basic Casting Process

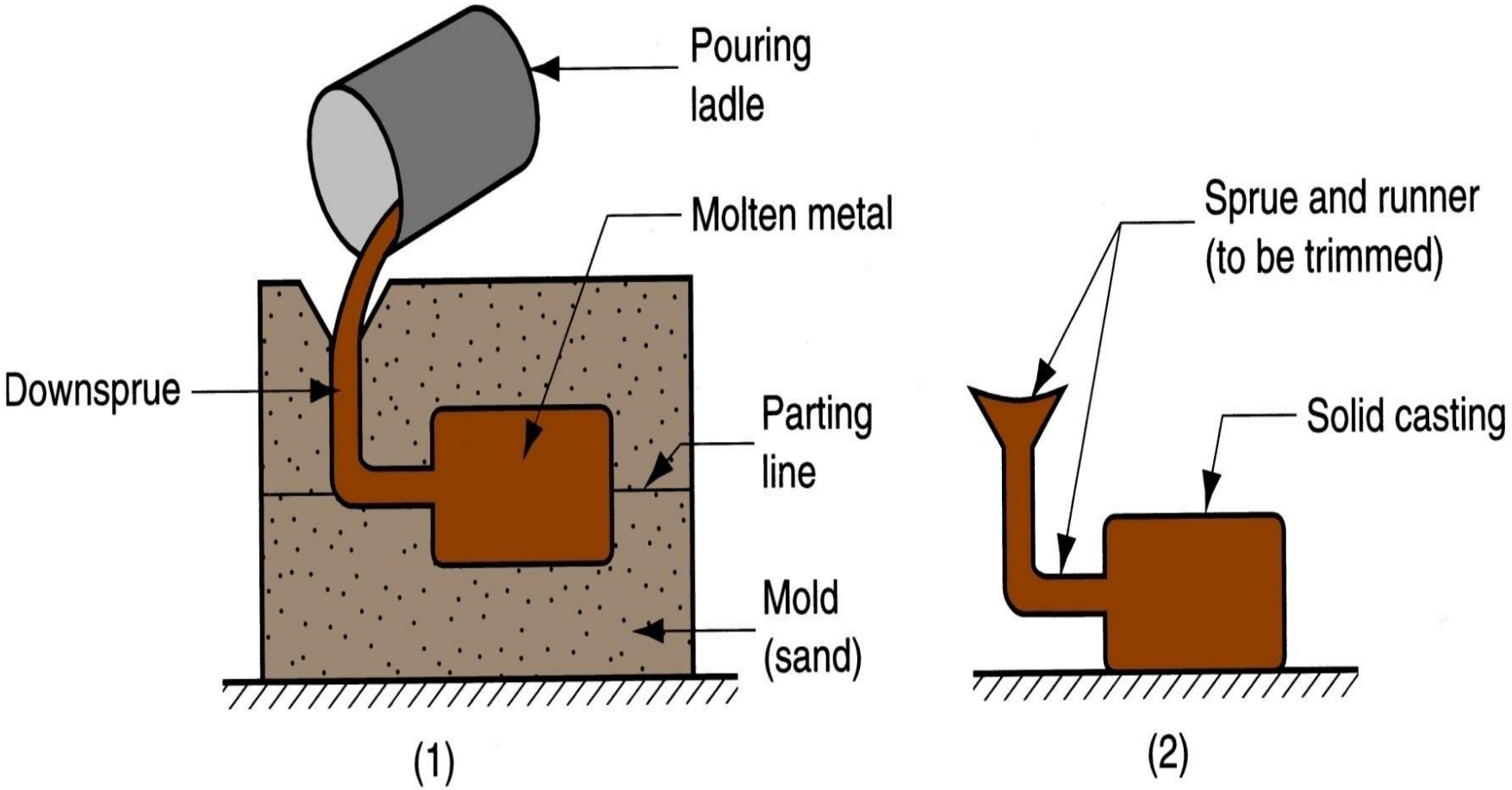
A mold is created – A cavity that holds the molten material in a desired shape until it is solidified

Multiple-use mold

Single-use molds

Steps:

- Material is heated to a specified temperature
- Molten material is poured into a mold cavity
- Molten material solidifies into the shape of the cavity
- Casting or mold is removed
- Casting is cleaned, finished, and inspected


Pouring ladle
Molten metal
Downsprue
Parting line
Mold (sand)
(1)
Sprue and runner (to be trimmed)
Solid casting
(2)

Forming and Metalworking Processes:

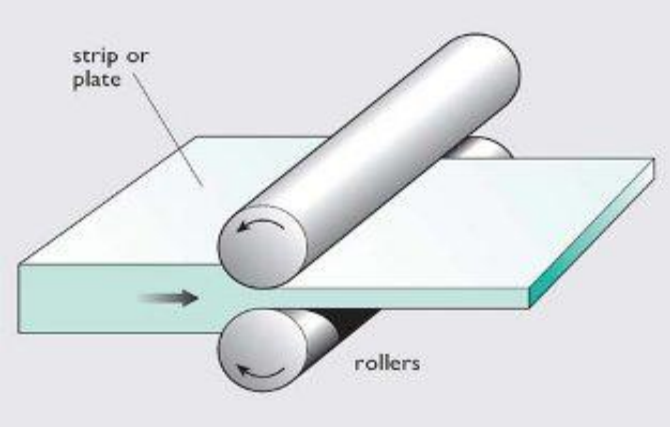
Utilizes material that has been cast

Modify the shape, size, and physical properties of the material

Hot and cold forming

Forming and Metalworking Processes

Rolling – Material passes through a series of rollers, reducing its thickness with each pass



Forging – Material is shaped by the controlled application of force (blacksmith)

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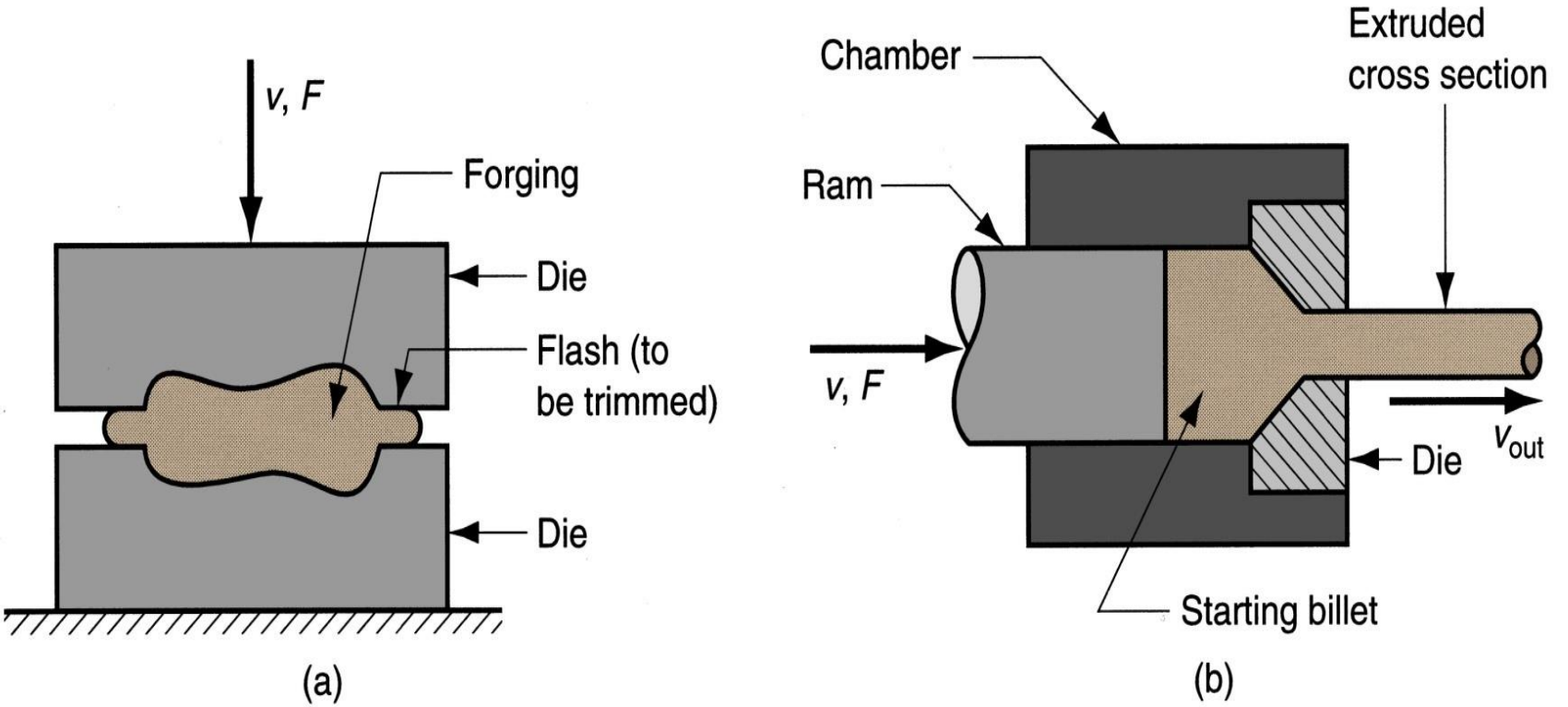
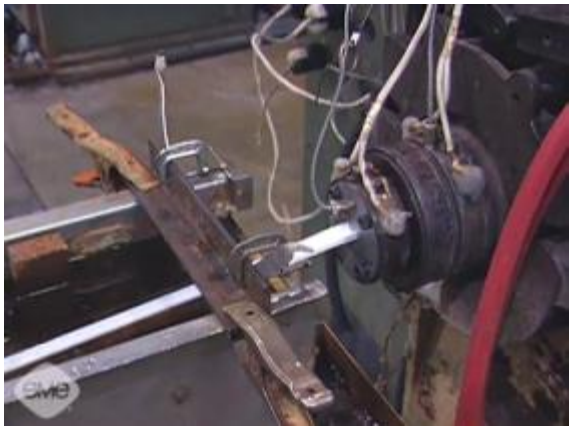

v, F
Forging
Die
Flash (to
be trimmed)
Die
(a)
Chamber
Extruded
cross section
Ram
v, F
Die
v_{out}
Starting billet
(b)

Forming and Metalworking Processes

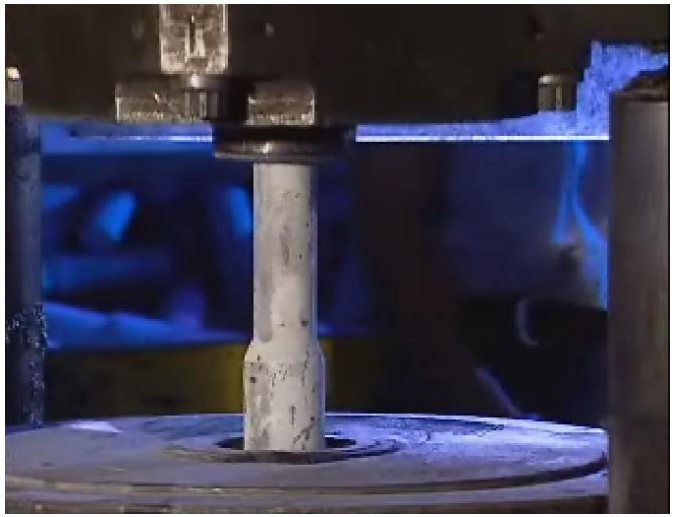
Extrusion – Material is **compressed and forced** through a die to produce a uniformed cross section

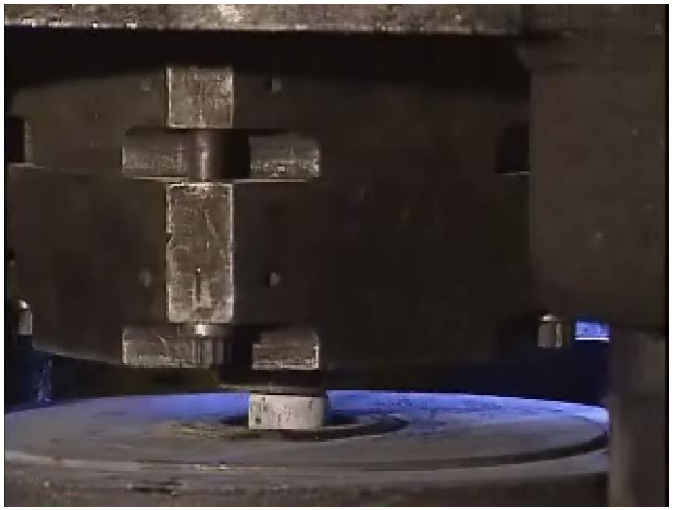


Wire, rod, and tube drawing – Material is **pulled** through a die to produce a uniformed cross section

Forming and Metalworking Processes

Cold forming and forging – Slugs of material are squeezed into dies





Machining – Purpose, Principle and Definition

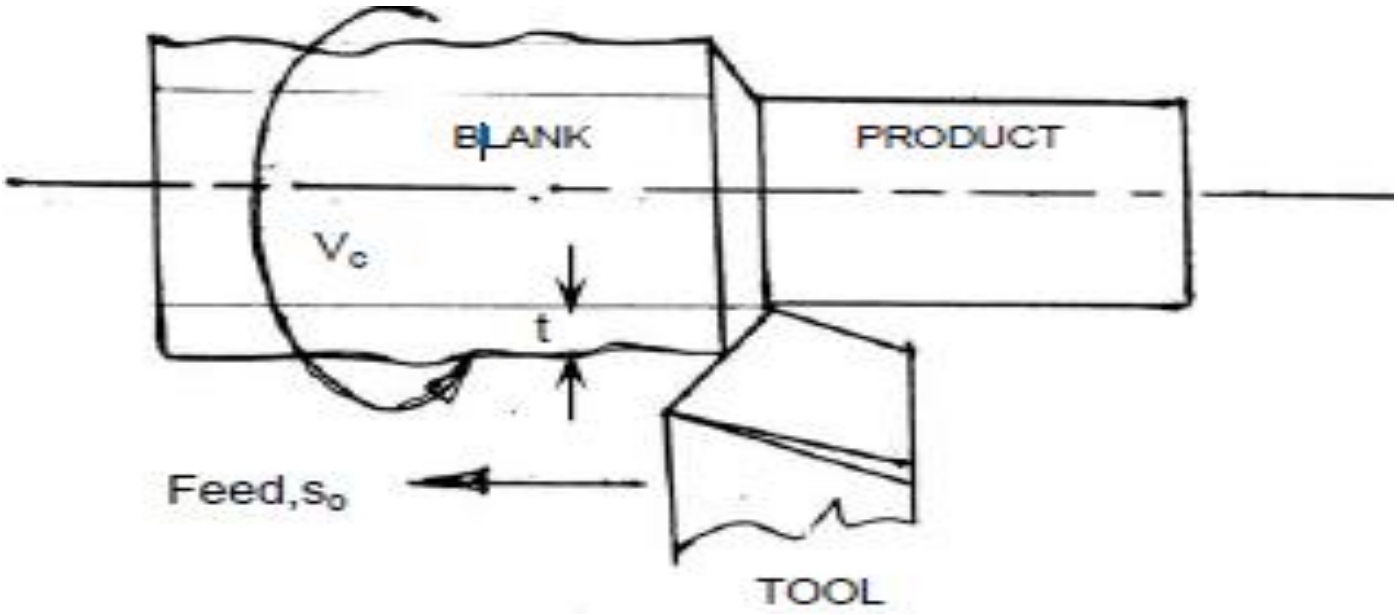
Purpose of Machining

Most of the engineering components such as gears, bearings, clutches, tools, screws and nuts etc. need dimensional and form accuracy and good surface finish for serving their purposes. Preforming like casting, forging etc. generally cannot provide the desired accuracy and finish. For that such preformed parts, called blanks, need semi-finishing and finishing and it is done by machining and grinding. Grinding is also basically a machining process.

Principle of Machining

A metal rod of irregular shape, size and surface is converted into a finished rod of desired dimension and surface by machining by proper relative motions of the tool-work pair.

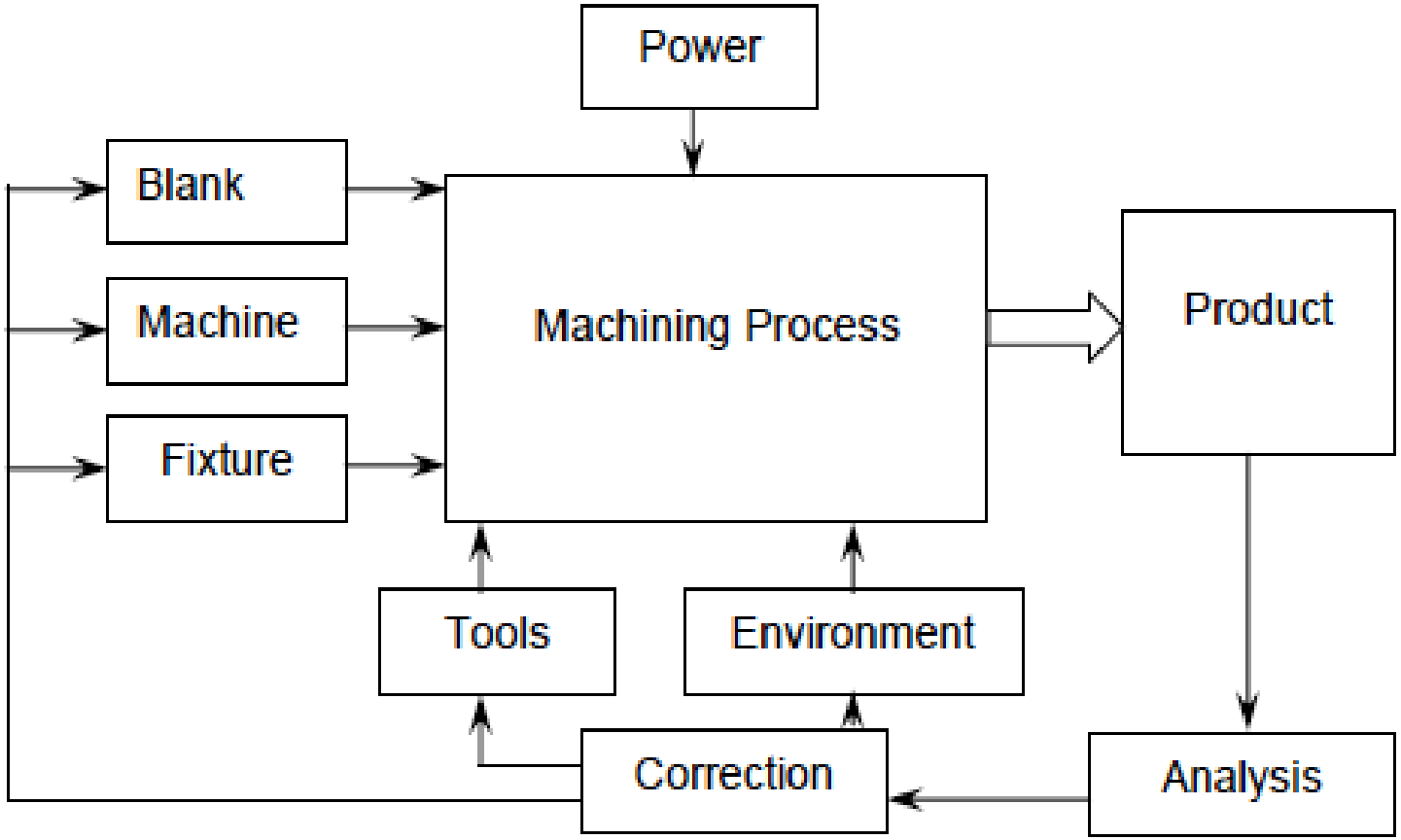
Turning process



Definition of Machining

Machining is an essential process of finishing by which jobs are produced to the desired dimensions and surface finish by gradually removing the excess material from the preformed blank in the form of chips with the help of cutting tool(s) moved past the work surface(s) .

Machining requirements



- The blank and the cutting tool are properly mounted (in fixtures) and moved in a powerful device called machine tool enabling gradual removal of layer of material from the work surface resulting in its desired dimensions and surface finish. Additionally some environment called cutting fluid is generally used to ease machining by cooling and lubrication

Basic functions of Machine Tools

Machine Tools basically produce geometrical surfaces like flat, cylindrical or any contour on the preformed blanks by machining work with the help of cutting tools.

The physical functions of a Machine Tool in machining are:

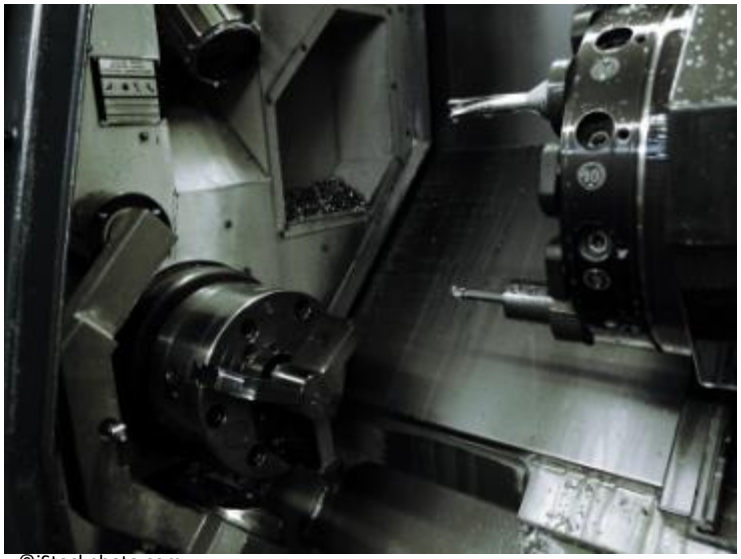
- firmly holding the blank and the tool
- transmit motions to the tool and the blank
- provide power to the tool-work pair for the machining action.
- control of the machining parameters, i.e., speed, feed and depth of cut.

Machining Processes

Turning Processes

Lathes and turning centers:

Processes include: Straight, taper, contour turning, facing, forming, necking, parting, boring, threading, and knurling



Machining Processes

Milling Processes

Operations that create flat or curved surfaces by **progressively** removing material

Cutting tools rotate as the work piece is secured and fed into the tool

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Machining Processes

Milling Processes

Mills – Vertical and horizontal

Processes include: Surfacing, shaping, forming, slotting, T-slotting, angle, straddle, dovetailing, and slab milling

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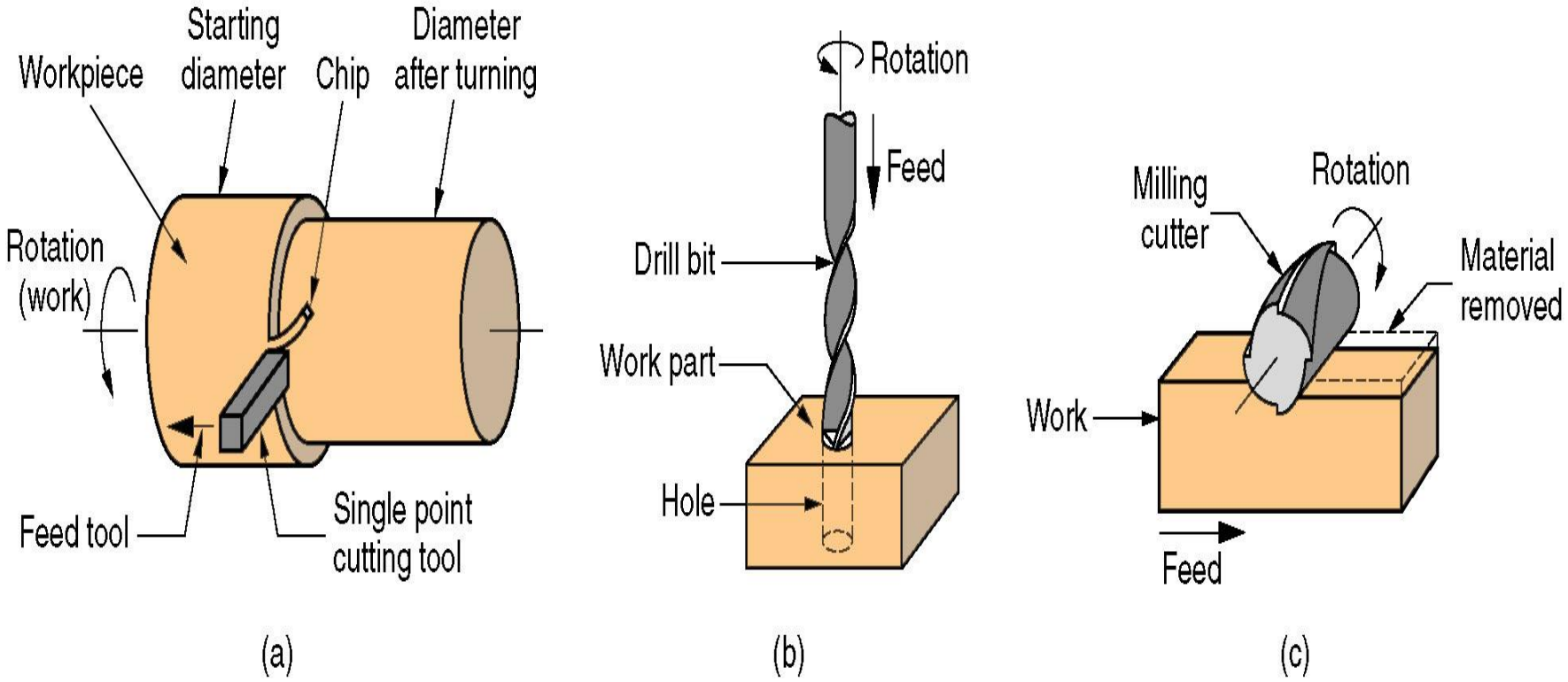
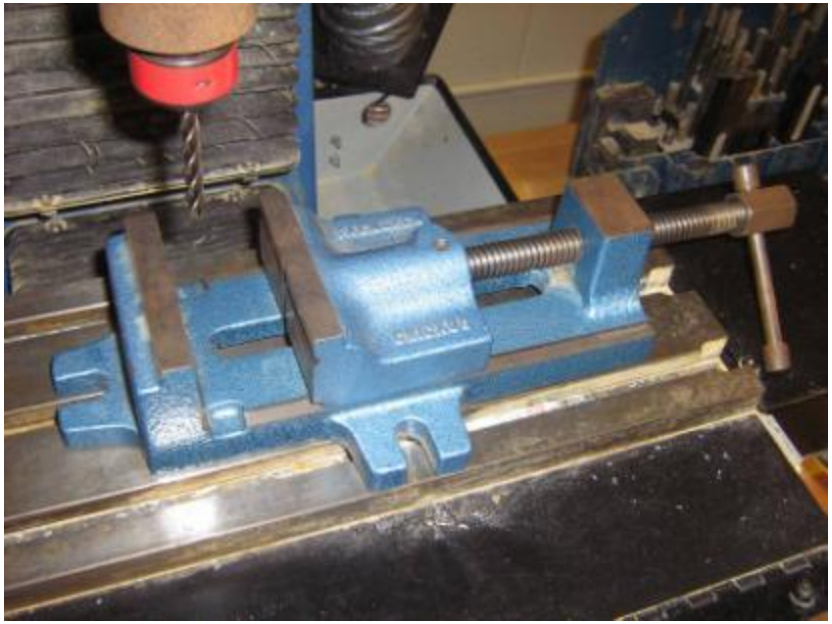

Workpiece
Starting diameter
Chip
Diameter after turning
Rotation (work)
Feed tool
Single point cutting tool
(a)
Rotation
Feed
Drill bit
Work part
Hole
(b)
Milling cutter
Rotation
Material removed
Work
Feed
(c)

Machining Processes

Drilling Processes

Operations that create holes

Cutting tools rotate and are fed into nonmoving secured work pieces



Machining Processes

Drilling Processes

Drilling and boring machines

Processes include: Drilling, counter drilling, step drilling, boring, counter boring, countersinking, reaming, spot facing, and tapping

Joining and Assembly Processes

Most products consist of multiple parts that are assembled to form a finished product.

Typical assembly processes include: Mechanical fastening; soldering and brazing, welding; adhesive bonding

Joining and Assembly Processes

Mechanical Fastening

Use physical force to hold parts together

Mechanical fasteners or part design

Screws, bolts, nails, rivets, cotter pins, retaining clips, and edge design

Joining and Assembly Processes

Welding

Operations that use heat, pressure, or both to permanently join parts

Gas, arc, stud, spot, forge, roll laminating, resistance, and induction welding

Joining and Assembly Processes

Adhesive bonding

Bonding of adjoining surfaces by filling the gap between each surface with a bonding material

Glue, cement, thermoplastic, thermosetting, and elastomers

Joining and Assembly Processes

Soldering and Brazing

Operation in which metal surfaces are bonded together by an alloy

Heated molten alloy flows between the adjoining surfaces

When the heat is removed, the molten metal solidifies and the metal surfaces are bonded

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Rapid Prototyping

Additive process

Parts are produced directly from software applications

Common rapid prototyping systems include: stereolithography (SLA), selective laser sintering (SLS), fused deposition modeling (FDM), laminated object manufacturing (LOM), digital light processing (DLP)

References:

1. ‘Manufacturing Technology by P.N. Rao, Tata McGraw Hill, New Delhi

2. ‘Production Technology’ by R K Jain, Laxmi Publisher

3. Ghosh A. and Mallik A. K., Manufacturing Science, EWP Pvt. Ltd

4. http://nptel.ac.in/courses

5. For Images: https://www.google.co.in/imghp?hl=en&tab=ri&ogbl