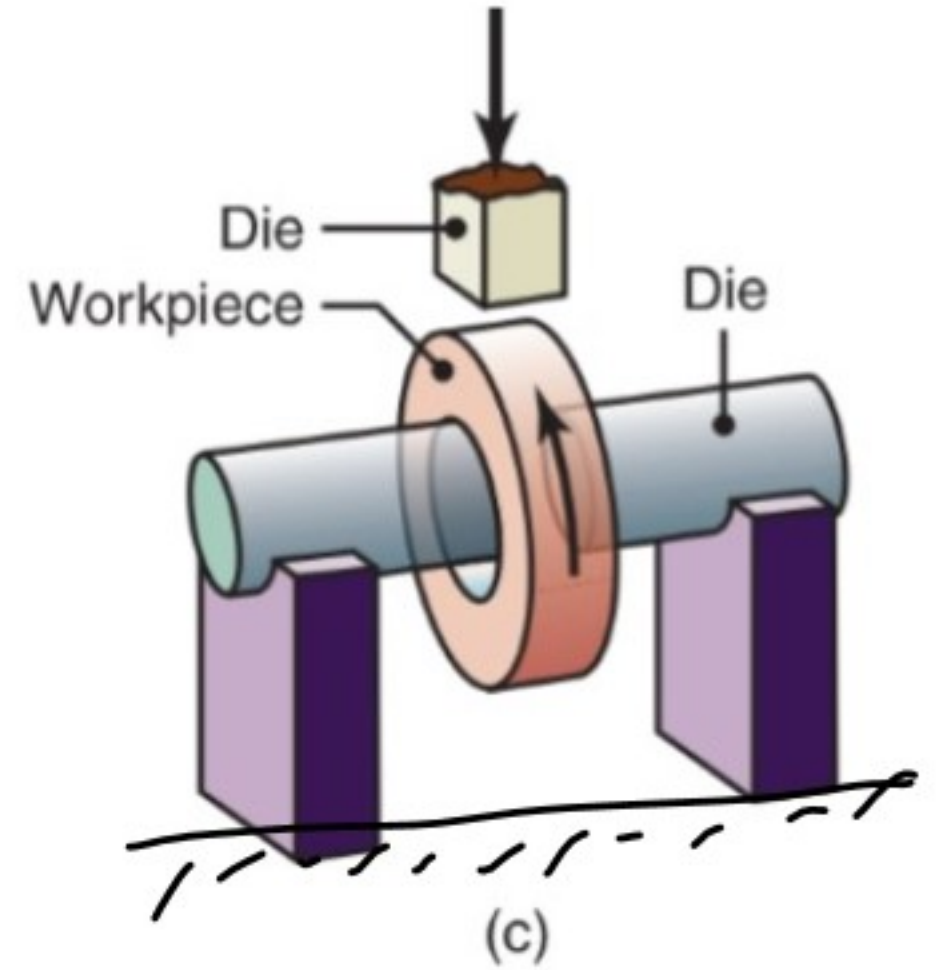
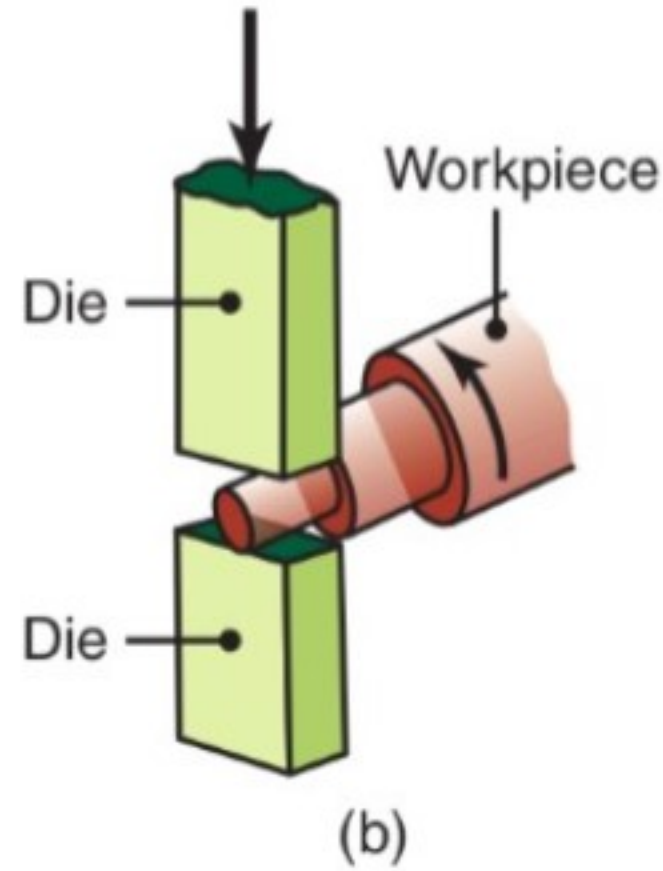
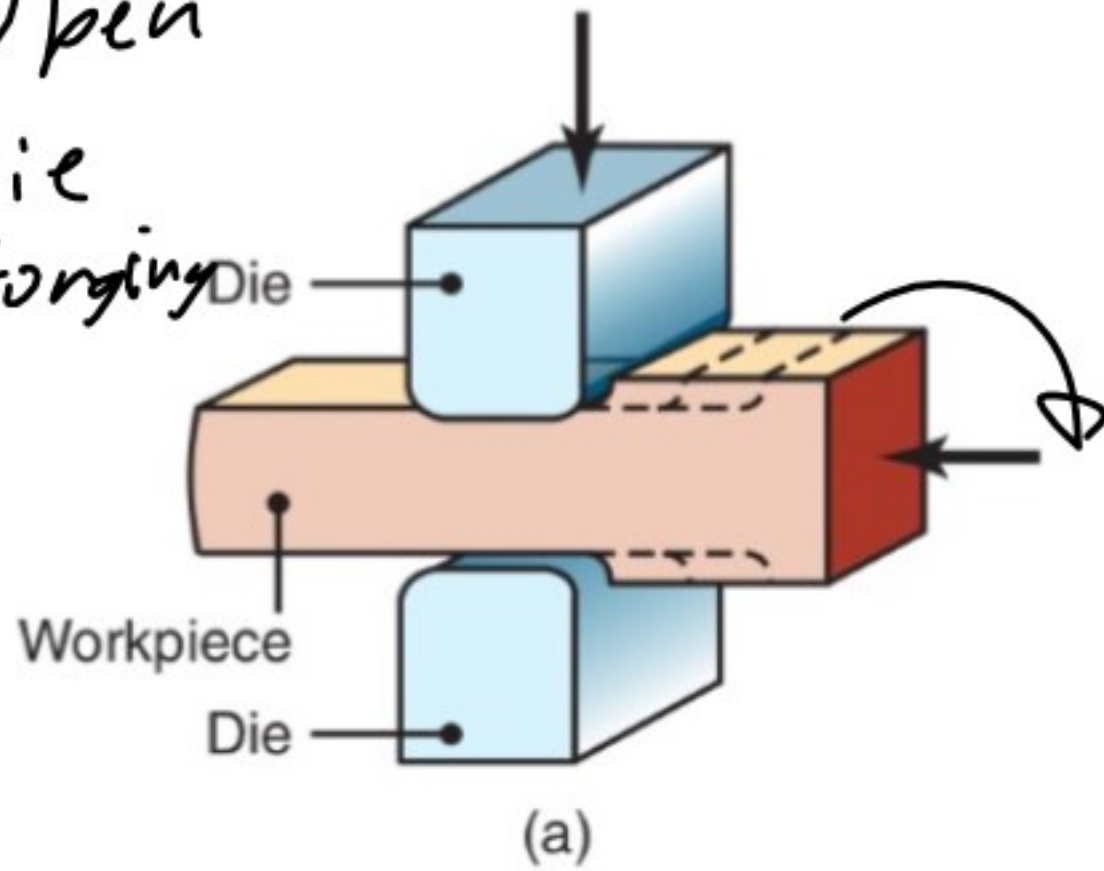


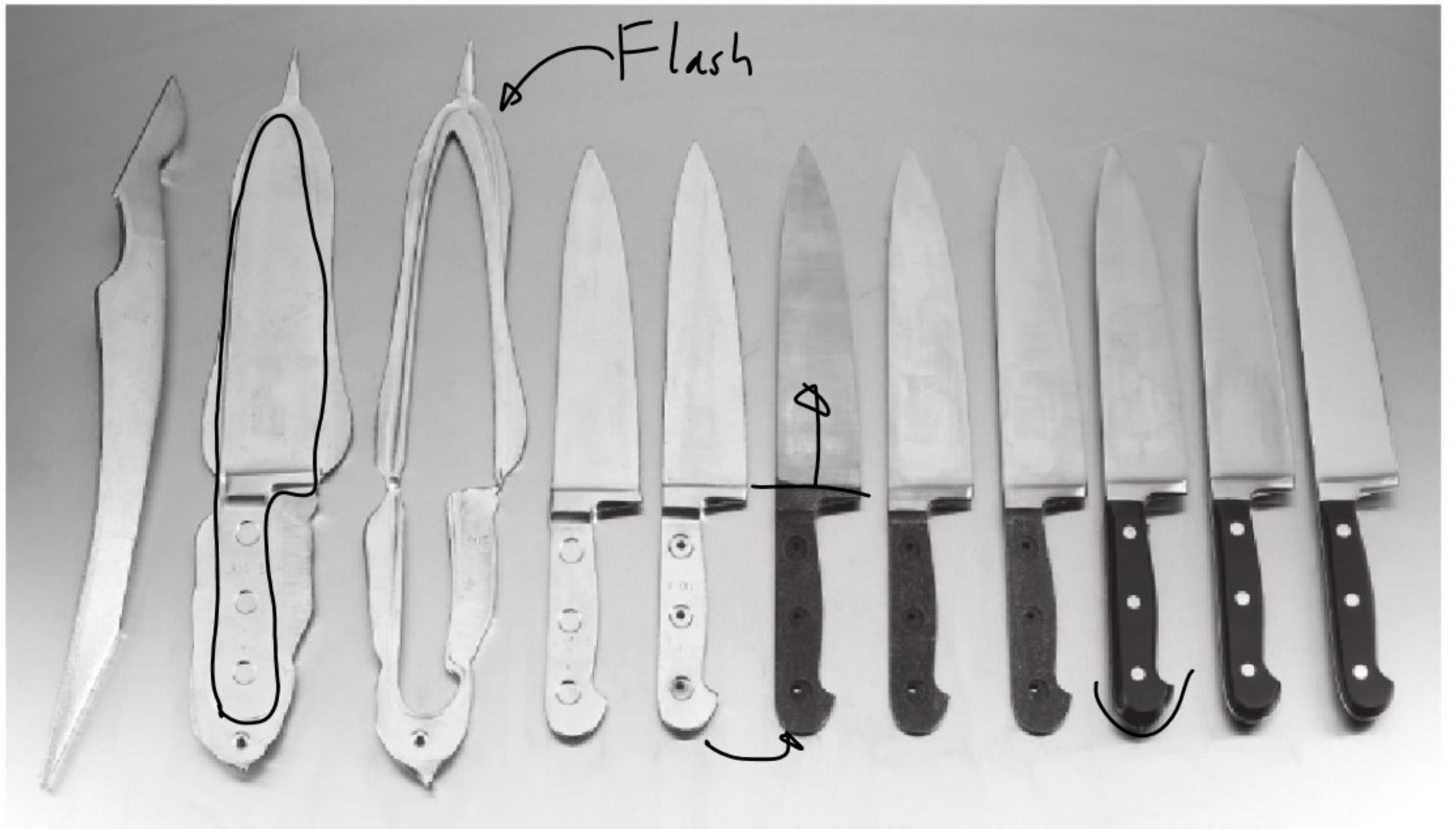
Forging

Open

Die

Forging

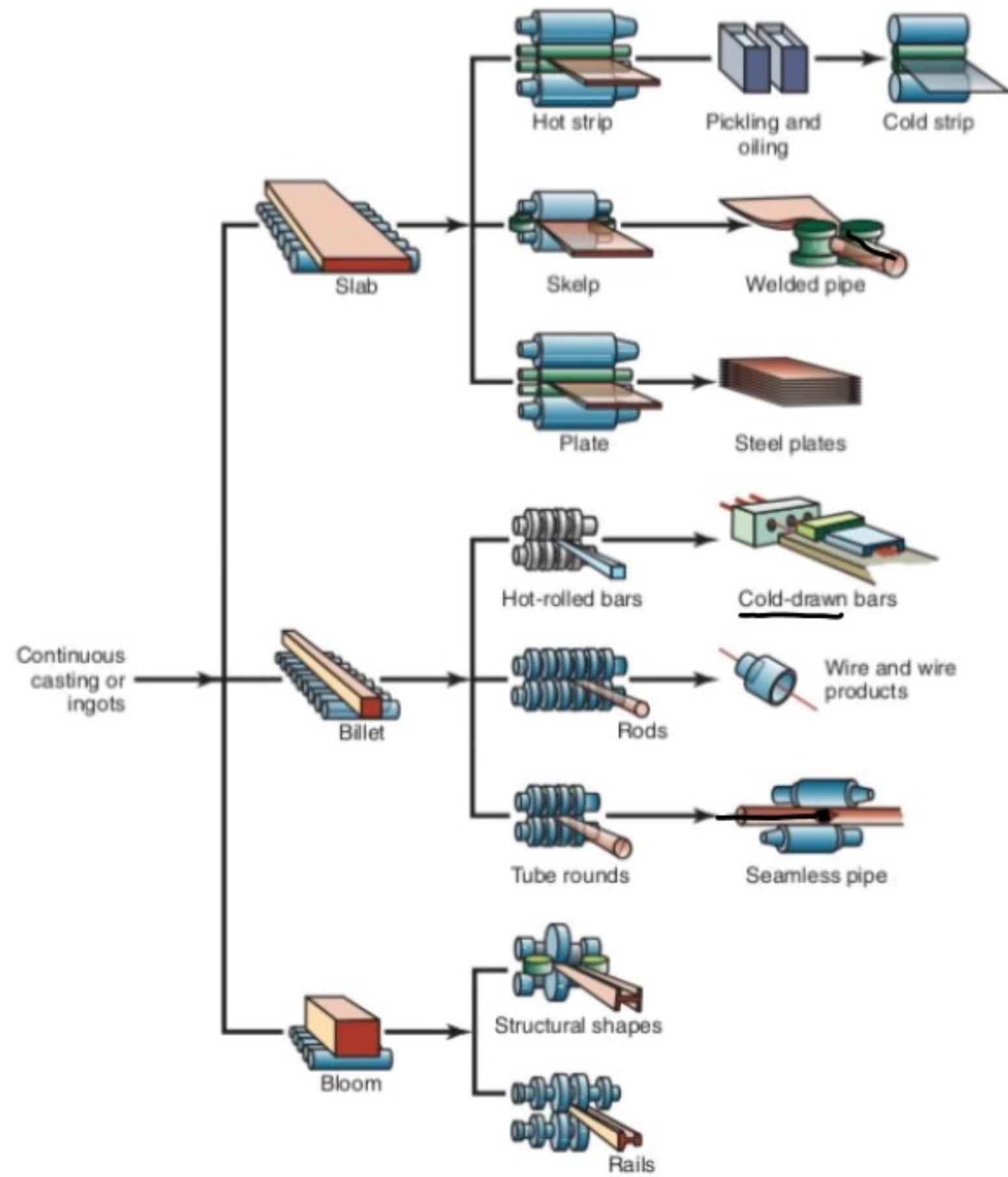




Flash



Rolling

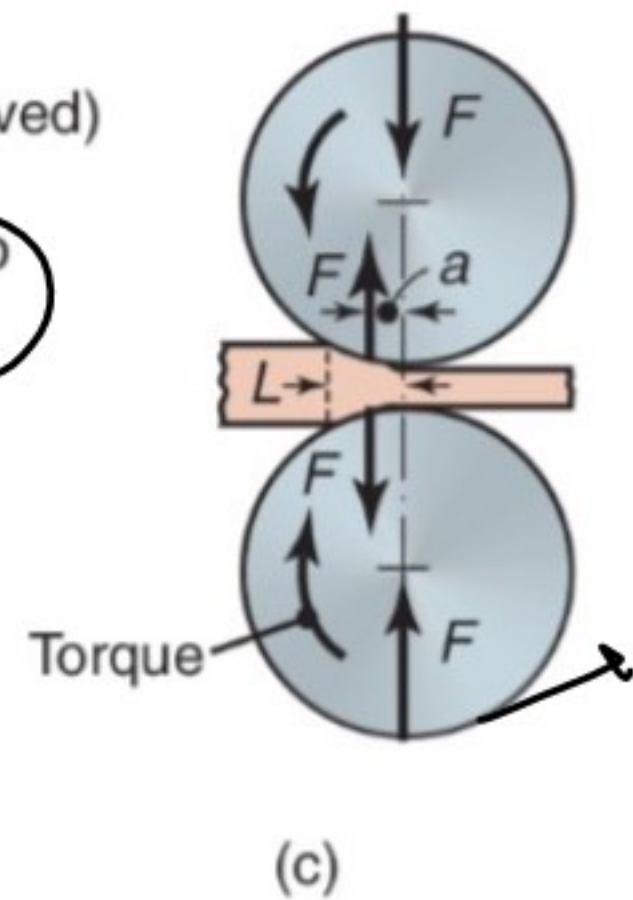
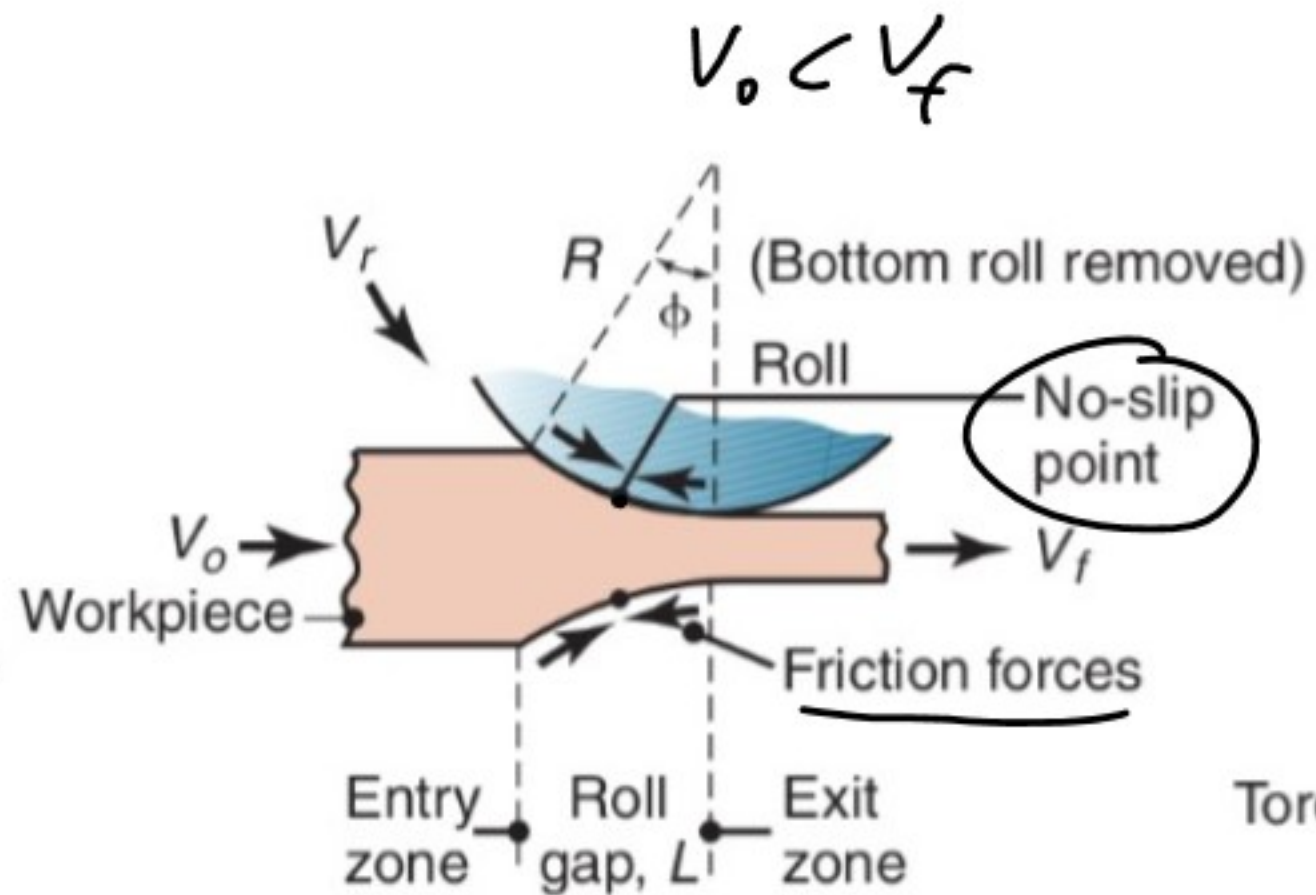
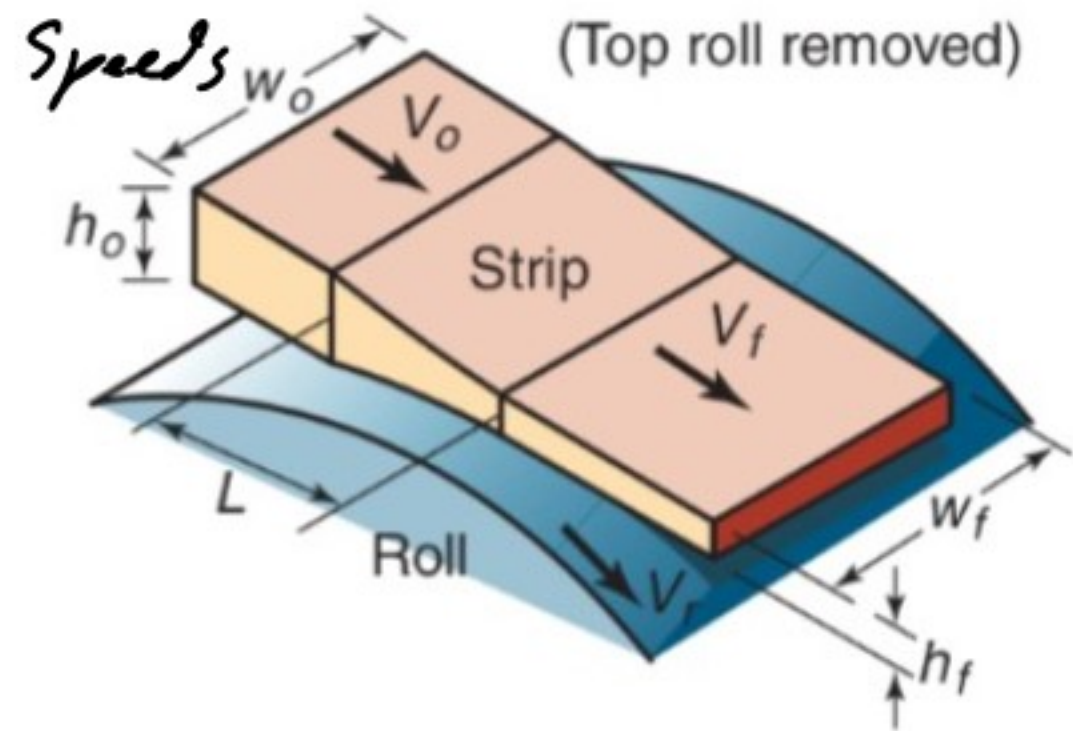


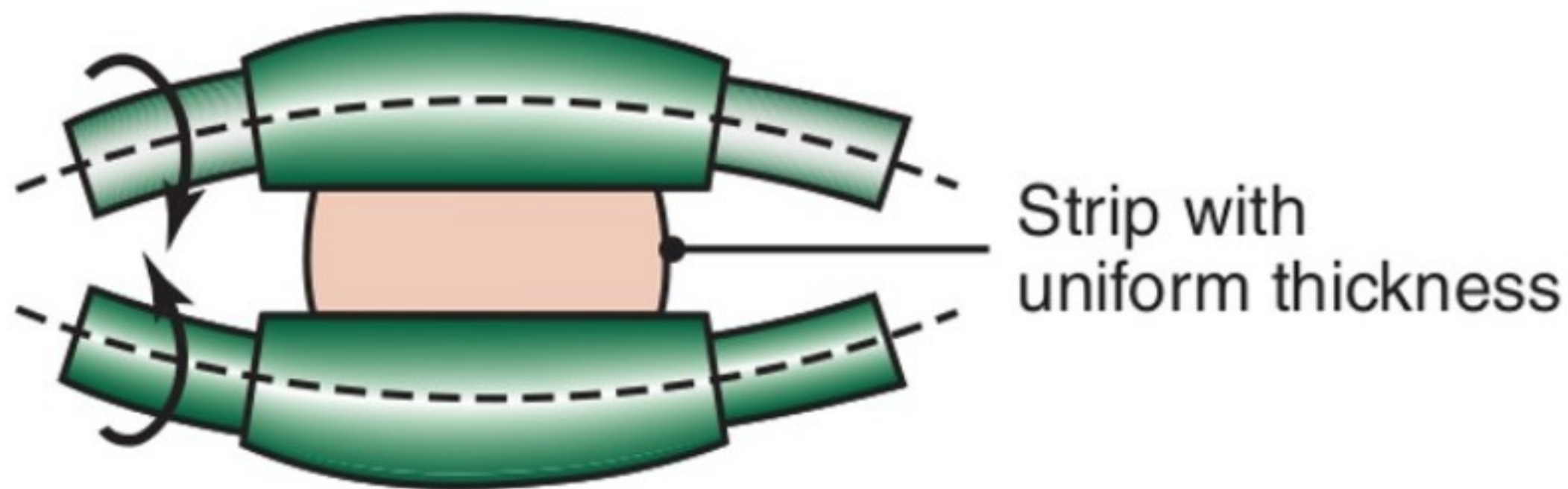
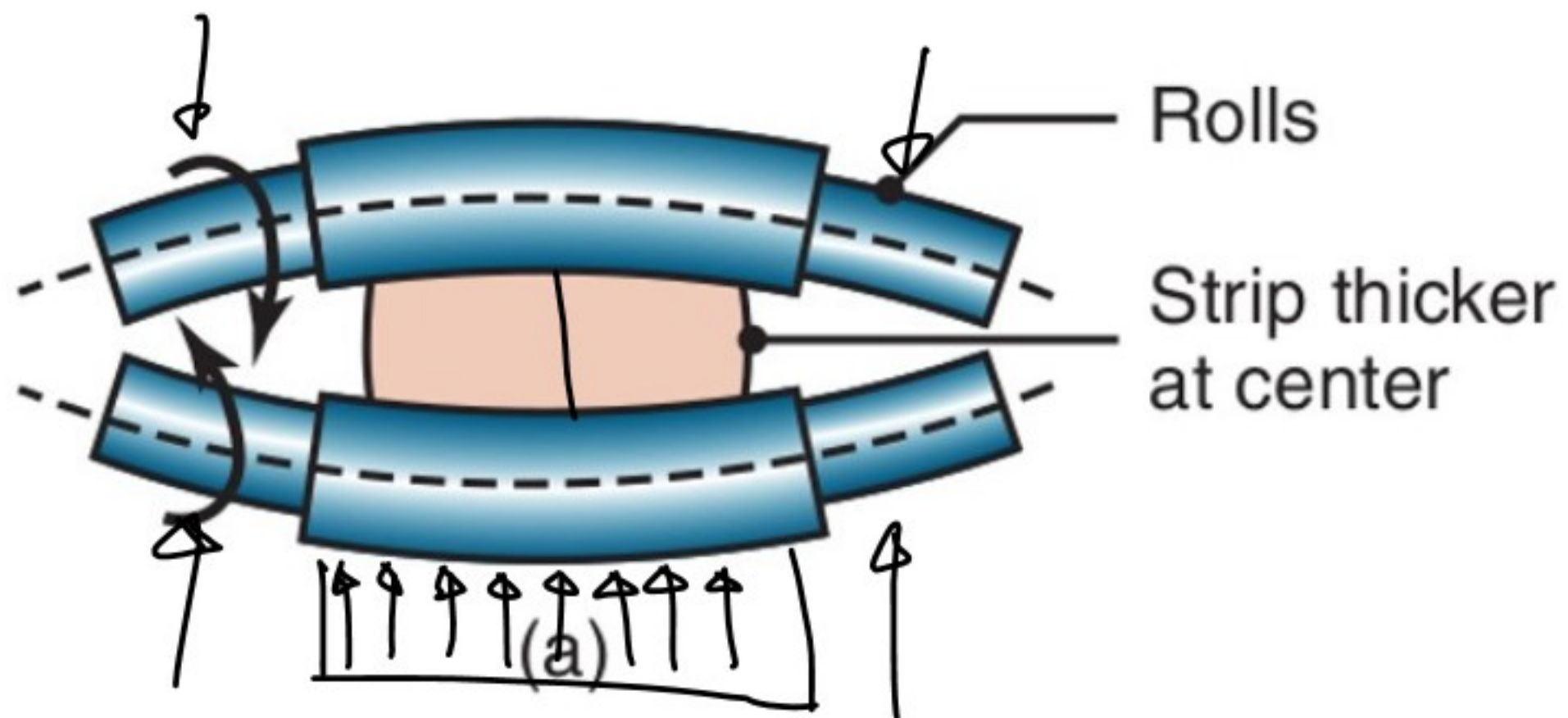
Can calculate

Force

Power

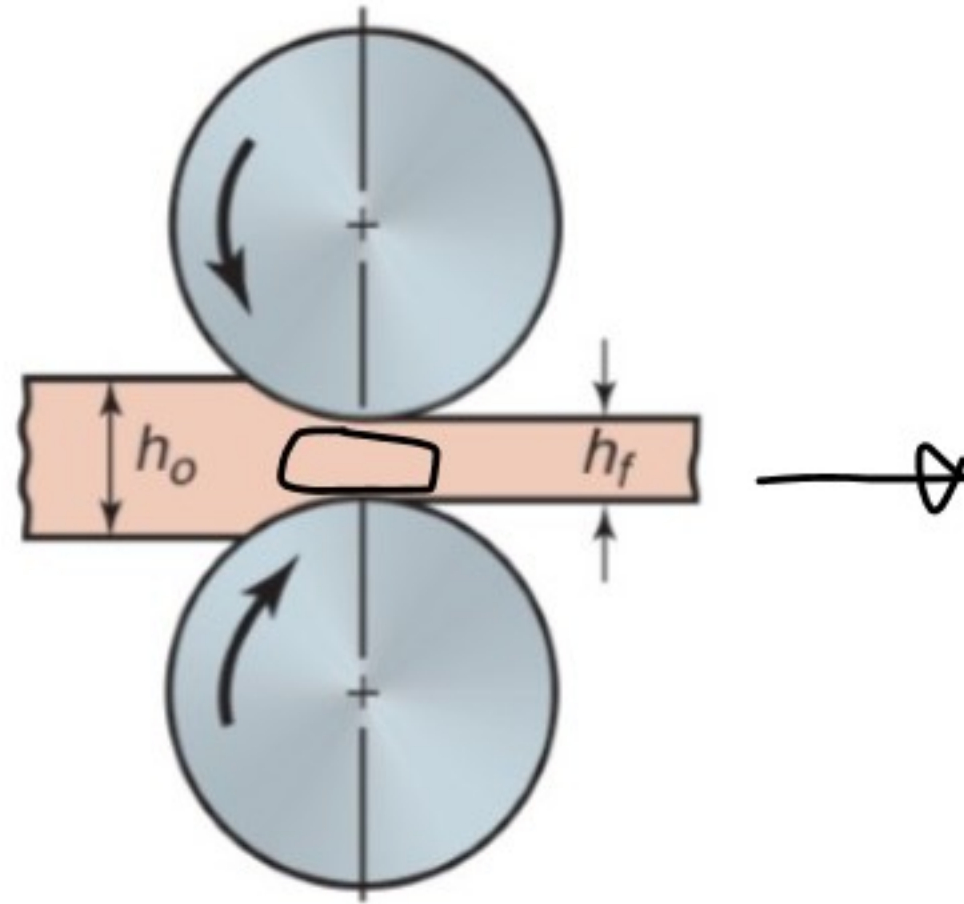
Speeds





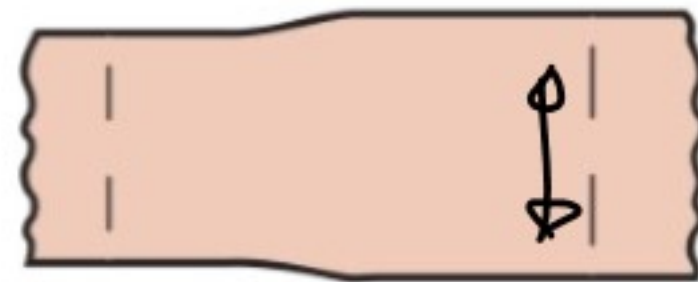
(b)

Side view

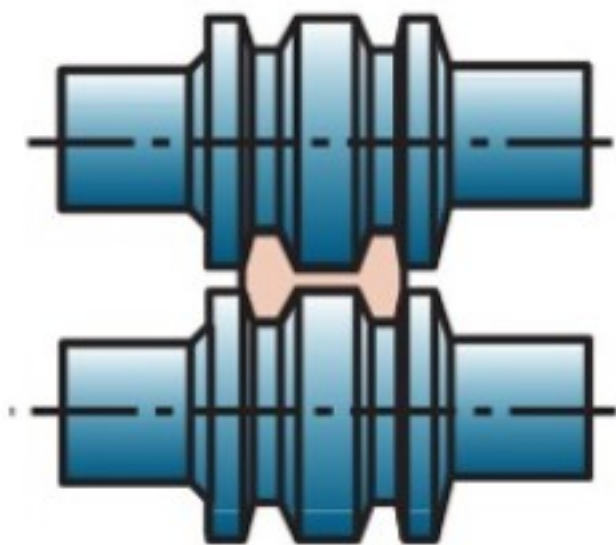


(a)

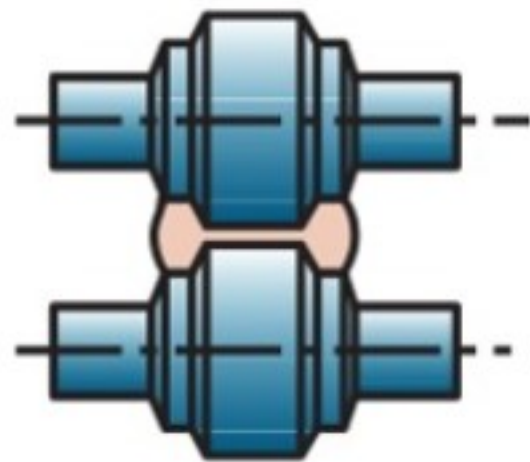
Top view



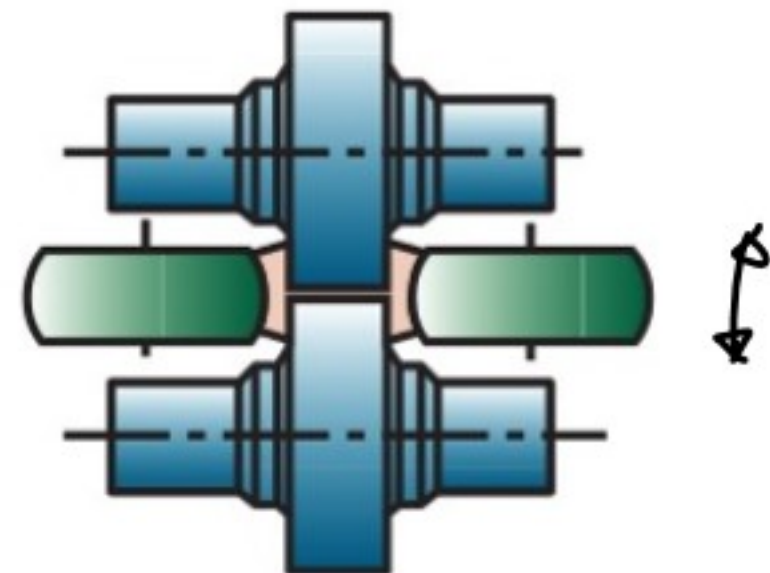
(b)



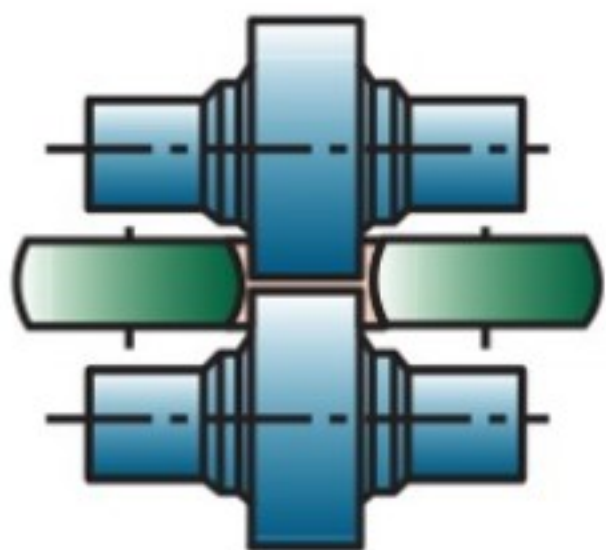
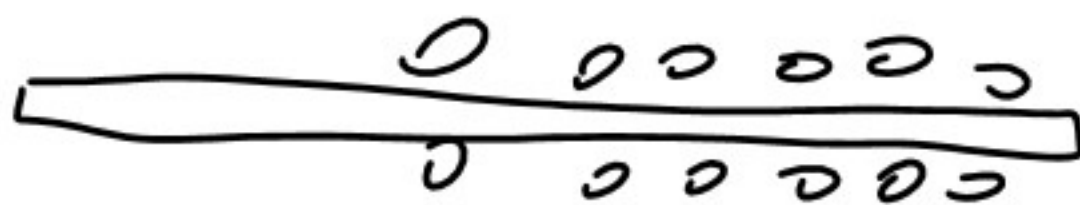
Stage 1: Blooming rolls



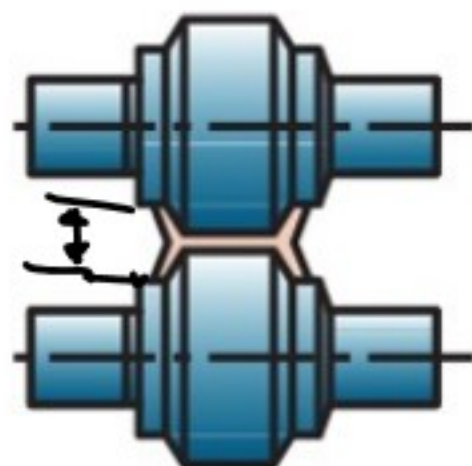
Stage 2: Edging rolls



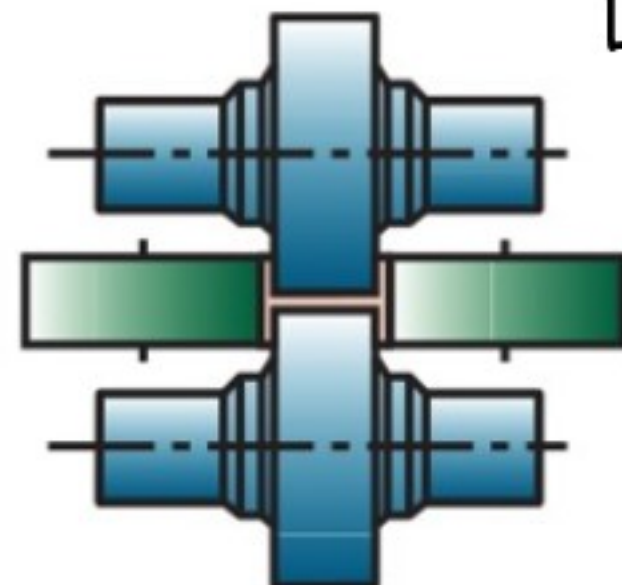
Stage 3: Roughing horizontal and vertical rolls



Stage 4: Intermediate horizontal and vertical rolls

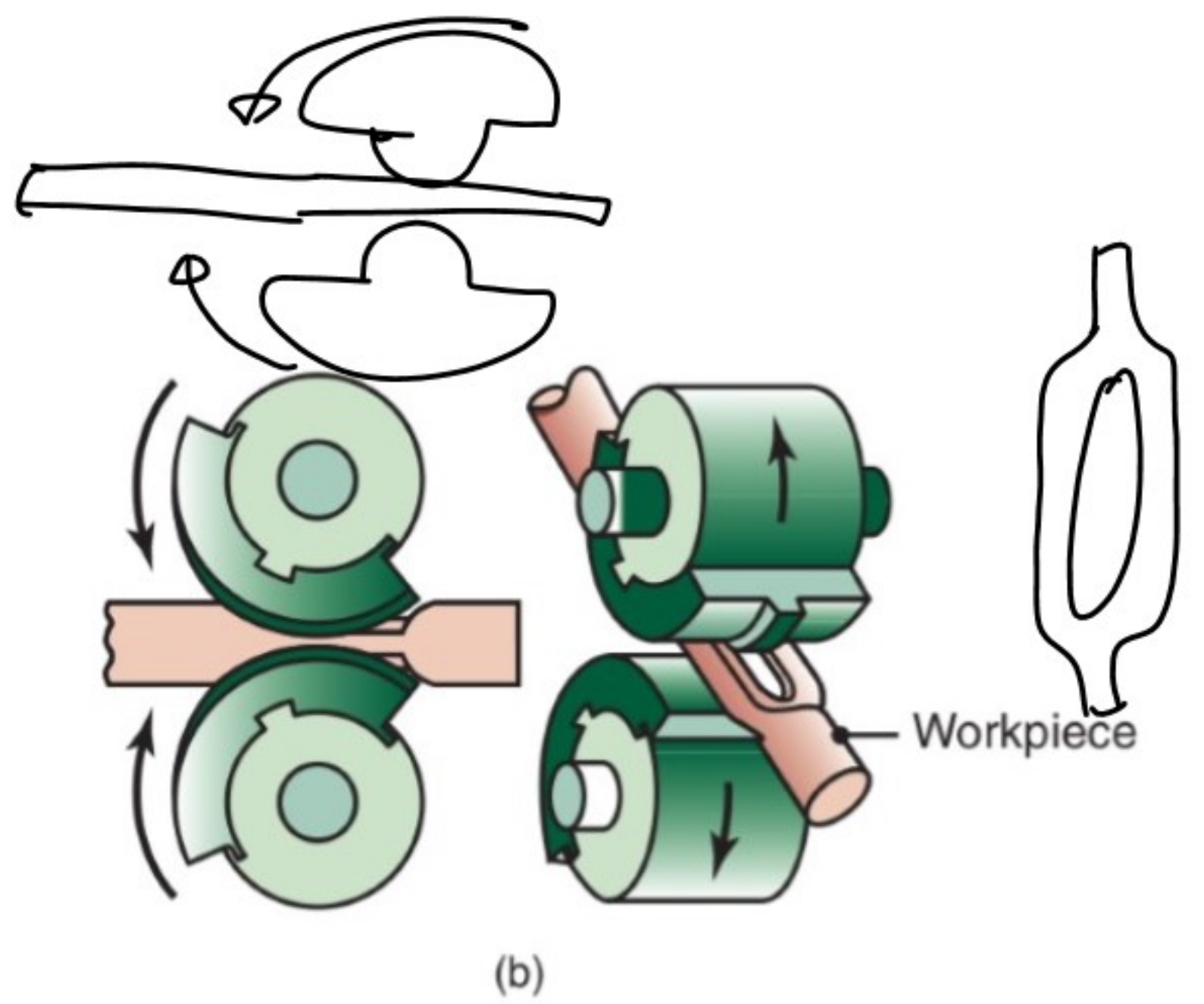
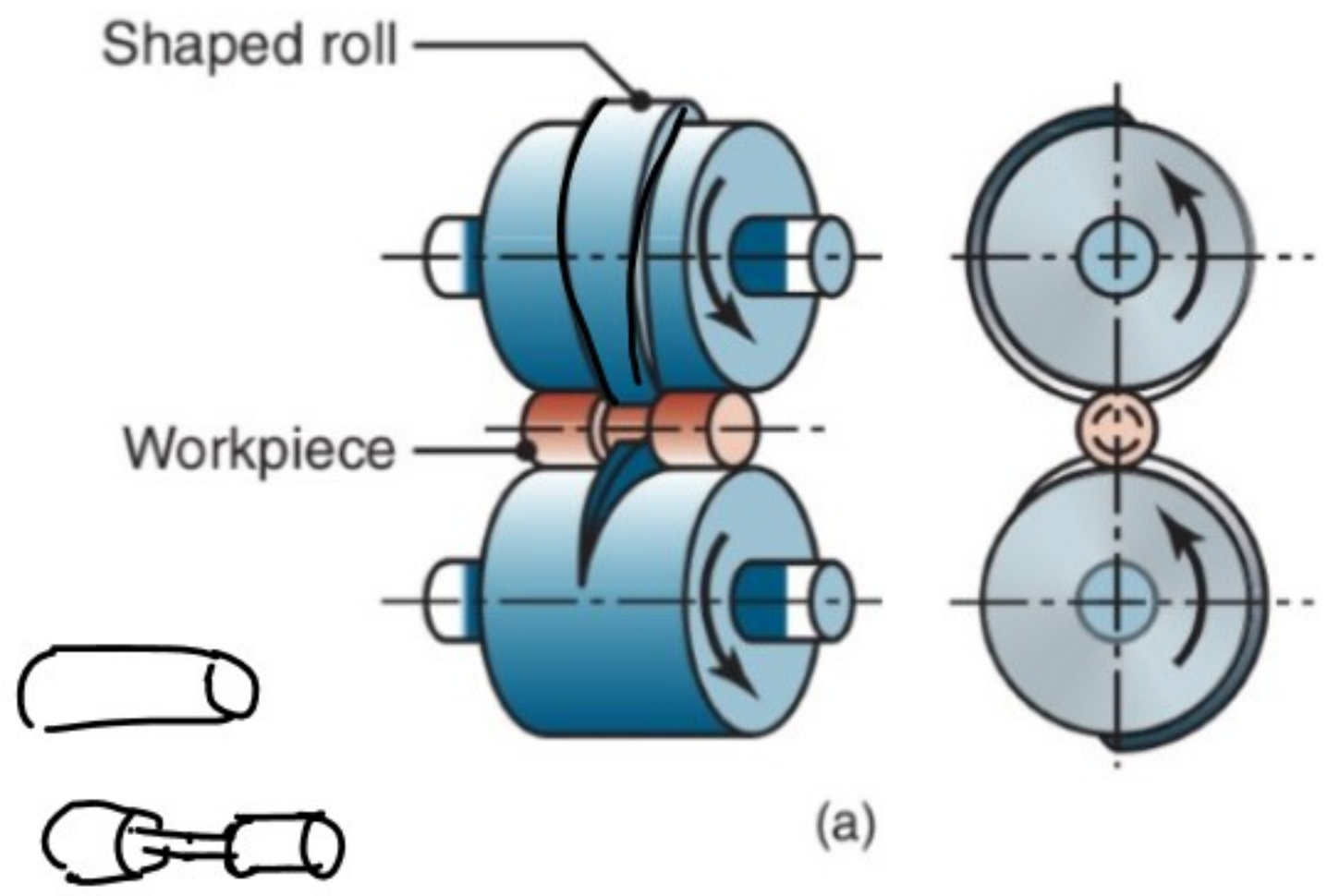


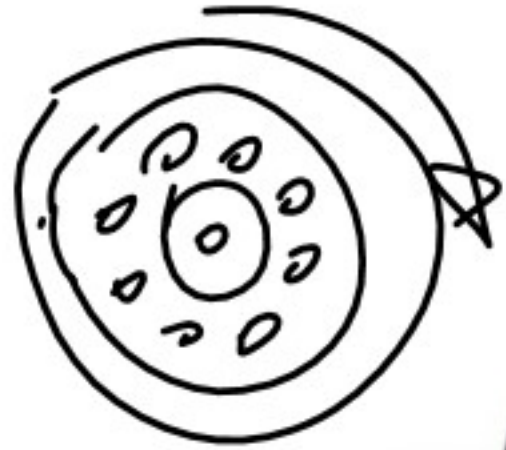
Stage 5: Edging rolls



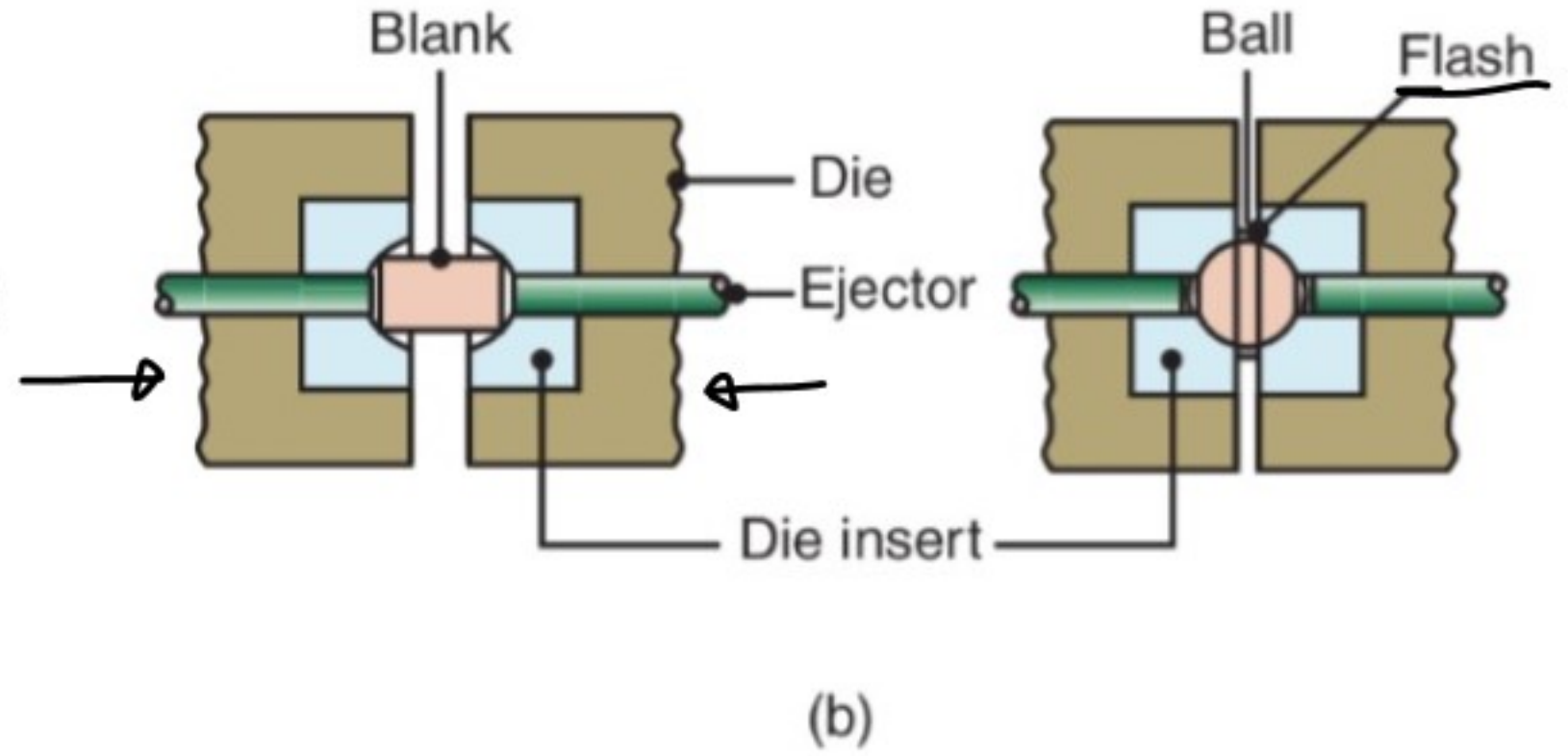
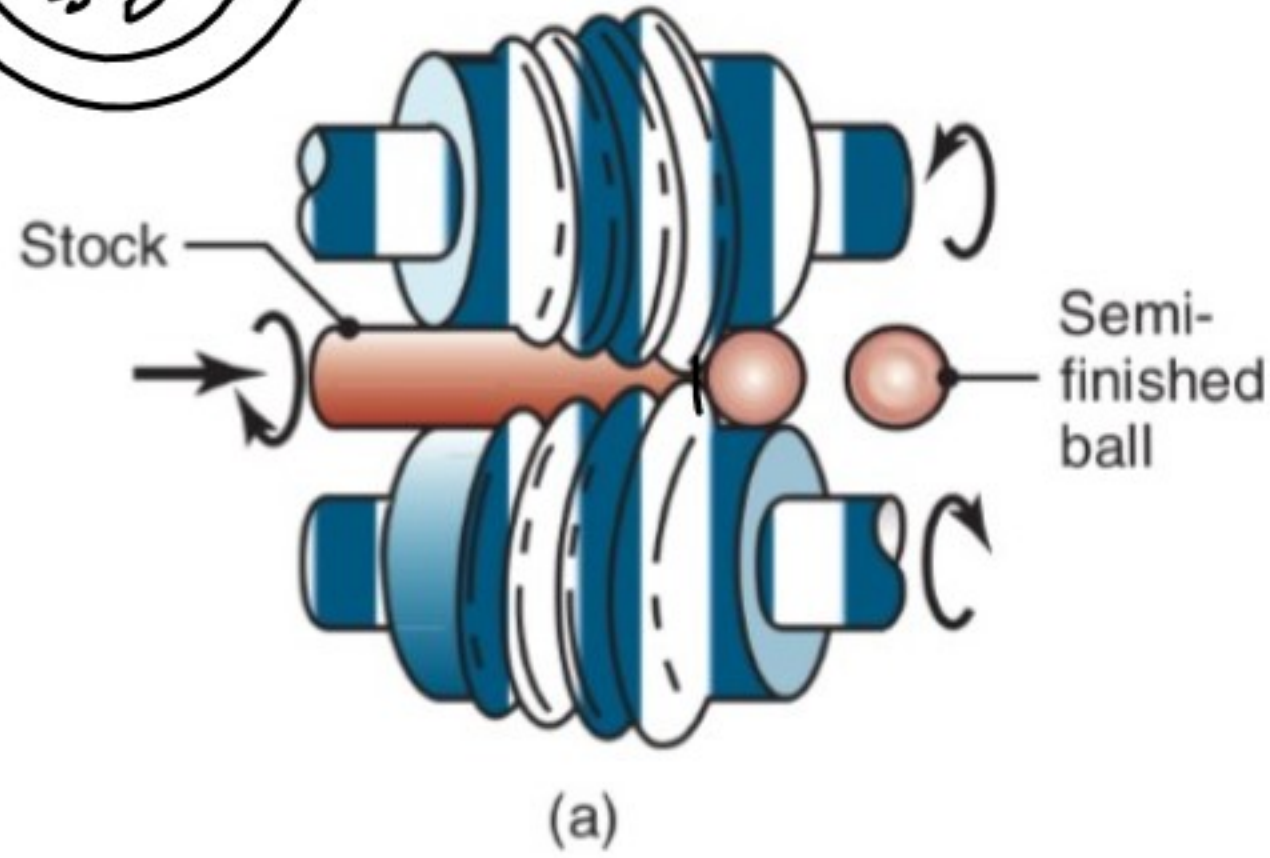
Stage 6: Finishing horizontal and vertical rolls

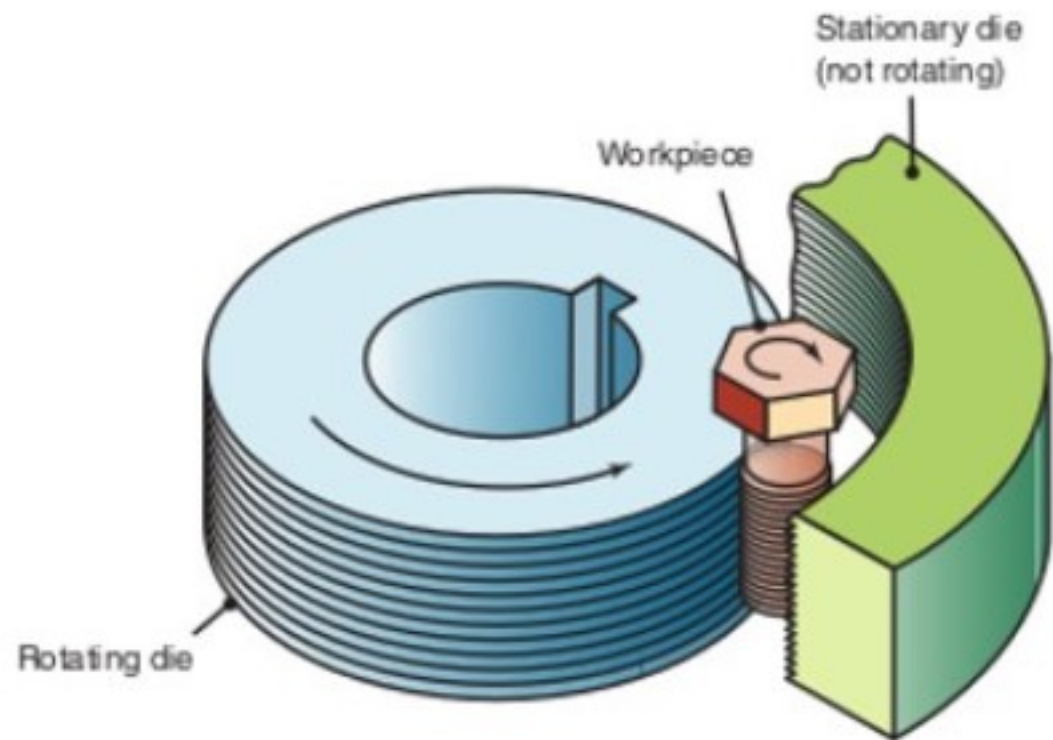
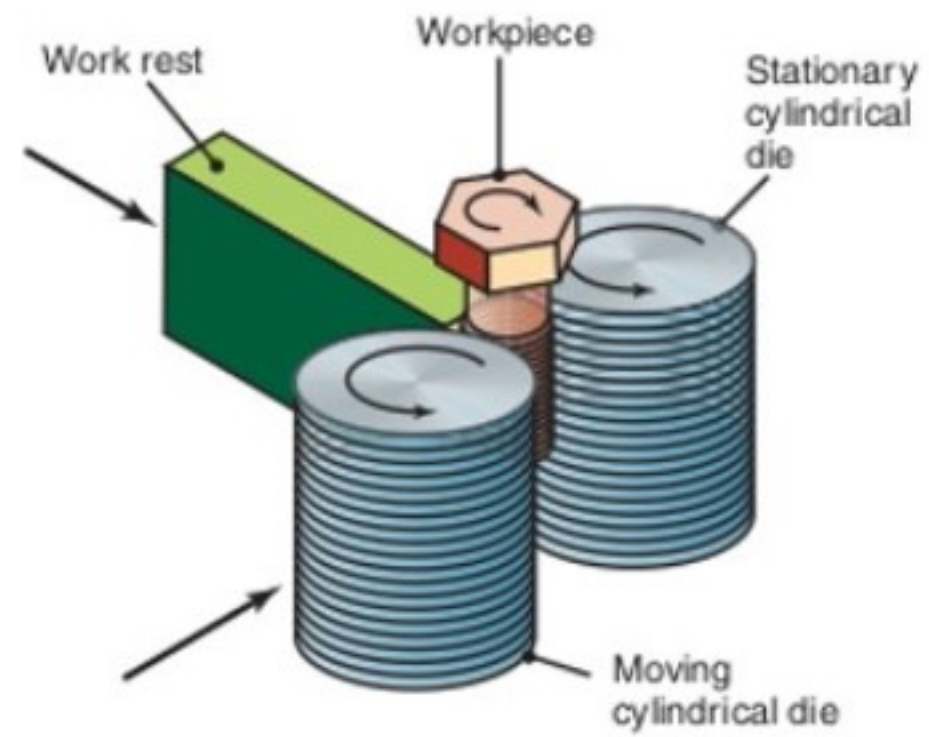
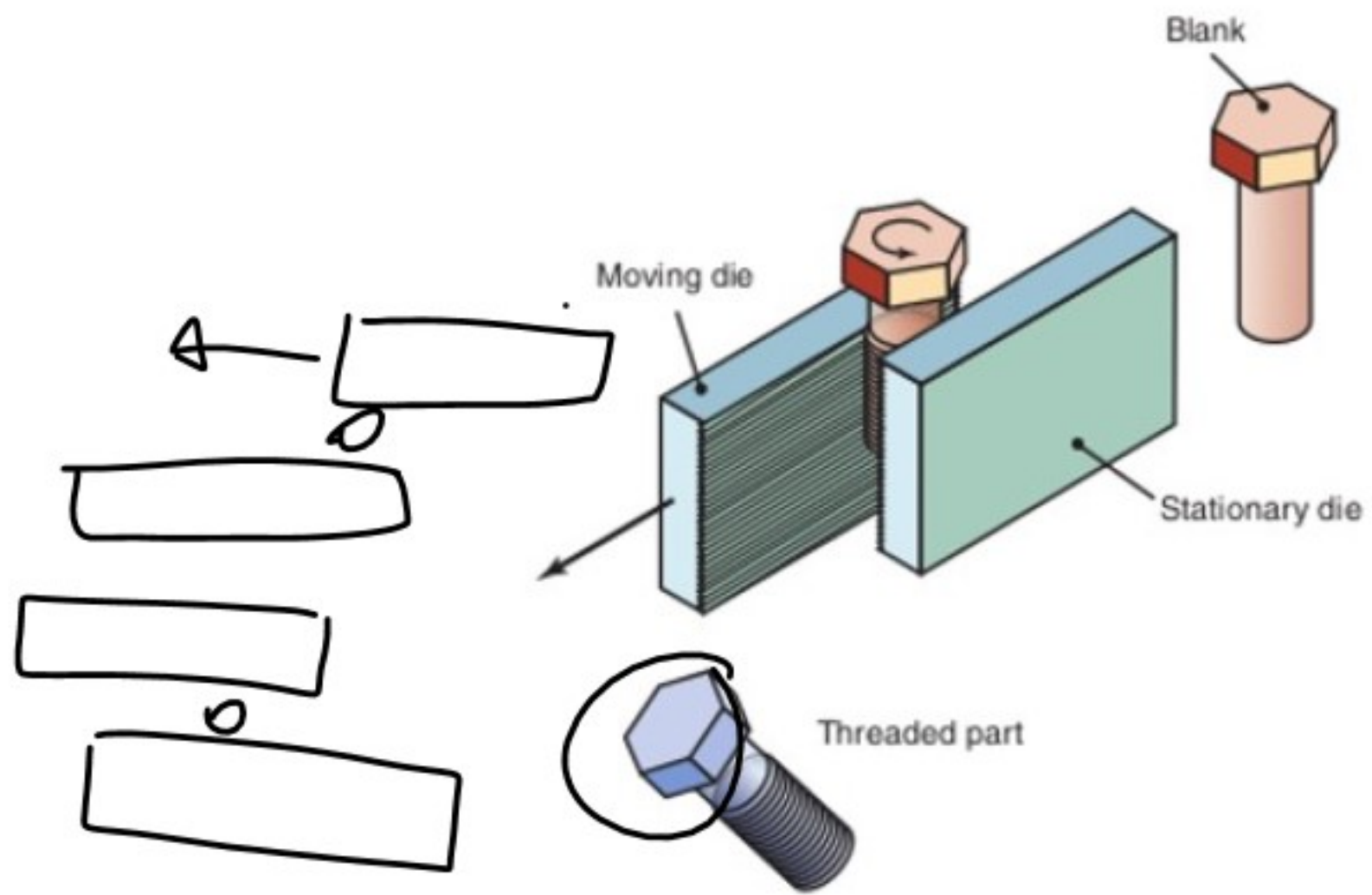


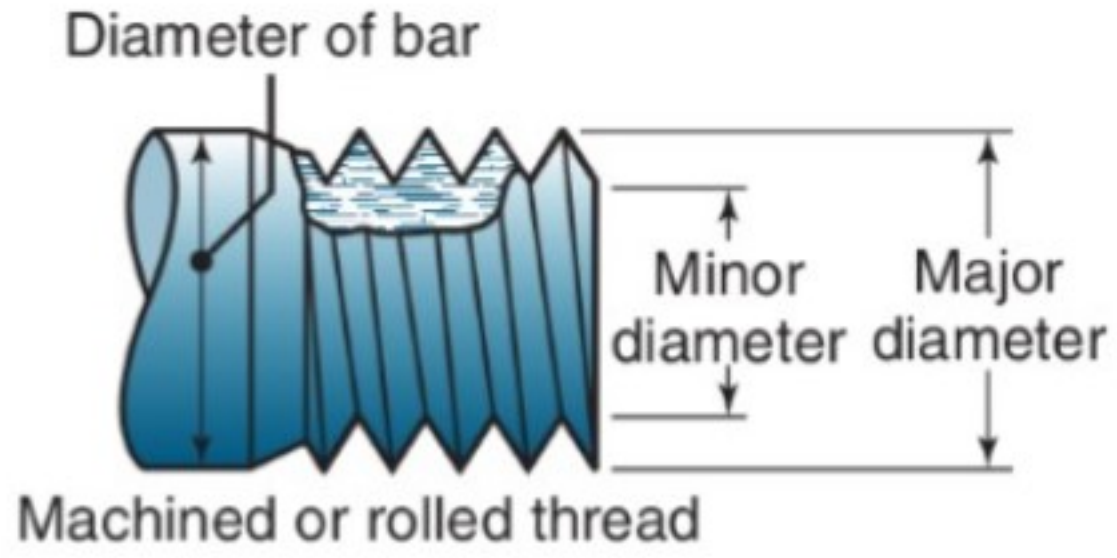




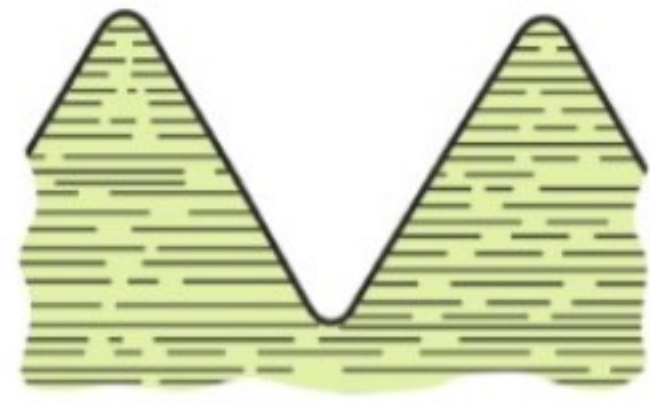
Used for ball bearings





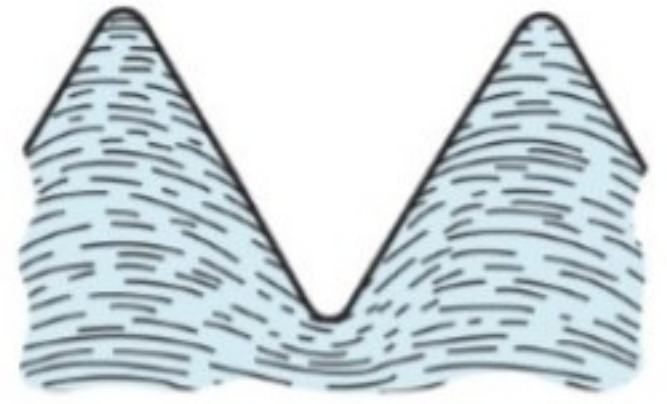


(a)



Machined thread

(b)



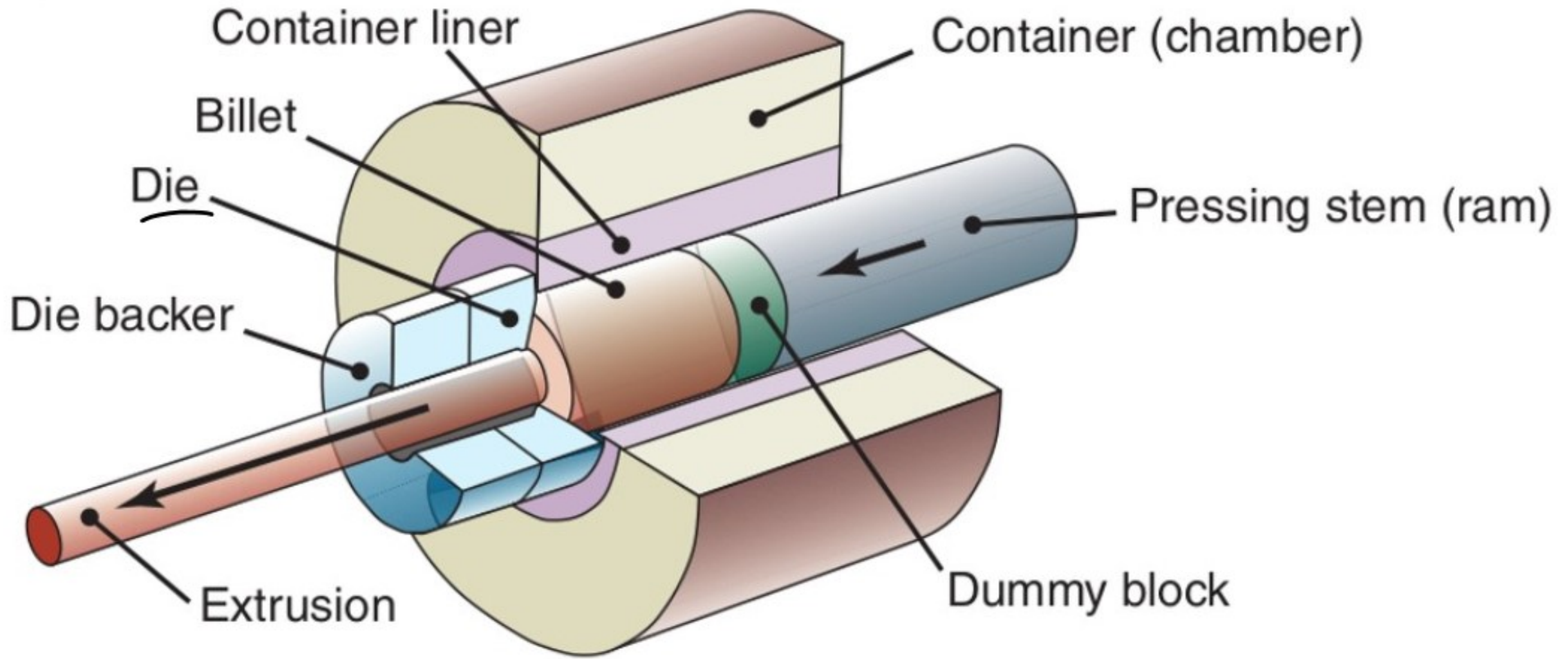
Rolled thread

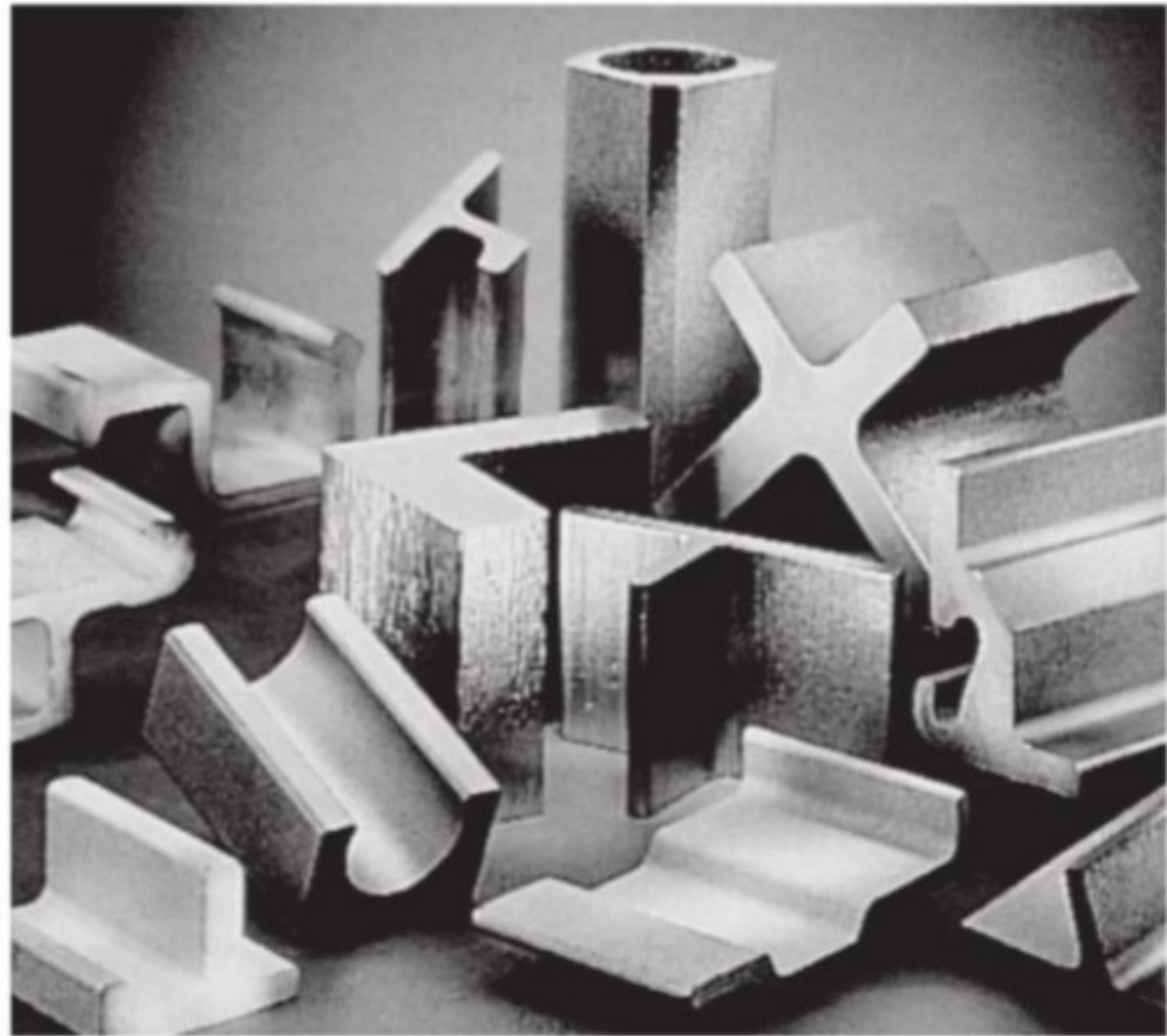
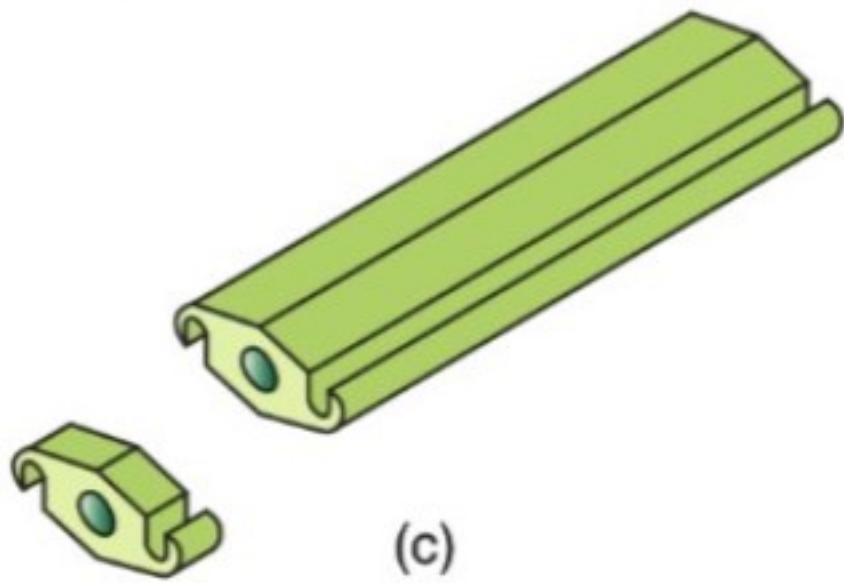
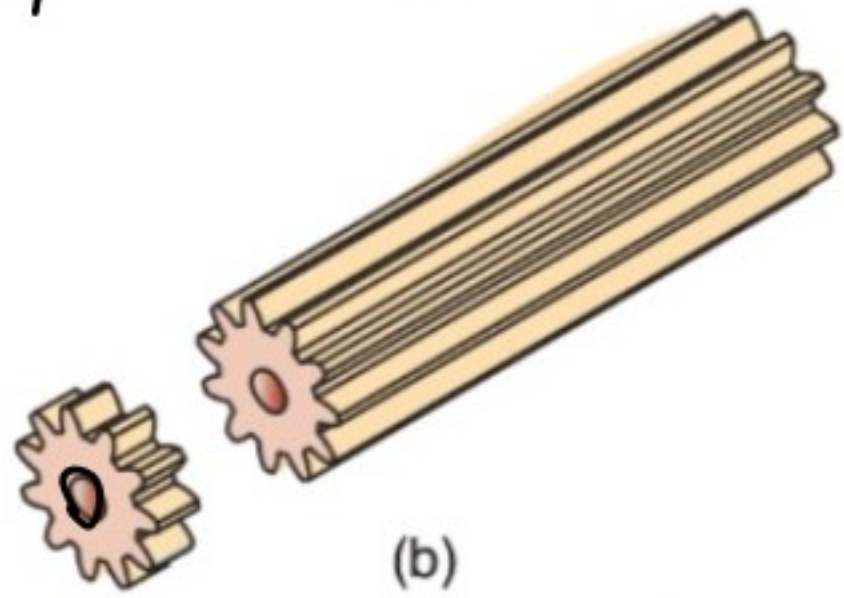
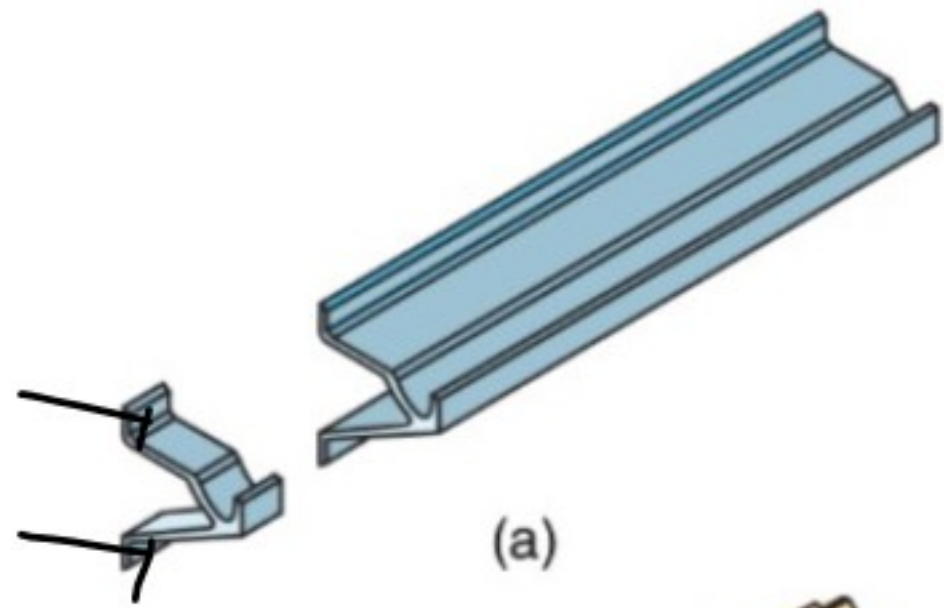
(c)

Stronger

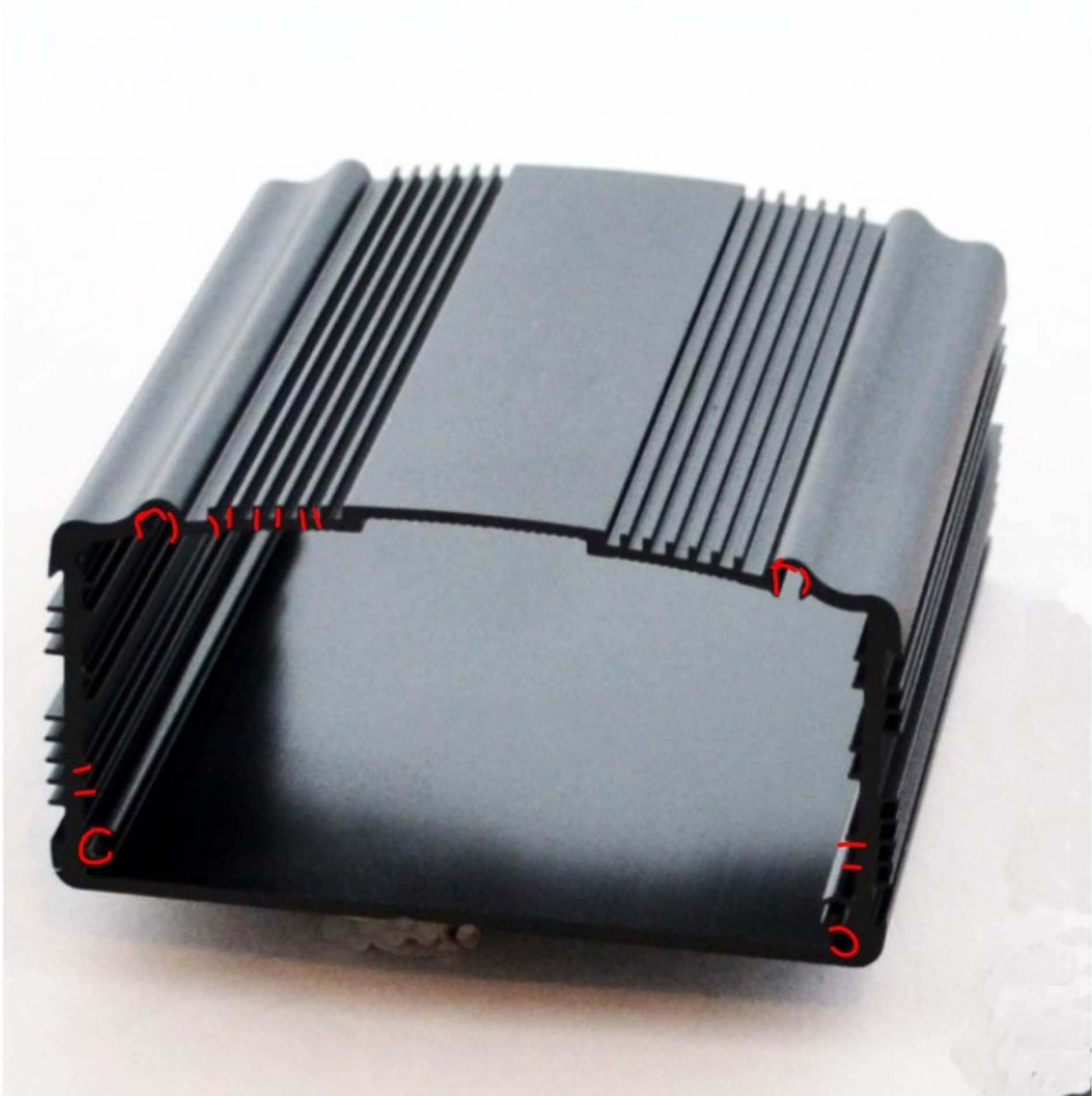
Extrusion

Cold on Hot

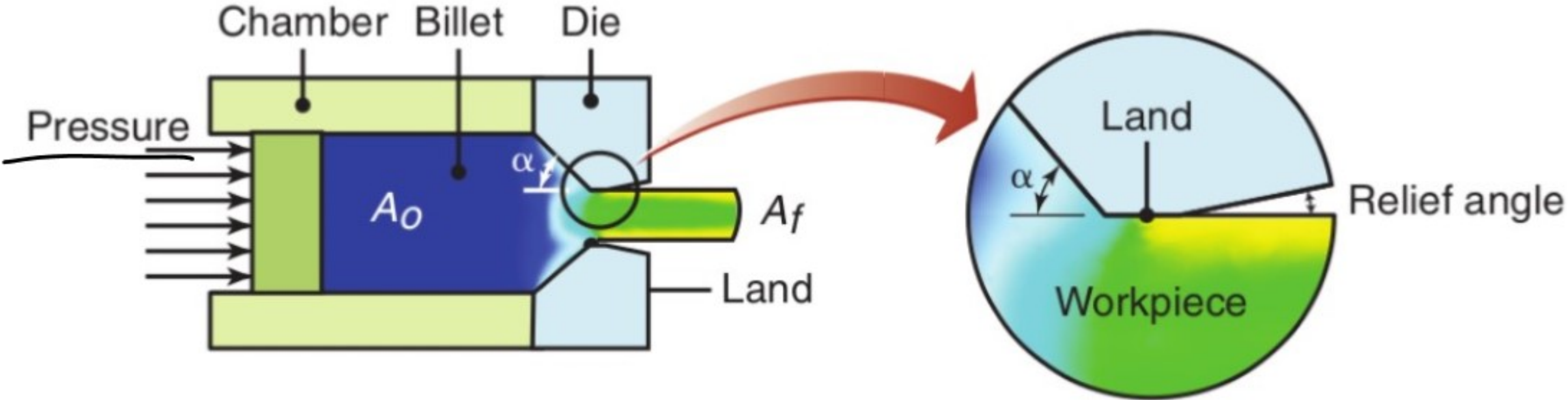




(d)



Stress

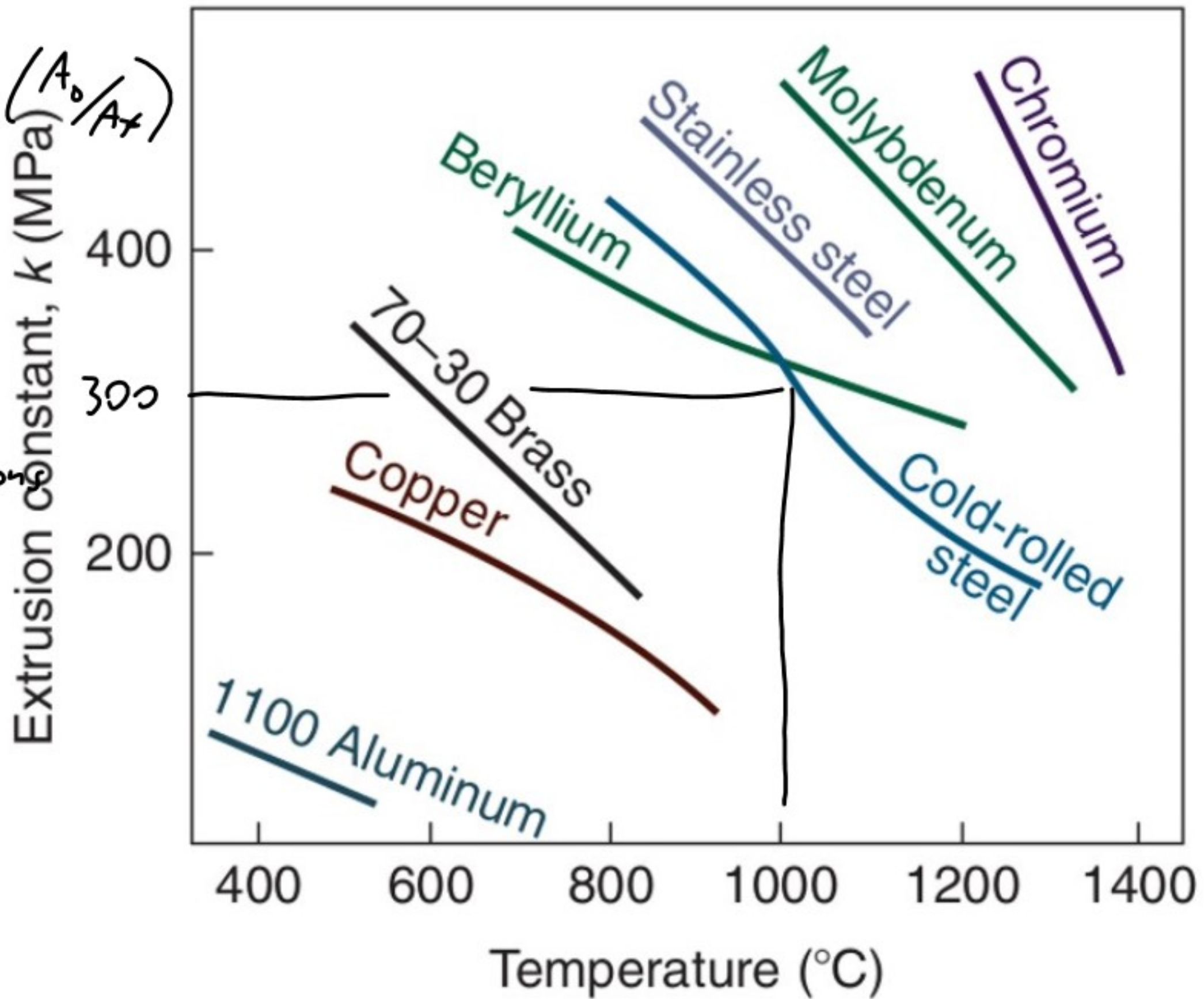


$$F = A_0 k \ln\left(\frac{A_0}{A_f}\right)$$

in MN

1 MN \approx 10 tons

Tolerance
0.21 in



Extrusion similar to drawing

Used to make wire

2000 BC

Poor

Good

