



MECHANICAL ENGINEERING

Stress & Strain

Hand Notes For GATE, IES, PSUs etc...

Hand Notes

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Note : We also providing IIT JEE, Advance, NEEt, JEE UG, GATE, IES, PSUs & Competitive Exam Materials [Handnotes, Shortnotes & Books], All Reports [Seminar Reports & PPT]

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Covered Topics :

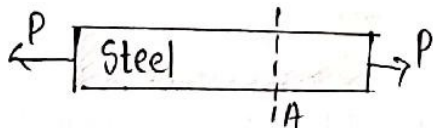
- Stress
- Strain
- Elongation
- Permitted Expansion
- Composite Bar
- Composite System
- Poisson's Ratio
- Relationship among elastic Constants
- Thermal Effect

STRESS AND STRAIN

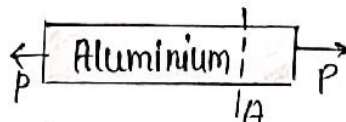
28 June 2019

Stress (σ) - When a material is subjected to an external influence (force, moment, torque etc) a resistance force is setup within a body. The internal resistance force per unit area acting in a particular plane is known as stress.

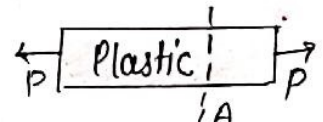
- Stress is not a vector, it is tensor (it depends on magnitude, direction and plane)
- Scalar \rightarrow Zeroth order tensor (it depends only on magnitude nothing else).
- Vector \rightarrow First order tensor (it depends on magnitude and one extra parameter i.e. direction)
- Stress, strain, moment of inertia \rightarrow Second order tensor (it depends on magnitude and two other parameters, direction and plane).
- Stress is not a measurable quantity but strain is a measurable quantity. Using strain gauge we can directly measure strain
- Stress is developed only when a body is constrained or restricted.
- Stress is independent of material property.



$$\sigma = \frac{P}{A}$$



$$\sigma = \frac{P}{A}$$



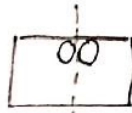
$$\sigma = \frac{P}{A}$$

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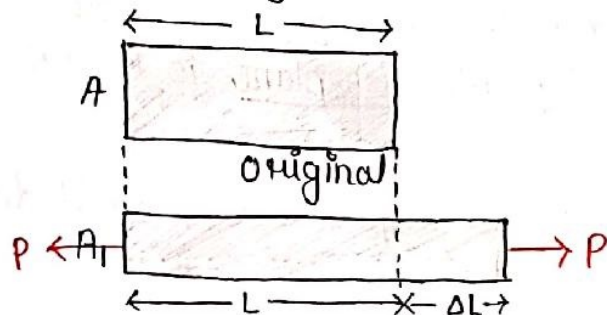
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- Strain पहले आता है, stress बाद में आता है।
Strain is the cause of stress. Stresses are developed only when deformation or strain is constraint.



Engineering stress / Conventional stress / Nominal stress



$$\sigma = \frac{P}{A_{\text{original area}}}$$

In strength of materials and machine design theory of elasticity we will always use engineering stress and engineering strain. In theory of plasticity (e.g. metal forming) we have to use true stress and true strain.

Units

$$\sigma = \frac{P}{A} \quad \text{SI unit} \quad \frac{N}{m^2} = Pa$$

Scientist name
First letter always capital

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Pa is very small unit.

$$kPa = 10^3 Pa$$

$$MPa = 10^6 Pa = \frac{N}{mm^2}$$

$$GPa = 10^9 Pa = 10^3 \frac{N}{mm^2} = 10^3 MPa = \frac{kN}{mm^2}$$

Pressure	Stress
<ul style="list-style-type: none"> 1. Pressure is a external normal force per unit area. 2. Pressure is always normal to the area. 	<ul style="list-style-type: none"> 1. Stress is an internal resistance force per unit area in a particular plane. 2. Stress need not to be normal to the area.

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