# National Institute of Technology Agartala


**Presented by:**

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# Institute history

TEC(Tripura Engineering College), Govt. of Tripura

**1965**

**31st March 2006**

**1st April 2006**

**NIT Agartala**

# Manufacturing Processes

1. Metal Casting 2. Metal Forming 3. Metal Cutting 4. Metal Joining

## Metal Forming Process

❖ Manufacturing processes in which materials are deformed plastically between two dies by application of force or pressure leads to applies stresses that exceed yield strength of metal to get the desire shape and size determined by the geometry of the dies as required.

❖ Practically all metals, which are not used in as cast form are reduced to some standard shapes by subsequent processing

❖ Manufacturing companies producing metals in the form of ingots which are obtained by metal casting process into a square cross section such as

(i) Slab (500-1800 mm wide and 50-300 mm thick)
(ii) Billets (40 to 150 sq mm)
(iii)Blooms (150 to 400 sq mm)

❖ These shapes are further processed through Forging, Rolling, Extrusion to produce materials in standard form such as plates, sheets, rods, tubes and structural sections etc.

## Applications of Forging

**Almost all metals and alloys can be forged. The low and medium carbon steels are readily hot forged without difficulty, but the high-carbon and alloy steels are more difficult to forge and require greater care. Forging is generally carried out on carbon alloy steels, wrought iron, copper-base alloys, aluminum alloys, and magnesium alloys. Stainless steels, nickel based super-alloys, and titanium are forged especially for aerospace uses. Producing of crank shaft of alloy steel is a good example which is produced by forging. Forging processes are among the most important manufacturing techniques utilized widely in manufacturing of small tools, rail-road equipment, automobiles and trucks and components of aero plane industries. These processes are also extensively used in the manufacturing of the parts of tractors, shipbuilding, cycle industries, railroad components, agricultural machinery etc.**

# Advantages of forging

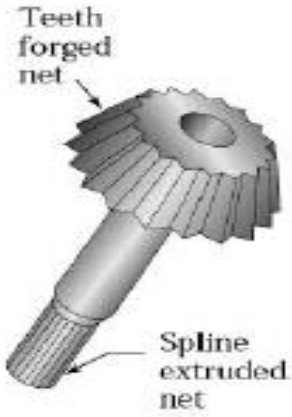
1. **Forged parts possess high ductility and offers great resistance to impact and fatigue loads.**
2. **Forging refines the structure of the metal.**
3. **It results in considerable saving in time, labor and material as compared to the production of similar item by cutting from a solid stock and then shaping it.**
4. **Forging distorts the previously created unidirectional fiber as created by rolling and increases the strength by setting the direction of grains.**
5. **Because of intense working, flaws are rarely found, so have good reliability.**
6. **The reasonable degree of accuracy may be obtained in forging operation.**
7. **The forged parts can be easily welded.**

# Forged Product

Blocker

Finished

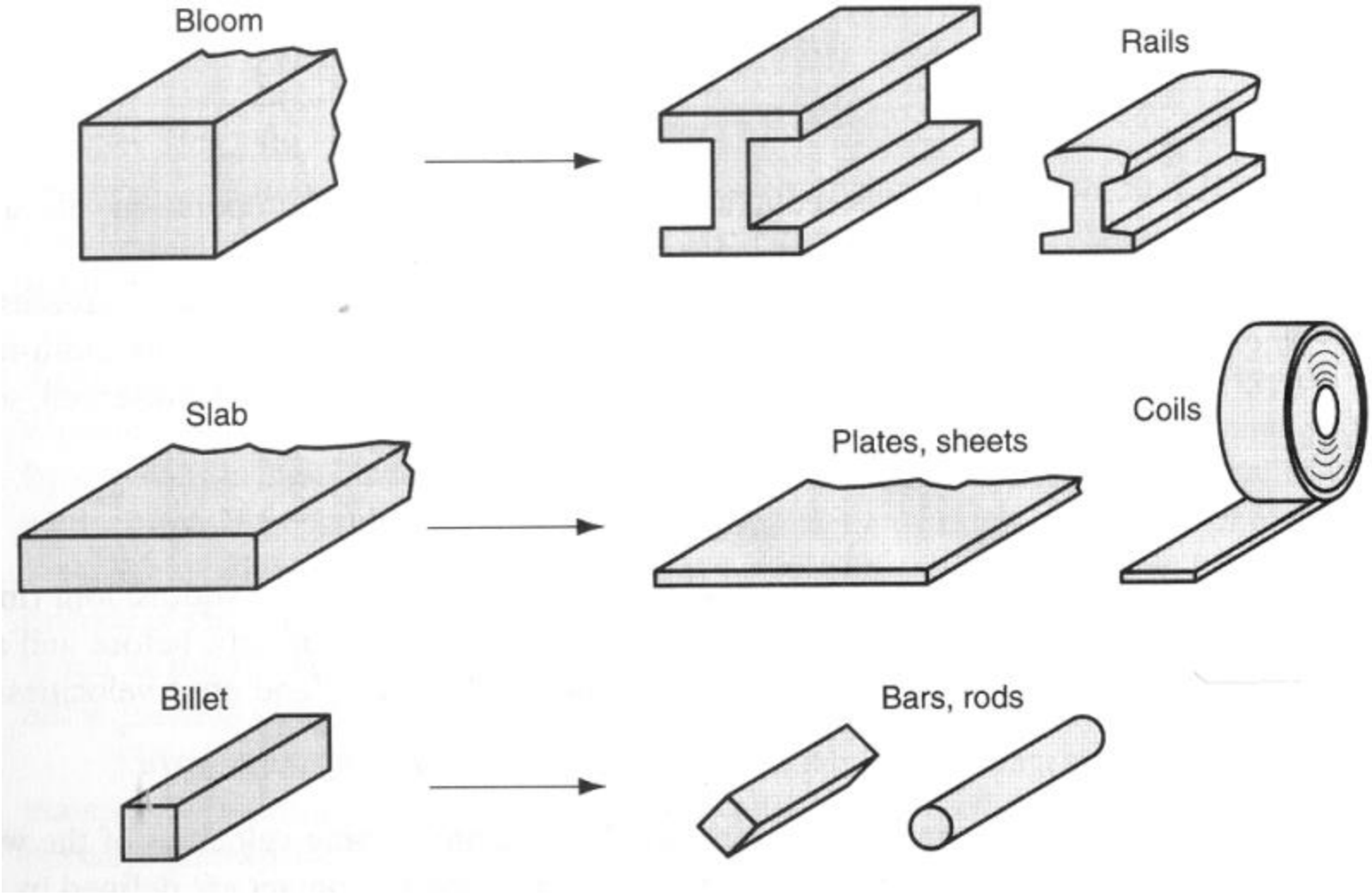
Near net



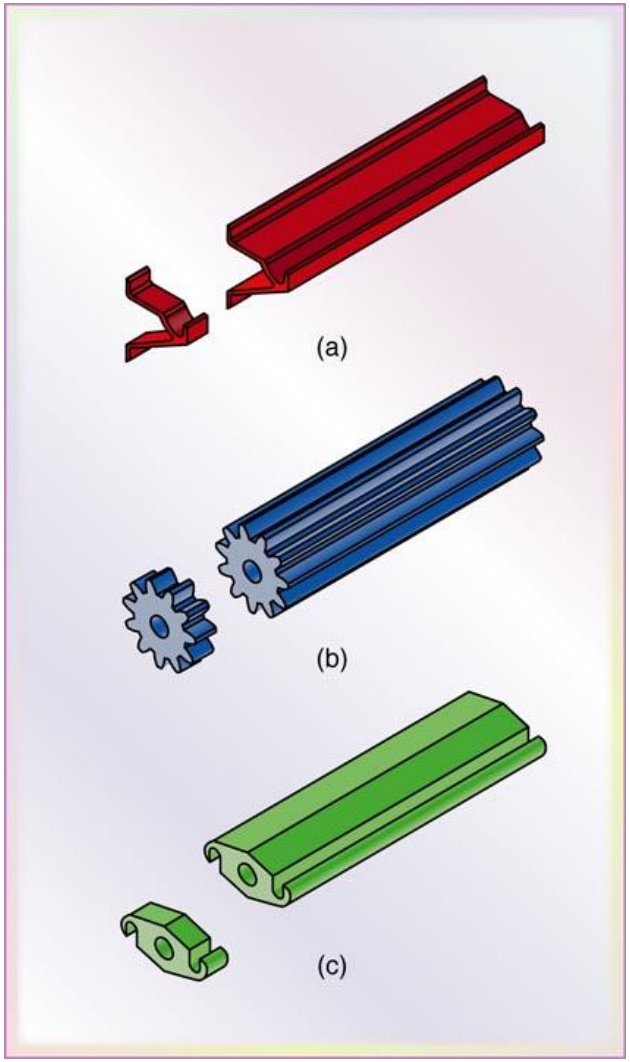
# Forged Product

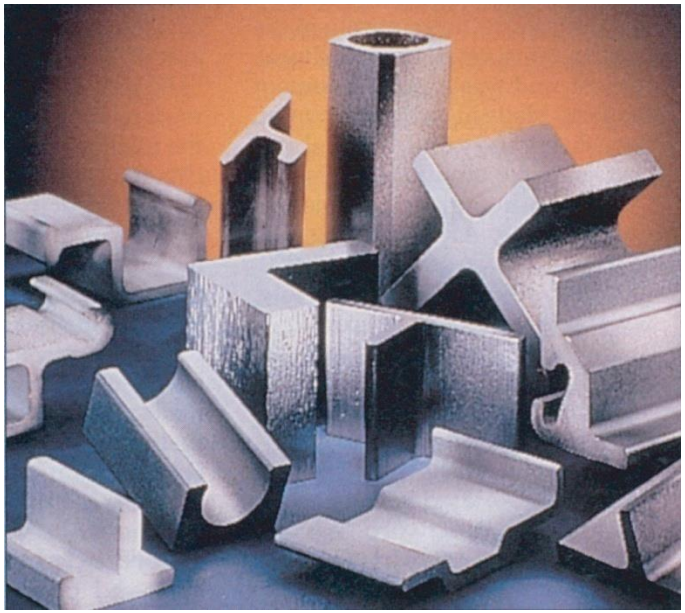
# Forged Product

# Rolled Product



# Extruded Product



# Types of Forging

**1. Based on Equipment**

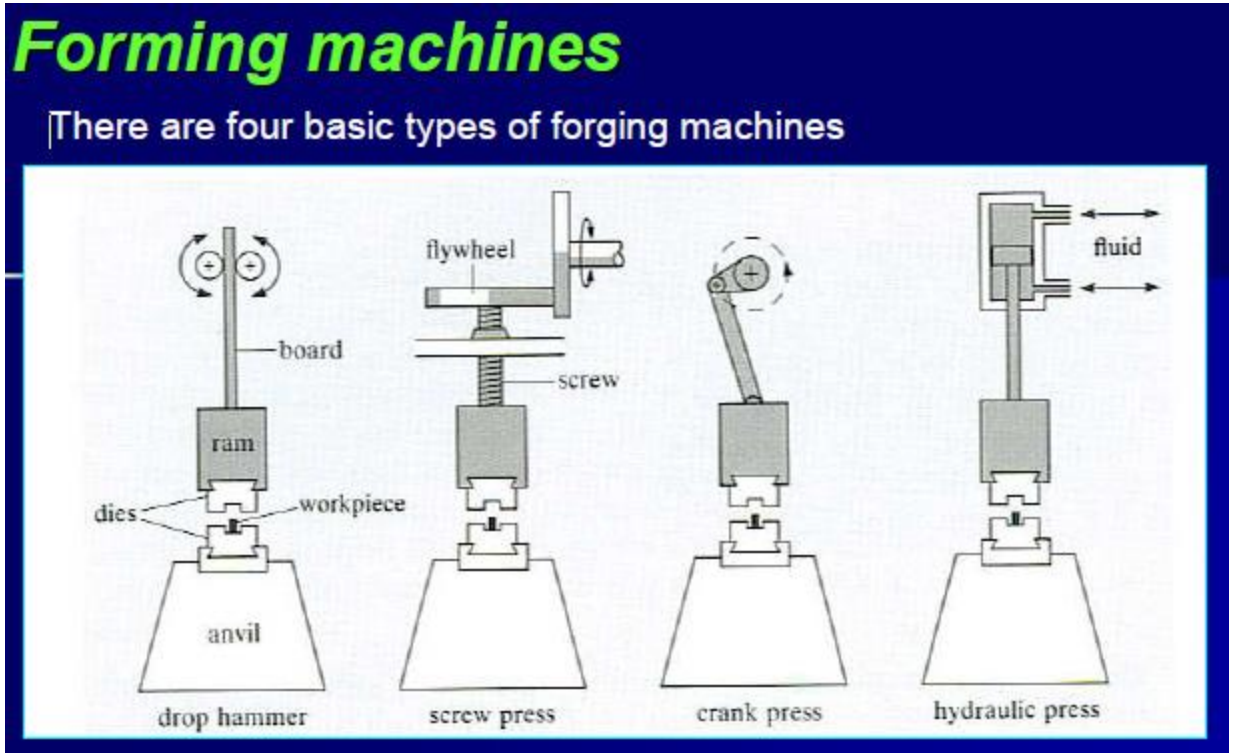
**(i) Hammer Forging**

**(ii) Press Forging**

**2. Based on Die**

**(i) Open Die Forging**

**(ii) Close Die Forging**



# Hammer and press forging processes

## Forging hammers

*There are two basic types of forging hammers used;*

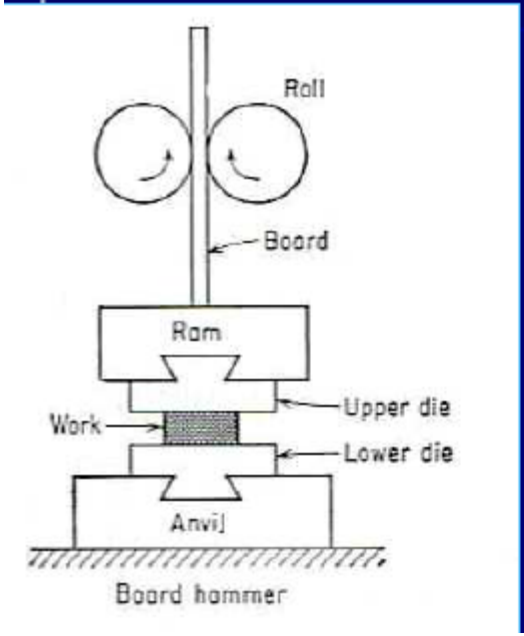
- **Board hammer**
- **Power hammer**

## Forging presses

*There are two basic types of forging presses available;*

- **Mechanical presses**
- **Hydraulic presses**

# Board hammer –forging hammer

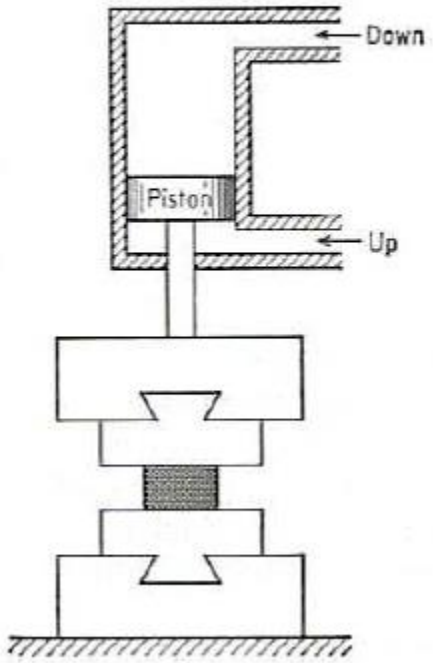


Board hammer

- The upper die and ram are raised by ***friction rolls*** gripping the board.
- After releasing the board, the ram falls under gravity to produce the ***blow energy***.
- The hammer can strike between ***60-150 blows*** per minute depending on size and capacity.
- The board hammer is an energy-restricted machine. The blow energy supplied equal the ***potential energy*** due to the weight and the height of the fall.

**Potential energy = *mgh*** …Eq 1

# Power hammer



Steam hammer

- ***Power hammer*** provides greater capacity, in which the ***ram is accelerated*** on the downstroke by steam or air pressure in addition to gravity.
- Steam or air pressure is also used to raise the ram on the upstroke.
- *The **total energy** supplied to the blow in a power drop hammer is given by*

$$W = \frac{1}{2}mv^2 + pAH = (mg + pA)H \qquad \text{...Eq 2}$$

Where
- ***m*** = mass
- ***v*** = velocity of ram at start of deformation
- ***g*** = acceleration of gravity
- ***p*** = air or steam pressure acting on ram cylinder on downstroke
- ***A*** = area of ram cylinder
- ***H*** = height of the ram drop


- ***Hydraulic presses*** are load-restricted machines in which hydraulic pressure moves a piston in a cylinder.

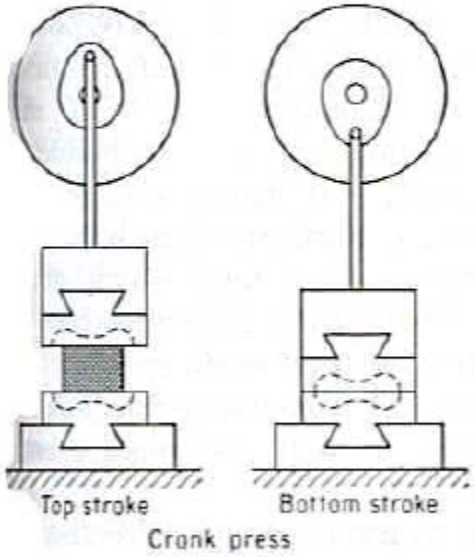
- The full press load is available at any point during the full stroke of the ram. Therefore, hydraulic presses are ideally suited for ***extrusion-type forging operation***.

- Due to slow speed, ***contact time is longer*** at the die-metal interface, which causes problems such as heat lost from workpiece and die deterioration.

- Also provide close-tolerance forging.

- Hydraulic presses are ***more expensive*** than mechanical presses and hammers.

# Mechanical press forging




Mechanical press

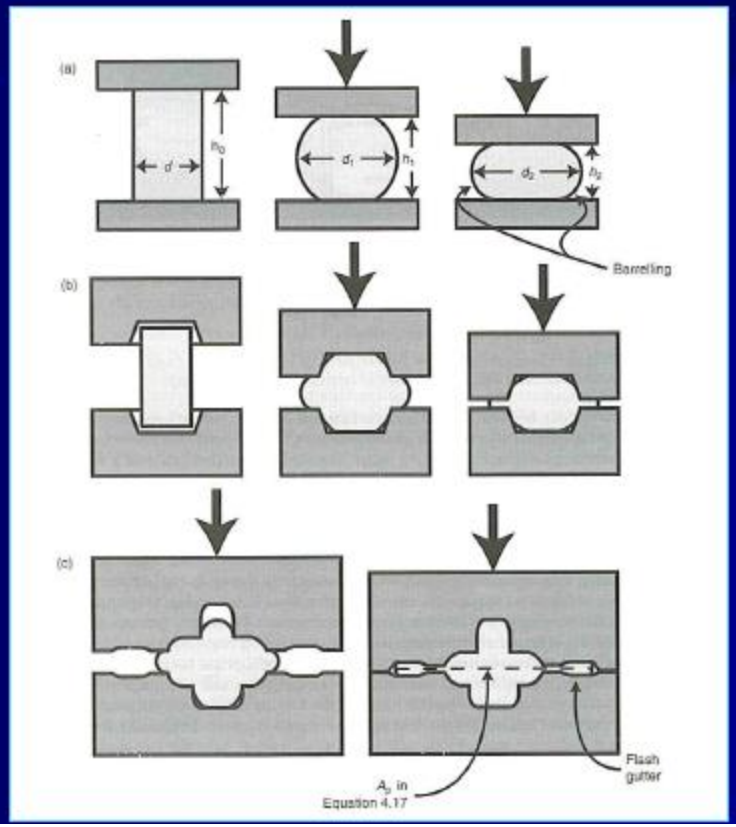
- Crank press translates rotary motion into reciprocating linear motion of the press slide.
- The ram stroke is shorter than in a hammer or hydraulic press.
- Presses are rated on the basis of the force developed at the end of the stroke.
- The ***blow press*** is more like ***squeeze*** than like the impact of the hammer, therefore, dies can be less massive and die life is longer than with a hammer.
- The ***total energy*** supplied during the stroke of a press is given by

$$W = \frac{1}{2} I\left[\omega_o^2 - \omega_f^2\right] \qquad \text{...Eq 3}$$

Where $I$ is moment of inertia of the flywheel

$\omega$ is angular velocity, $\omega_o$-original, $\omega_f$-after deformation, rad.s$^{-1}$

# Closed and open die forging processes



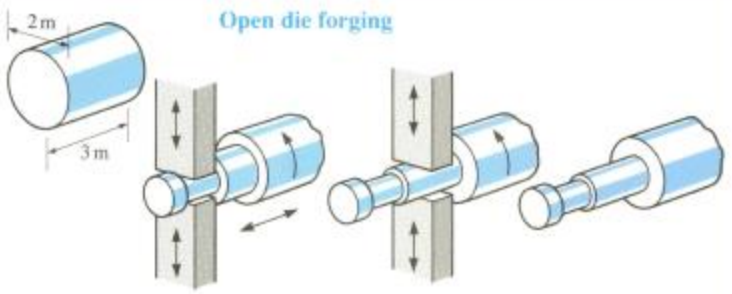

Open-die forging

Closed-die forging

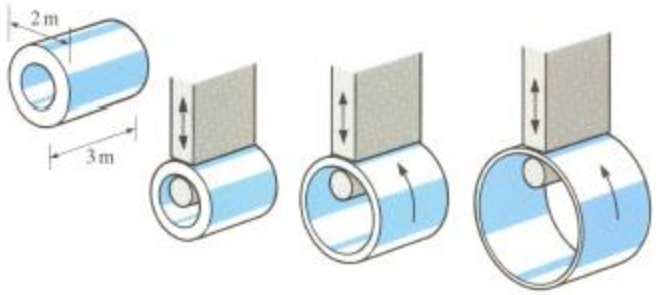
Impression-die forging

# Open-die forging

- ***Open-die forging*** is carried out between flat dies or dies of very simple shape.
- The process is used for mostly ***large objects*** or when the number of parts produced is small.
- Open-die forging is often used to ***preform*** the workpiece for closed-die forging.



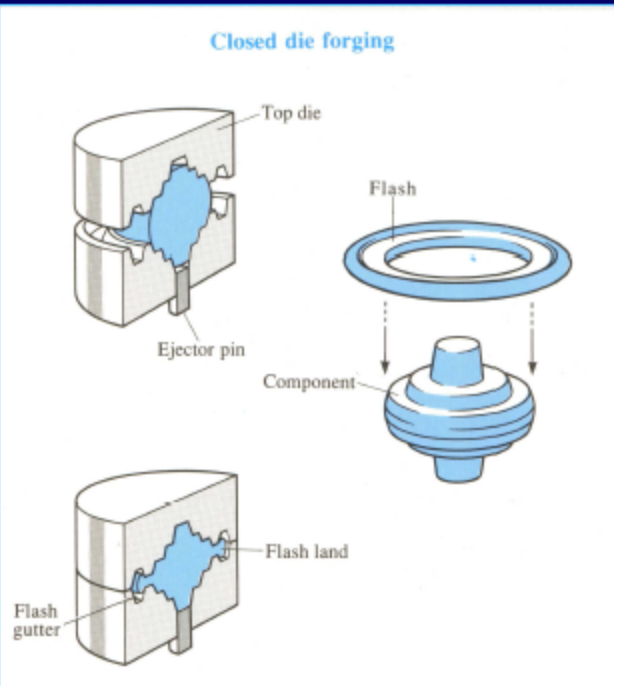

Forging large turbine shaft



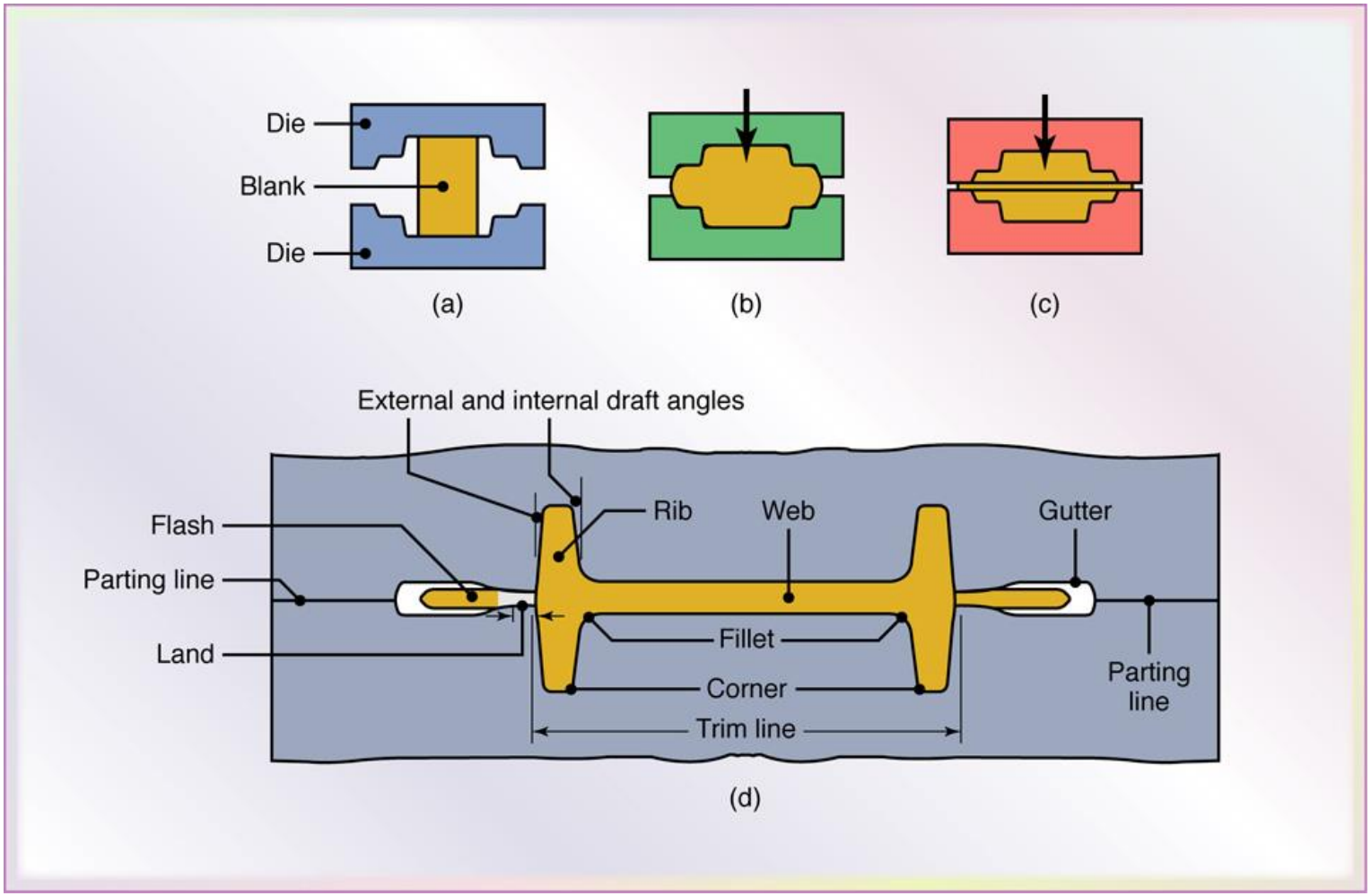

Forging pressure vessel cylinder

# Closed-die forging (or impression-die forging)

- The workpiece is deformed between two die halves which carry the ***impressions*** of the desired final shape.
- The workpiece is deformed under high pressure in a closed cavity.
- Normally used for ***smaller components***.
- The process provide precision forging with ***close dimensional tolerance***.
- Closed dies are ***expensive***.



# Flash Land and Flash Gutter



## Performing operation or steps in forging

(i) Fullering
(ii) Edging
(iii) Blocking
(iv) Finishing
(v) Trimming