TEKNOLOGI BETON LANJUT

Stress

- Force per unit area

$$\sigma = \frac{\textbf{Load}}{\textbf{Area}} = \frac{\textbf{P}}{\textbf{A}}$$

- Units: MPa, psi, ksi
- Types: bearing, shearing, axial

Strain

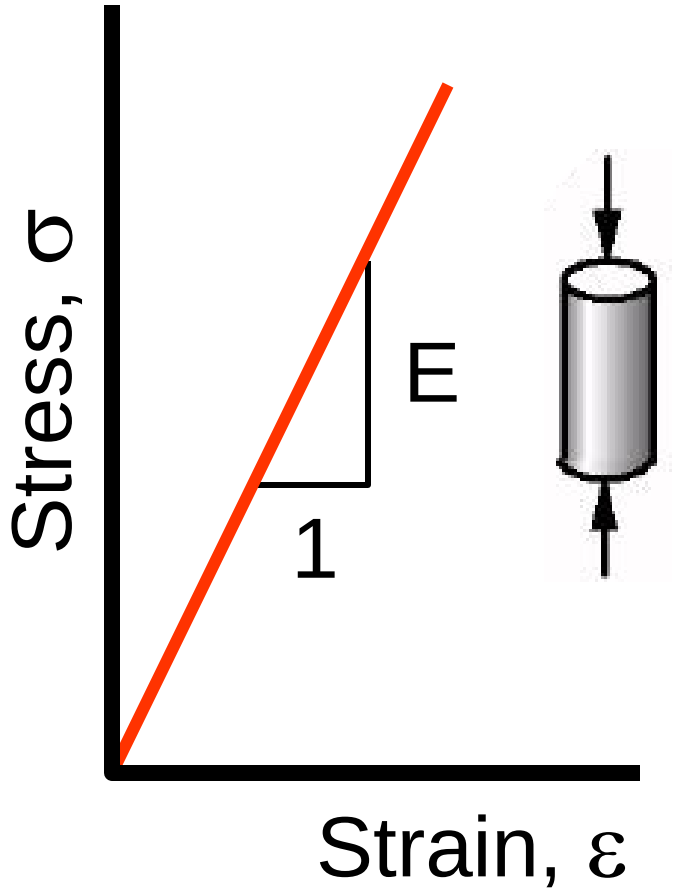
- Ratio of deformation caused by load to the original length of material

$$\varepsilon = \frac{\text{Change in Length}}{\text{Original Length}} = \frac{\Delta L}{L}$$

- Units: Dimensionless

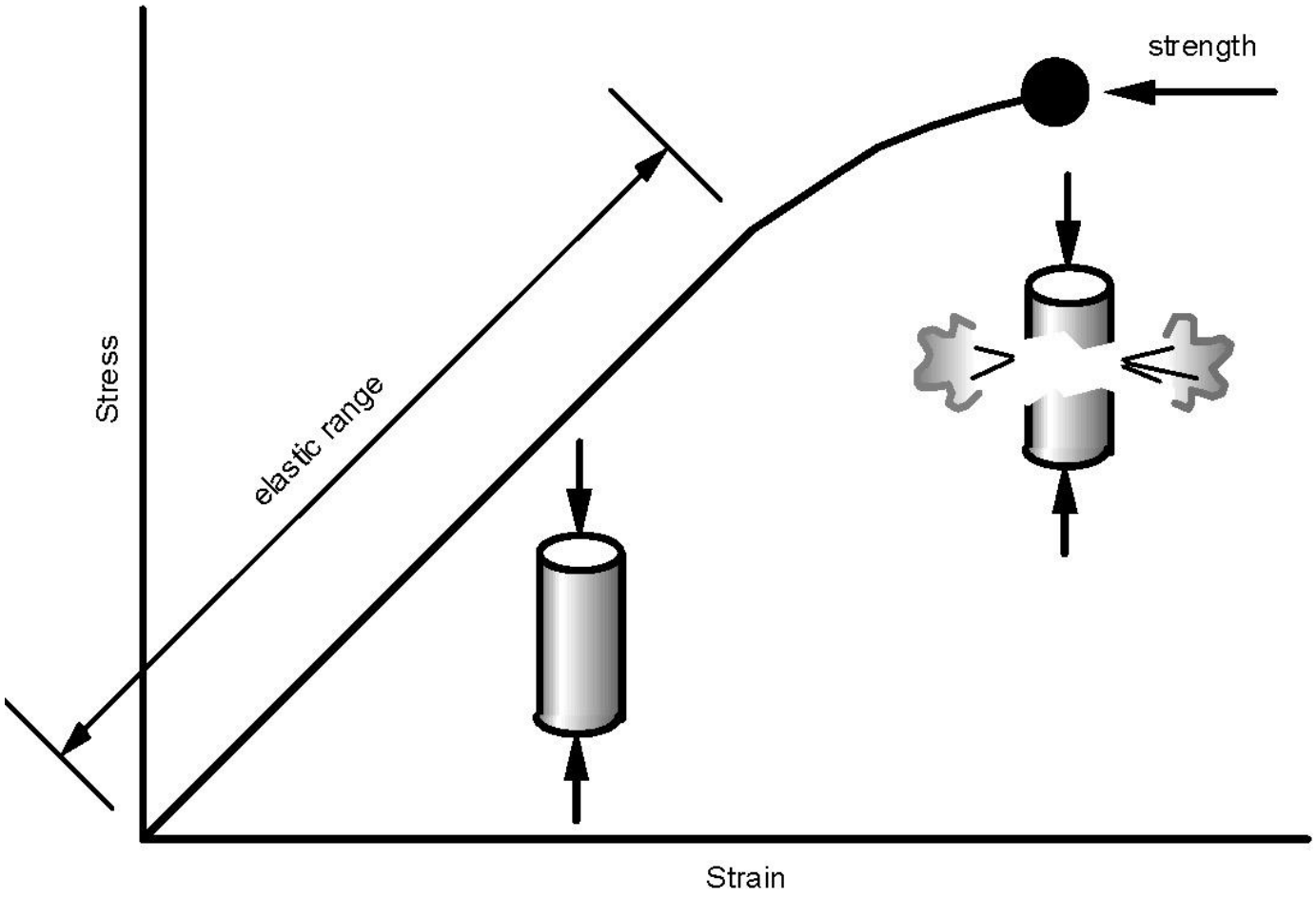
Stiffness

- Stiffness = stress/strain = $\frac{\sigma}{\varepsilon}$

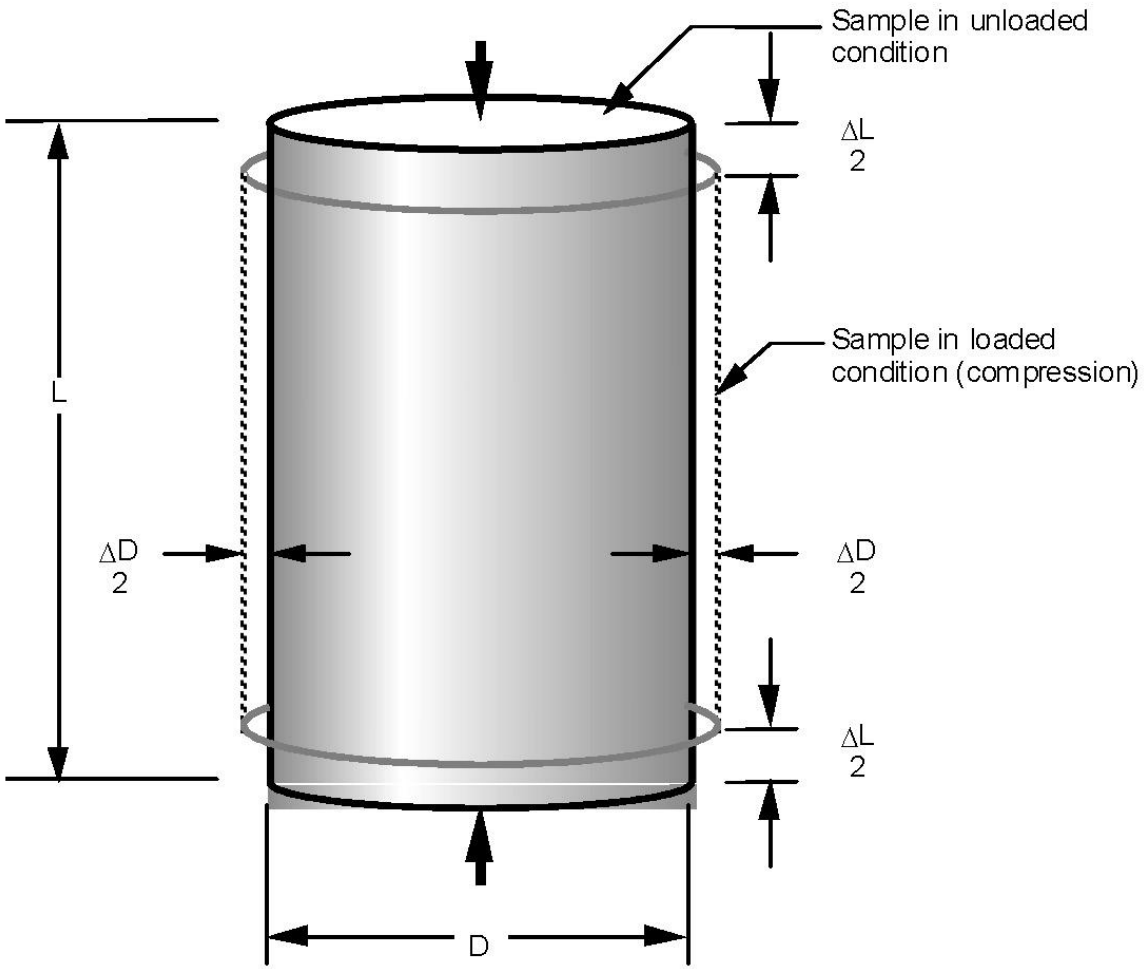


- For elastic materials:
  - Modulus of Elasticity
  - Elastic Modulus
  - Young's Modulus

Stress vs. Strain of a Material in Compression



Poisson's Ratio



$$\mu = -\frac{\varepsilon_D}{\varepsilon_l}$$

Typical Modulus (E) Values

Material	E (psi)
Rubber	1,000
Wood	1,000 – 2,000,000
Aluminum	10,000,000
Steel	30,000,000
Diamond	170,000,000

Typical Modulus Values

Material	Range (ksi)	Typical (ksi)
HMA	200 - 800	450
PCC	3,000 - 8,000	4,000
ATB	70 - 450	150
CTB	500 - 1,000	700
Lean concrete	1,000 - 3,000	1,500
Granular base	14 - 50	30
Granular soil	7 - 22	15
Fine-grained soil	3 - 10	4

Typical Poisson's Ratios

Material	Range	Typical
PCC	0.10 - 0.20	0.15
HMA / ATB	0.15 - 0.45	0.35
Cement Stab. Base	0.15 - 0.30	0.20
Granular Base / Subbase	0.30 - 0.40	0.35
Subgrade Soil	0.30 - 0.50	0.40

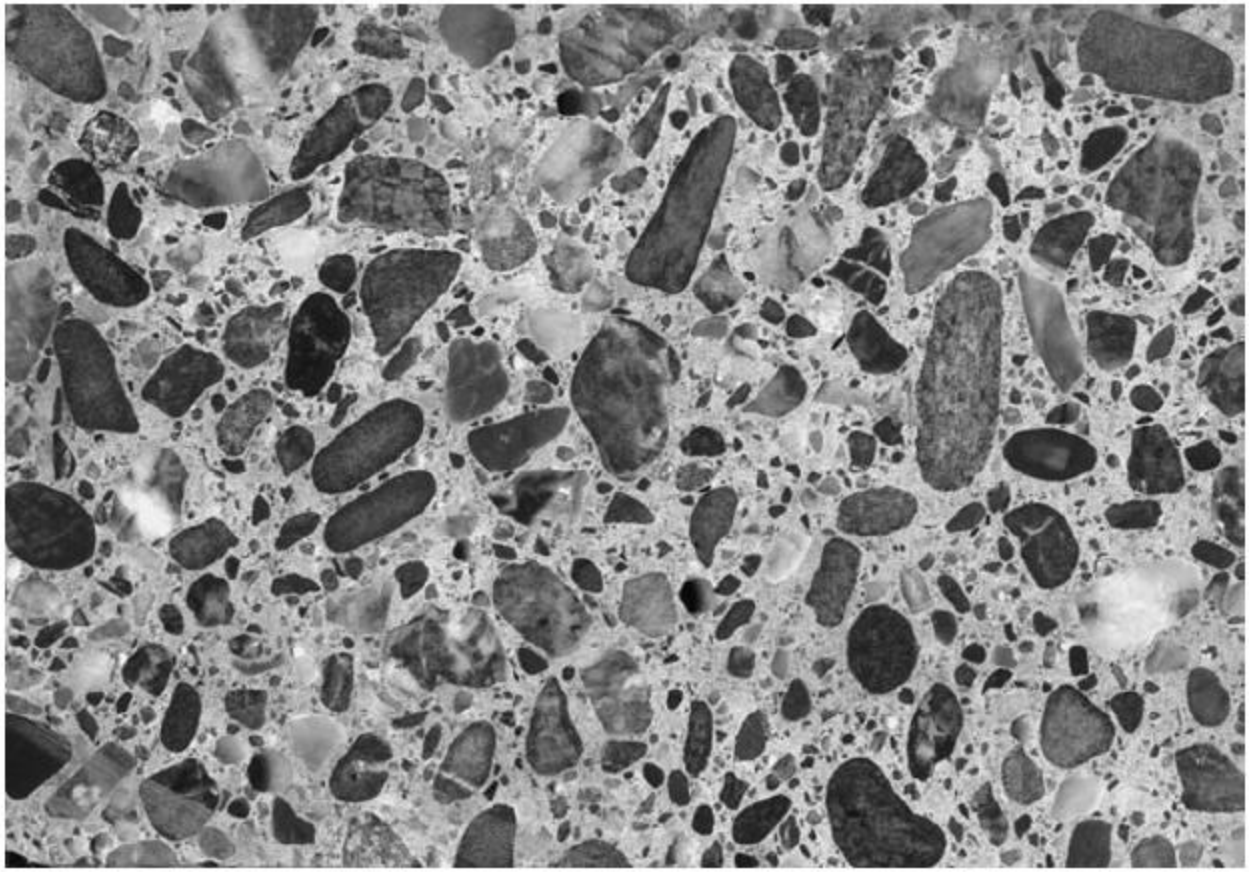


Figure 2-1 Polished section from a concrete specimen. (Photograph courtesy of Gordon Vrdoljak.)

Macrostructure is the gross structure of a material that is visible to the unaided human eye. In the macrostructure of concrete two phases are readily distinguished: aggregate of varying shapes and size, and the binding medium, which consists of an incoherent mass of the hydrated cement paste.

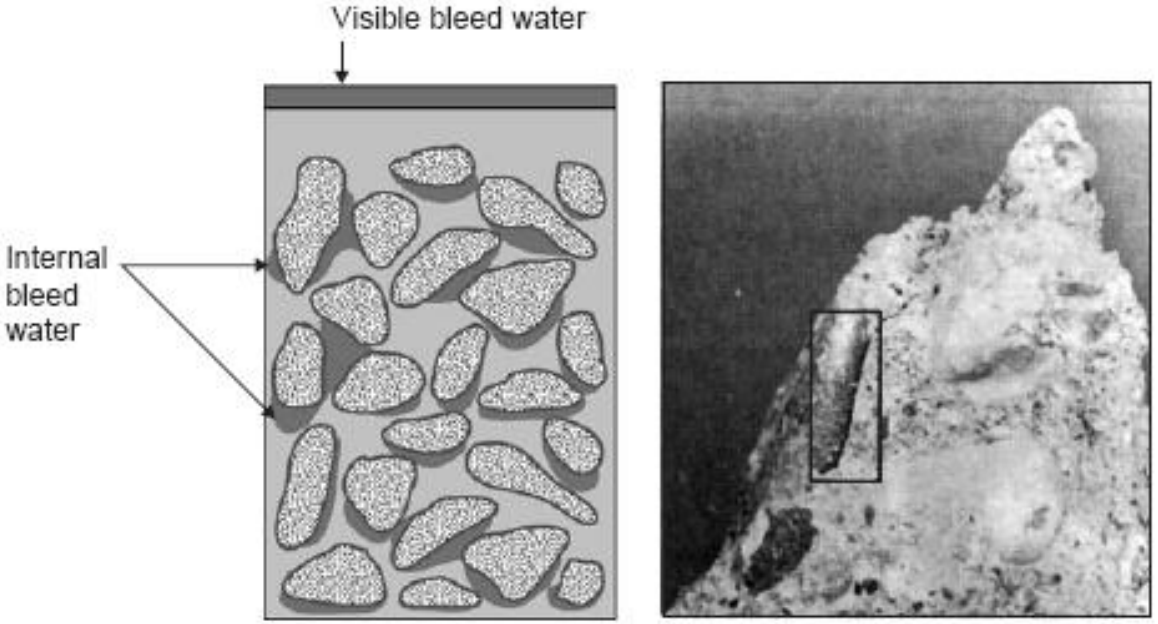


Figure 2-4 (*a*) Diagrammatic representation of bleeding in freshly deposited concrete; (*b*) shear-bond failure in a concrete specimen tested in uniaxial compression.