Dental materials

المرحلة الأولى

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Lecture 3

Mechanical Properties of Dental Material

Stress

It is **defined** as the force per unit area induced in a body in response to some externally applied force.

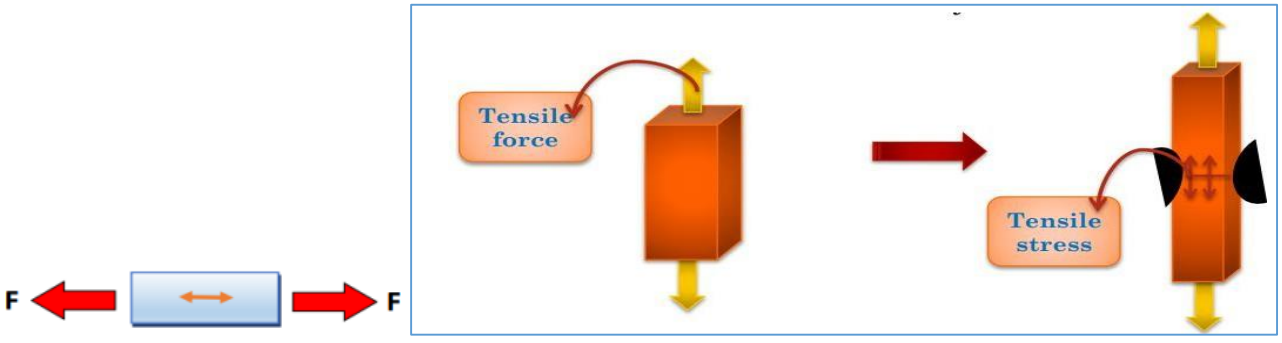
$$\text{Stress } (\sigma) = \frac{\text{Force}}{\text{Unit area}}$$

- Stress: measured in pascals (Pa)
- Force: measured in Newton (N)
- Unit area: measured in square meter (m^2) **(1 Pa = 1 N/m^2 = 1 MN/mm^2**

Types Of Stress:

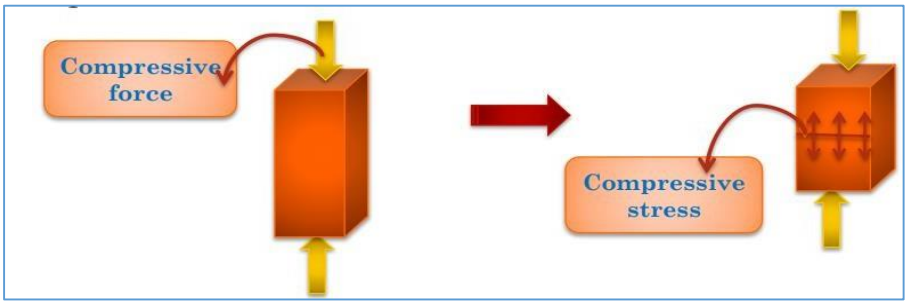
1. **Tensile stress**:

it results from two sets of forces **directed away from each other** in the same straight line or when one end is constrained and the other end is subjected to a force directed away from the constraint; it is accompanied by tensile strain. Examples: enamel: 10 Mpa, dentin: 106 Mpa, amalgam: 32 Mpa.



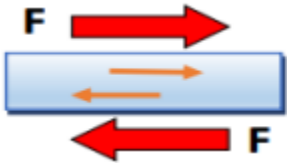
2. Compressive stress:

It results from two sets of forces directed **toward each other** in the same straight line or when one surface is constrained and the other is subjected to a force directed toward the constraint. It is accompanied by compressive strain. Investment material, restorative materials and models should have high compressive strength. Examples: enamel: 384 Mpa, dentin: 297 Mpa, amalgam: 388Mpa



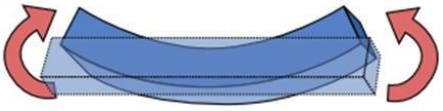
3. Shear stress:

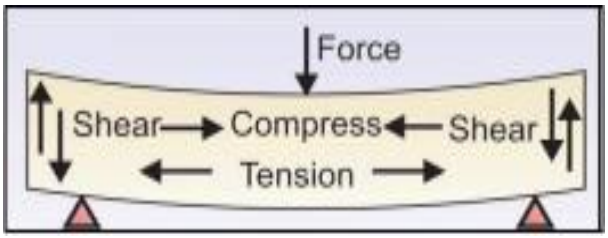
Shear is the result of two sets of forces **directed parallel to each other** (not along the same straight line) which is applied to one part of the body in one direction, and the rest is being pushed in the opposite direction. The result is sliding of the molecules over each other. It is accompanied by shear strain . Shear force is the force which causes tearing a paper or a card.



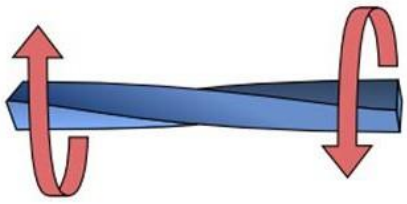
4. Flexural stress (bending stress):

It is the force per unit area of a material that is subjected to flexural loading.it results from an applied bending moment.





5. **Torsion stress**: Force per unit area of a material that is subjected to twisting of a body.



Strain (Ɛ):

It is the change in length (dimension) or deformation per unit length (dimension) caused by externally applied force.

Strain is denoted as **'ε'**. It has no unit of measurement. Examples of some dental materials strain are: acrylic: 1.5%, stainless steel: 35%

$$\text{Strain} = \frac{\text{Change in length } (\Delta L)}{\text{Original length } (Lo)} = \frac{L - Lo}{Lo} = \frac{\Delta L}{Lo}$$

L=final length

Lo= original length

- **Strain under tensile stress** is an elongation in the direction of loading.
- **Strain under compression** is shortening of the body in the direction of loading.

Elongation:

The deformation that results from the application of tensile stress. An alloy with high percent of elongation can be bent or adjusted without danger of fracture.

$$\text{Elongation} = \frac{\text{Increase in length}}{\text{Original length}} \times 100$$

Types of the strain:

1. Temporary of elastic or recoverable strain: the material is returned to its original length after removal of the applied force.

2. Permanent or plastic or unrecoverable strain: the material is not returned to its original length after removal of the applied force. The material may remain deformed.