LECTURE #28 :
3.11 MECHANICS OF MATERIALS F03

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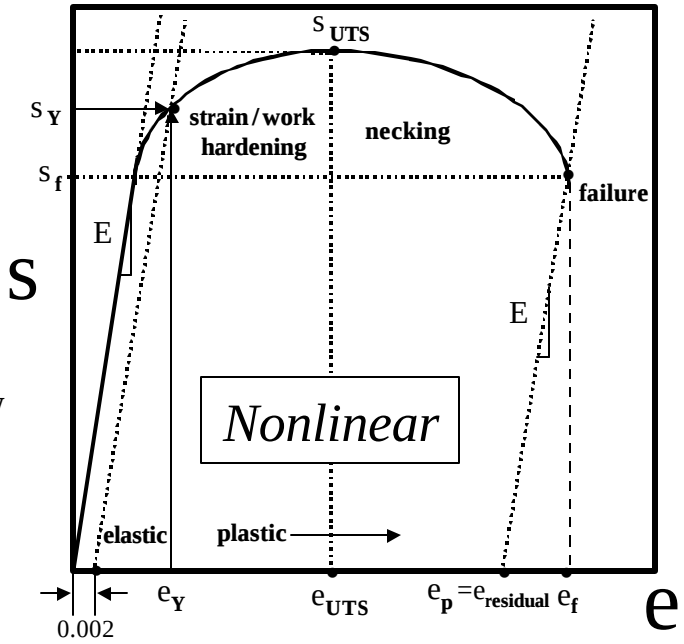
• PLASTICITY IN METALS II

SUMMARY : LAST LECTURE

I. Stress versus Strain Curves of a Plastically Deforming in Uniaxial Tension

σ_f=stress or strength at failure
ε_f=strain at failure
σ_Y=yield stress or strength
(proportional limit, elastic limit,
proof stress=0.2% strain offset)
ε_Y=strain at yield
σ_{UTS}= ultimate tensile stress or strength
ε_{UTS}= strain at the ultimate tensile stress
$\varepsilon_p=\varepsilon_{residual}$= plastic strain or tensile ductility
• ductile • brittle • plastic deformation
• yielding • plastic flow • necking
• strain / work hardening



II. Deformation Energies

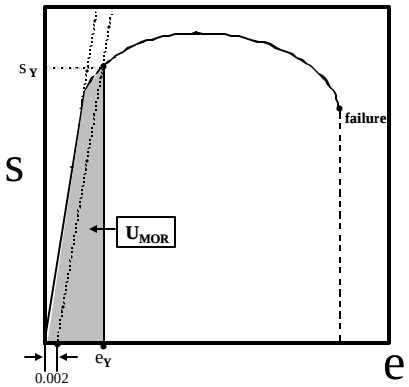
Mechanical or Deformational Energy : $U = \int_0^e s\,de$

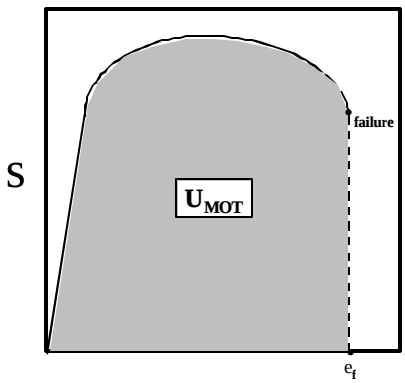
Modulus of Resilience or Elastic Strain Energy : $U_{MOR} = \int_0^{e_Y} s\,de = \frac{Ee_Y^2}{2} = \frac{s_Y^2}{2}$

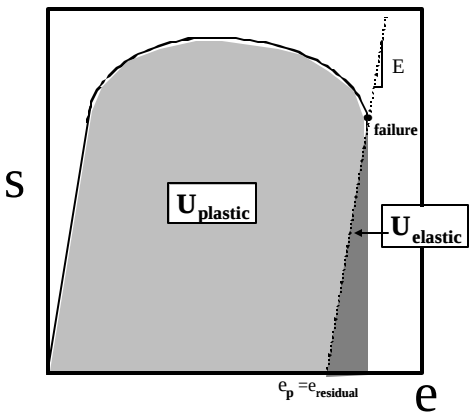
Modulus of Toughness : $U_{MOT} = \int_0^{e_f} s\,de$

Plastic Work of Fracture : $U_{PLASTIC}$

Elastic Energy Released on Fracture : $U_{ELASTIC}$







Plastic Deformation In Ductile Metals

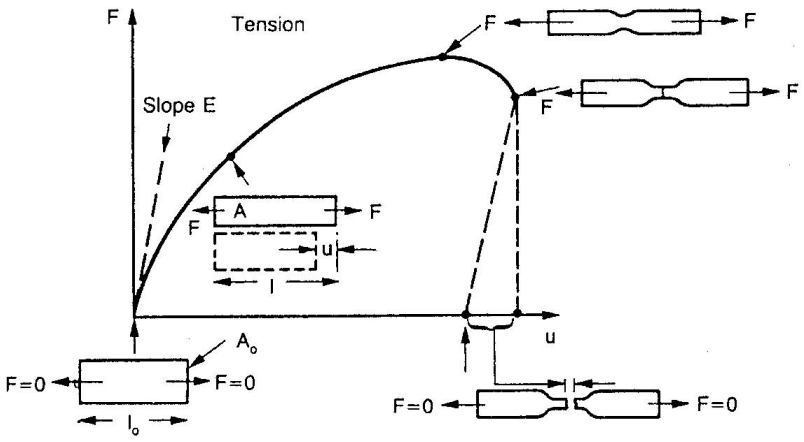
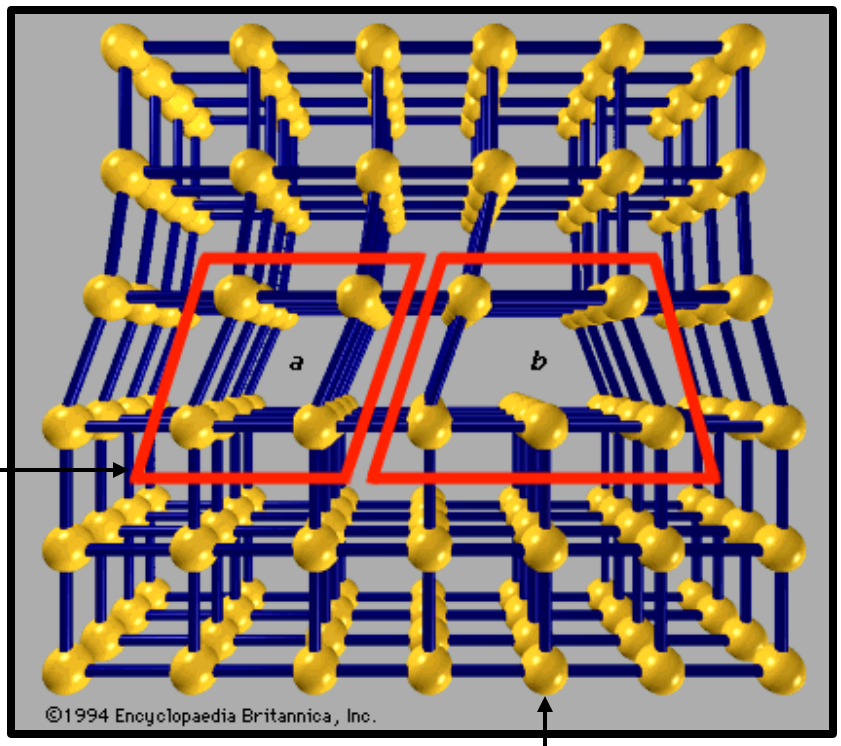


Fig. 8.4. Load–extension curve for a bar of ductile metal (e.g. annealed copper) pulled in tension.

THE EDGE DISLOCATION

CRYSTAL LATTICE

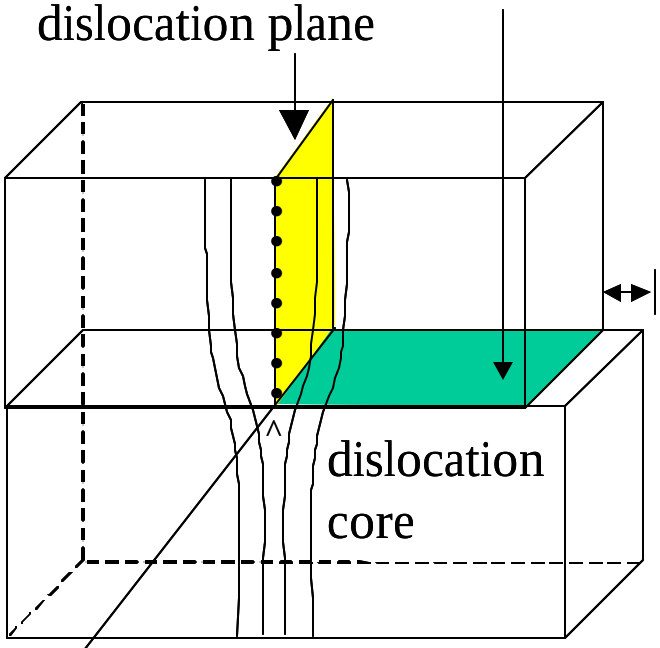


lattice strain

extra half plane of atoms

slip or glide plane : defined by $\vec{b}$ and dislocation line

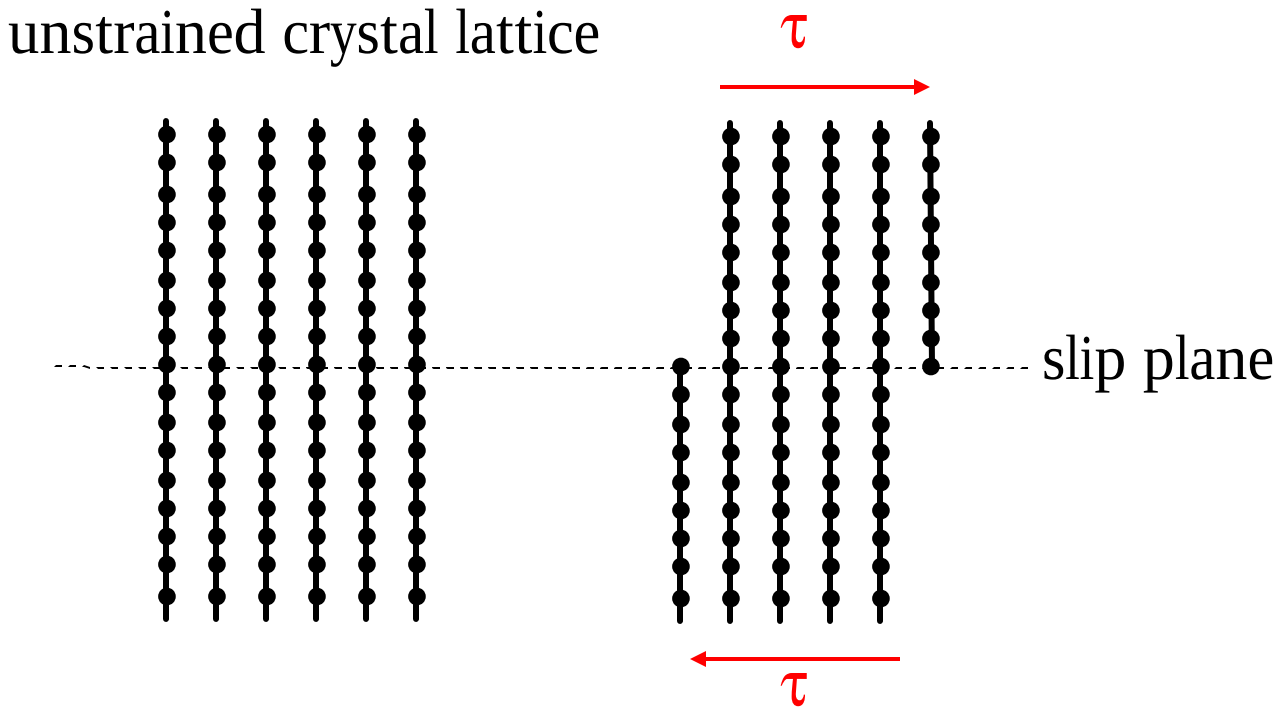
dislocation plane



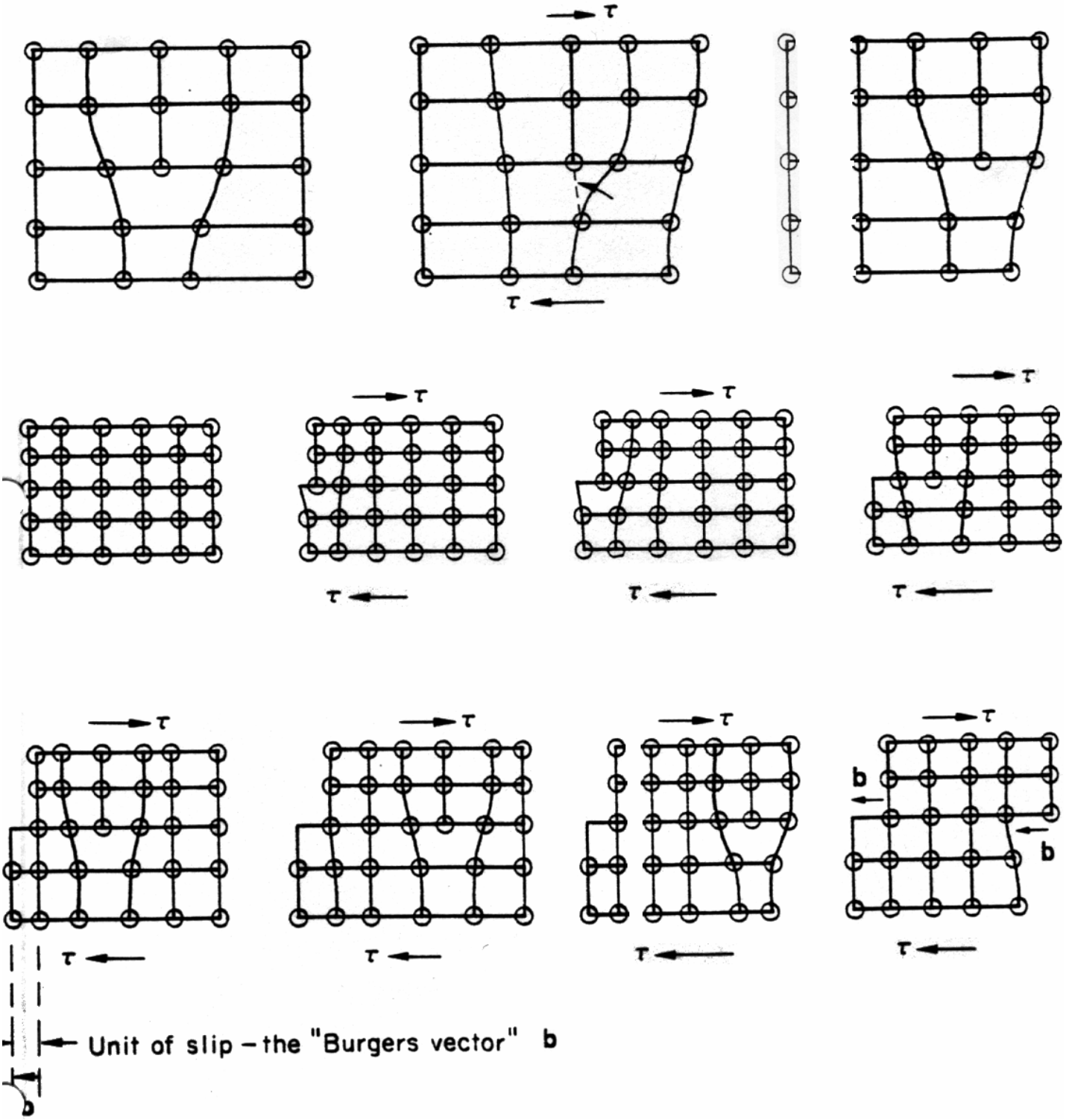
Burger's vector, $\vec{b} \perp$ dislocation line = lattice parameter or atomic spacing

dislocation line

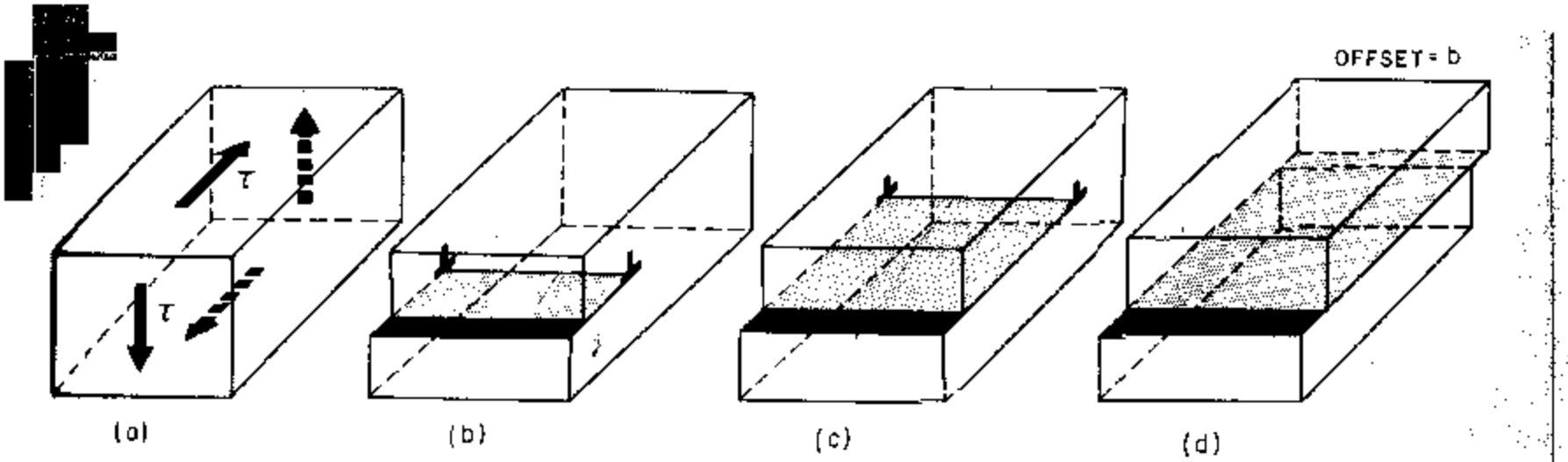
SLIP

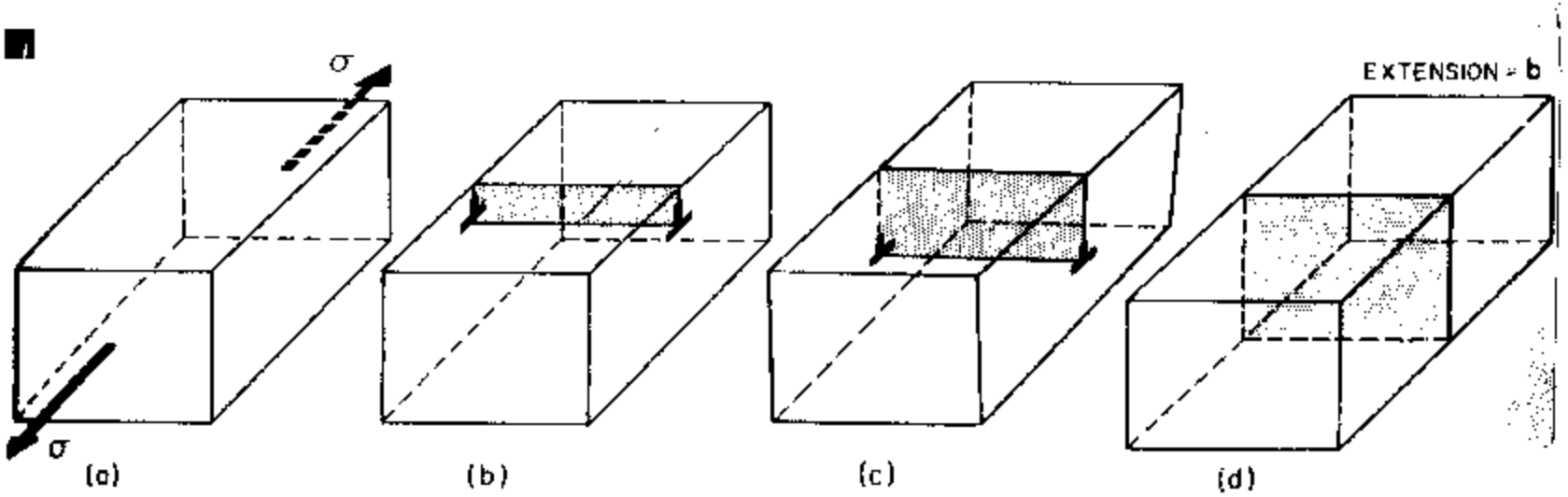


SLIP

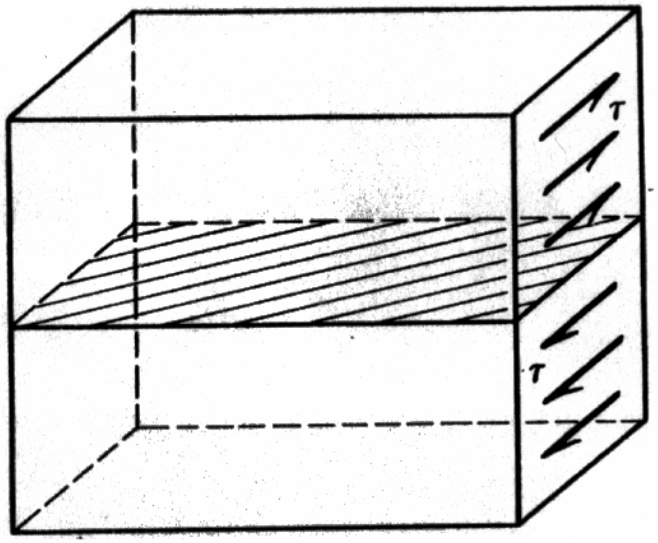


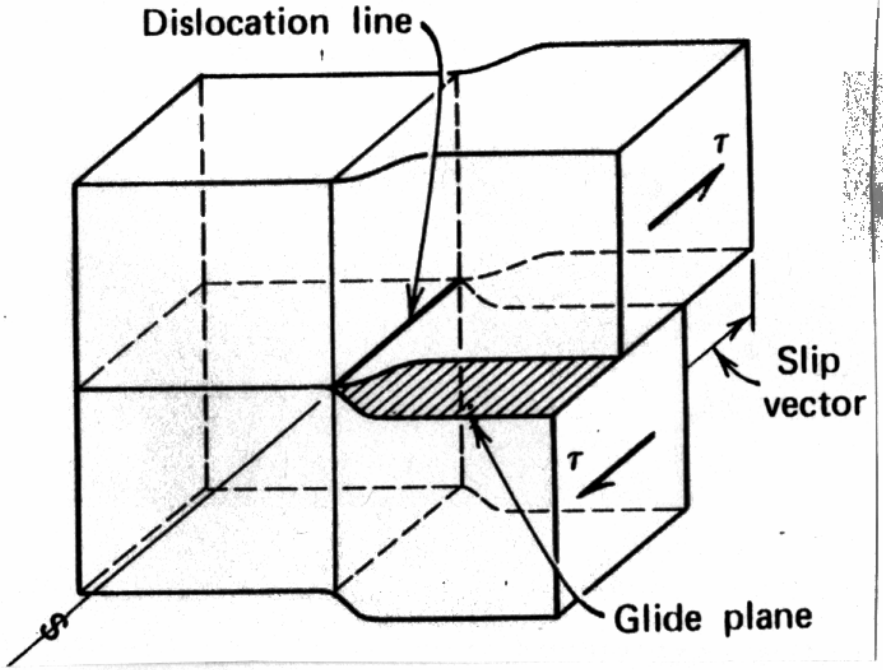
Movement of Edge Dislocation in 3-D



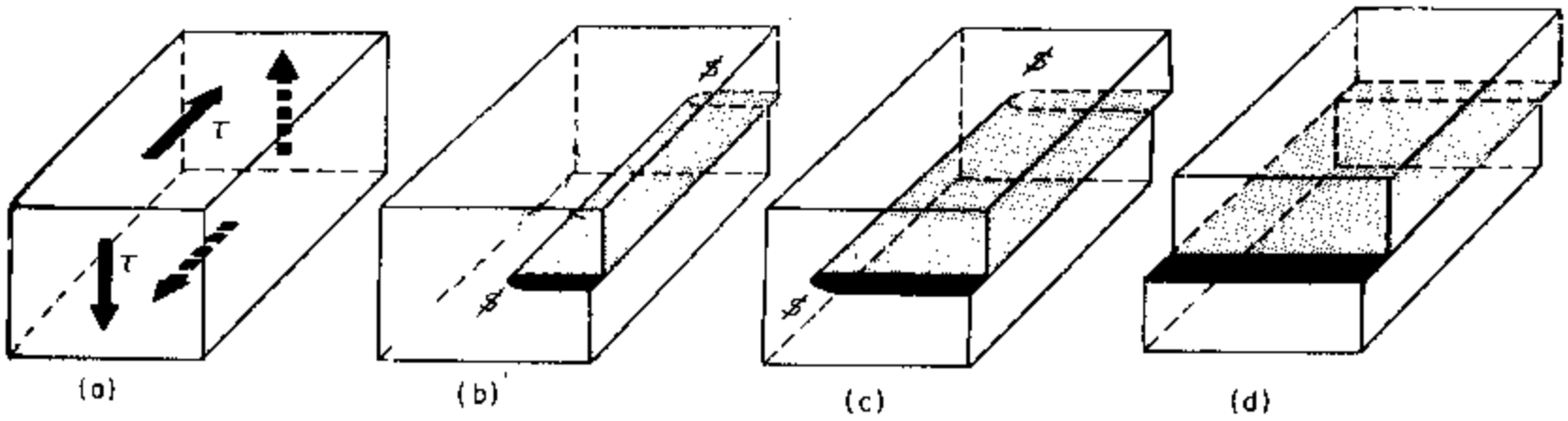


3-D View of a Screw Dislocation

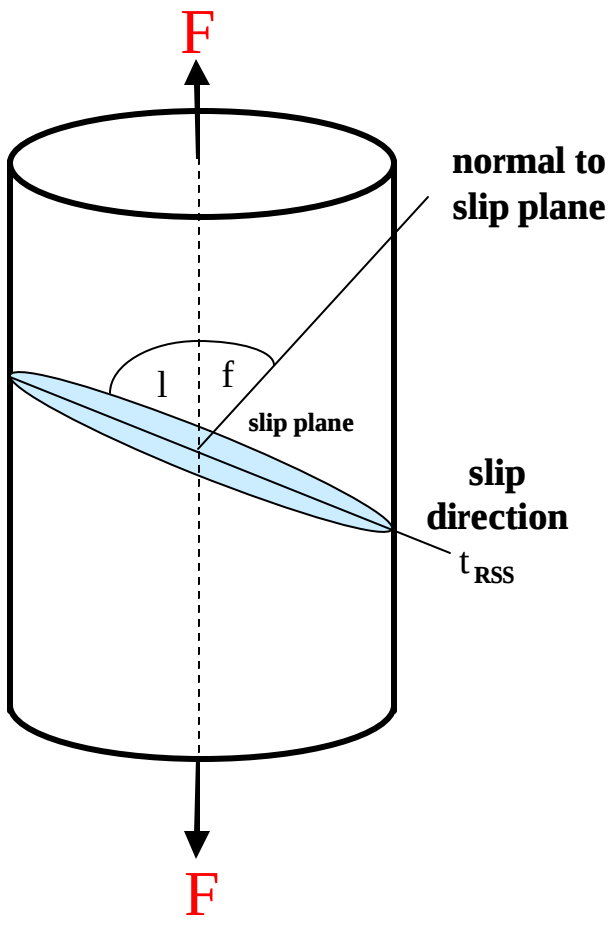




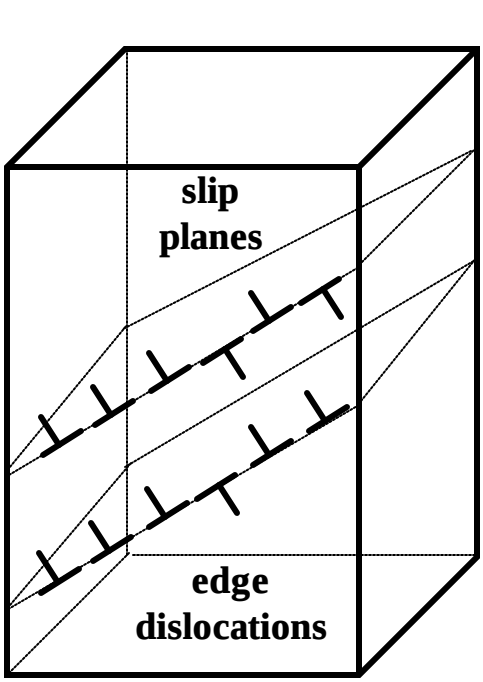
Movement of a Screw Dislocation in 3-D

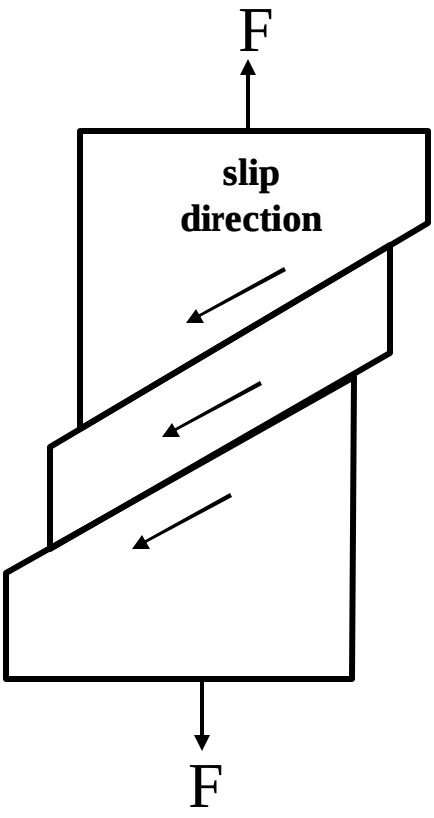


CRITICAL RESOLVED SHEAR STRESS



PLASTIC DEFORMATION IN SINGLE CRYSTALS





Polycrystalline Plastic Deformation

http://www.jwave.vt.edu/crcd/farkas/lectures/dislocations/tsld022.htm