

Materials and Stresses

1. Mechanics
2. Mechanics of material
3. Stress and Strain
 - (1) stress
 - (2) strain
 - (3) Hook's law
 - (4) Stress-strain diagram

1. Mechanics

: Science of force and motion

- ◆ Every analysis of mechanical system
 - ① study the force
 - ② study of motion and deformation
 - ③ application of laws relating the force to the motion and deformation

2. Mechanics of material

: 물체 (body)에 외력이 작용할 때 변형과 내력을 다루는 학문

① body (물체)

② external force (외력)

③ deformation (변형)

④ internal force (내력)

◆ Mechanics of material

① force: should be state of balance

② deformation : deformation of a individual parts of a structure should be consistent
with the overall deformation

③ relation of the force and deformation : take into account the special properties of the
particular material involved

(1) body

Machine structure (구조물) → members (부재)

① bar (봉) : rod

② beam (보)

③ plate

④ shell

⑤ 2-D plane

⑥ 3-D solid

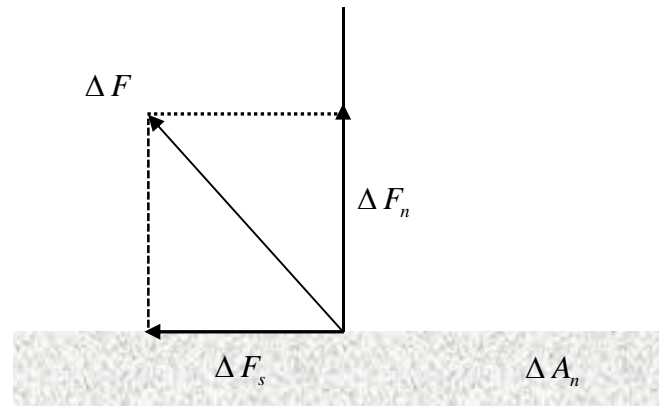
(2) load

(3) supports

3. Stress-strain

(1) Stress (응력)

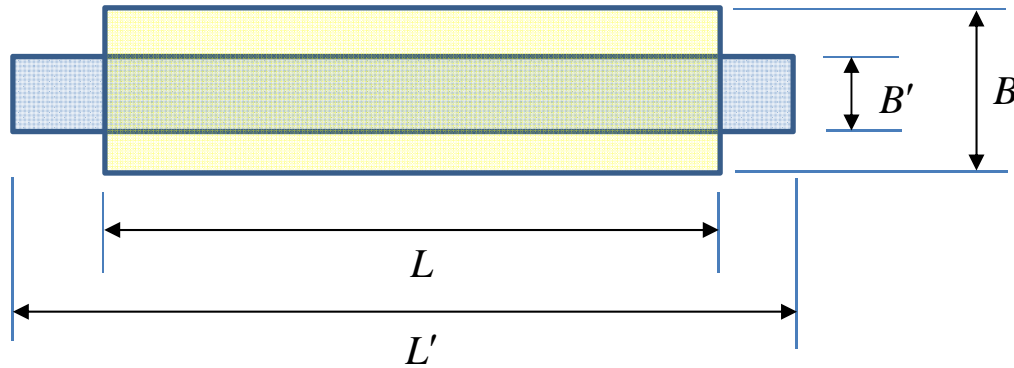
: 단위면적에 작용하는 내력의 크기



◆ Normal stress (수직응력)

◆ shear stress (전단응력)

(2) Strain (변형률)



$L B$: Initial length, width

$L' B'$: deformed length, width

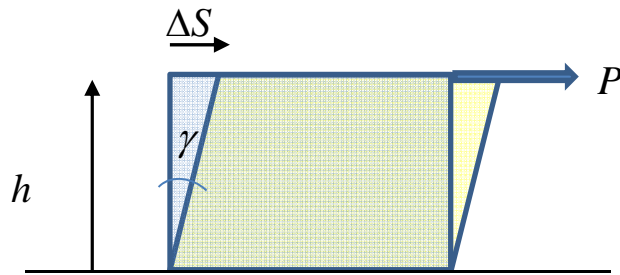
1) Normal strain

2) Poisson's ratio

$$-1 \leq \nu \leq \frac{1}{2}$$

$$\left. \begin{array}{l} 0 \leq \nu \leq \frac{1}{2} \\ -1 \leq \nu < 0 \\ \nu = \frac{1}{2} \\ \nu = 0 \end{array} \right\}$$

3) Shear strain (전단변형률)



(3) Hook's law

$$\sigma = E \varepsilon \quad E : \text{Young's modulus}$$

$$\tau = G \gamma \quad G : \text{Shear modulus}$$

Material	Young's modulus (Gpa)	Poisson's ratio
Aluminum alloy	72	0.32
Brass and bronze	110	0.33
Copper	121	0.33
Steel alloy	207	0.30
Stainless steel	190	0.30
Titanium alloy	114	0.33

(4) Stress-strain diagram

