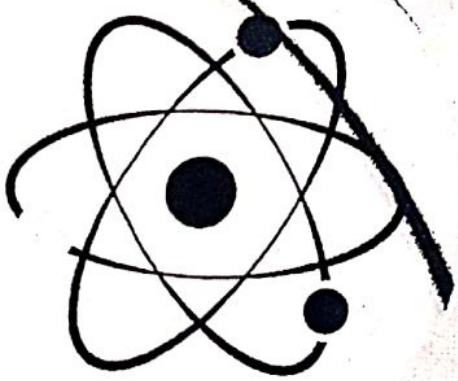
Lec. (3)

PHYSICS 1

1ST LEVEL 2020 - 2021



+201064763583

ENGINEERING CAMP

SCAN FOR FACEBOOK GROUP

ISMAIL GOMAA 0106 476 3583 ISMAIL GOMAA

"CH.2: Elasticity"

المرونة

(1) Elasticity: is the property by which the object can restore the original shape when the force is removed.

خاصية — يستعيد — إزالة

هي الخاصية التي تجعل الجسم يستعيد شكله الأصلي عن إزالة القوة المؤثرة.

(2) Elastic material: المادة المرنة

- can restore the original shape.

(3) Plastic material: مادة غير مرنة

- can not restore the original shape.

(4) Modulus of elasticity: معامل المرونة

- Is the ratio of the applied stress to the resulting strain.

معامل — إجهاد — الإنفعال الناتج

$$\text{Modulus} = \frac{\text{stress (}\sigma\text{)}}{\text{strain}}$$

5 Stress (σ): الإجهاد

is the applied force per unit area.

$$\sigma = \frac{F}{A}$$ N/m^2 or Pascal

* القوة المسلطة على وحدة المساحات.

هام

6 Strain (ε): الإنفعال

is mathematically defined as the relative change due to the stress.

* التغير النسبي في الشكل نتيجة الإجهاد.

هام

7 Hook's Law: قانون هوك

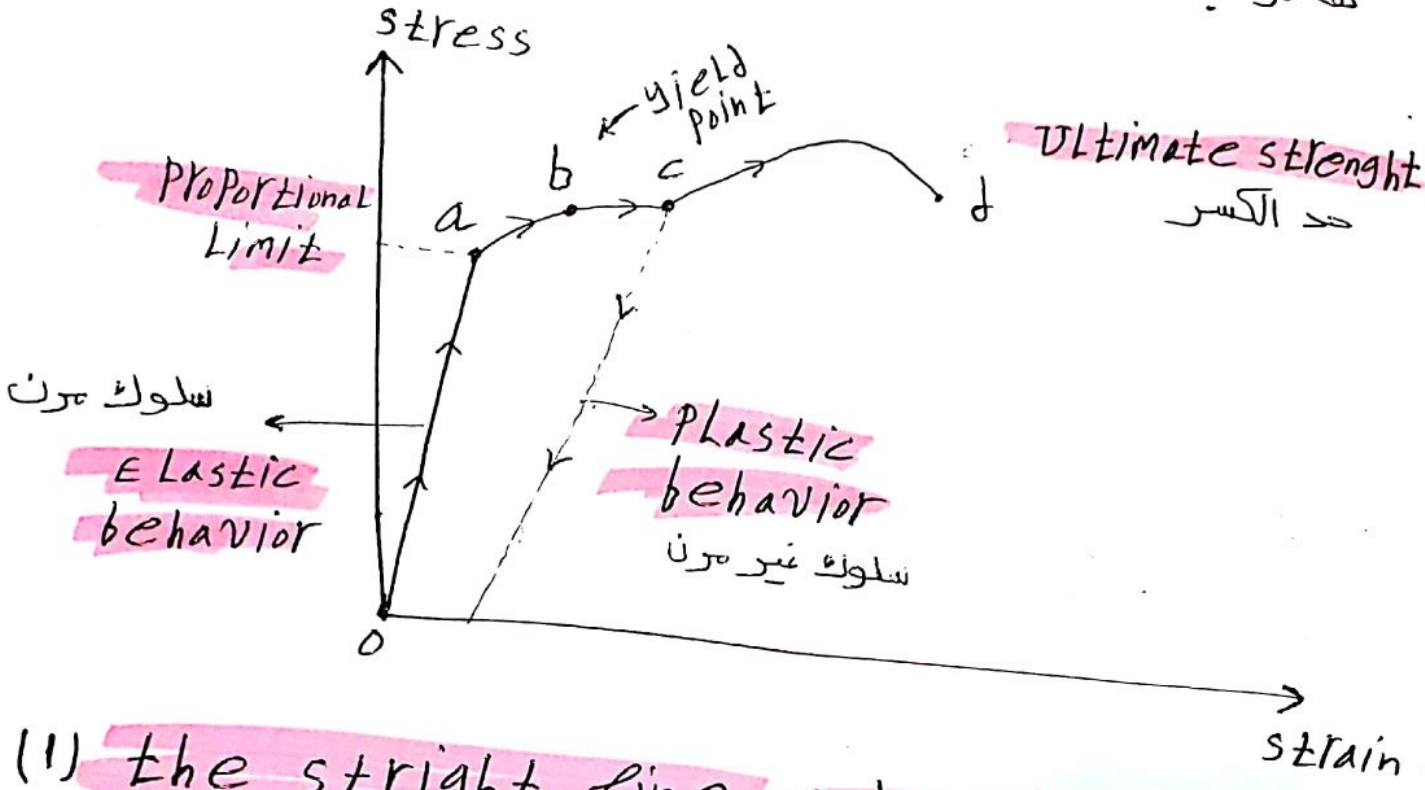
→ within the Limit of elasticity the strain directly proportional to the applied stress.

$$\sigma = K\varepsilon$$

* في حدود المرونة يتناسب الإنفعال مع الإجهاد.

$$K = \frac{\text{stress}}{\text{strain}} = \text{Modulus of elasticity}$$

8 Stress – strain curve: هام جداً



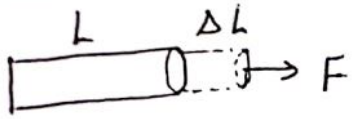
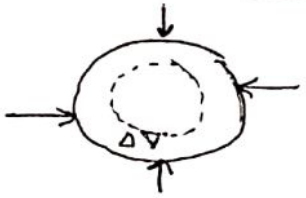
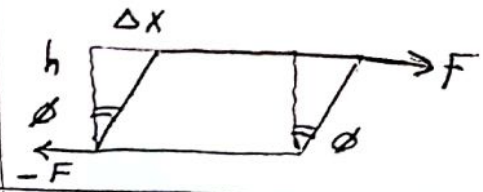
(1) the stright line ends at Point (a) which called the proportional limit.
حد التناسب نهاية المنطقة الخاضعة لقانون هوك

(2) Point (b) is called the "yield Point" and the stress at this Point called the "elastic limit".
النقطة (b) تسمى نقطة الخضوع و الإجهاد عندها يسمى حد المرونة

(3) Ultimate strength: (break stress) حد الكسر
→ the stress required to cause fracture (كسر).

4

Elasticity: مرونة

	Tensile مرونة الشد	BULK مرونة الحجم	Shear مرونة القص
			
stress	* Tensile stress: When the applied Force has the same direction of the extension. المتدد $\sigma = \frac{F}{A}$	* BULK stress: the total force acting on the body per unit area. $\sigma = \frac{F}{A} = P$	* shear stress: مماسية The tangential Force per unit area acting on the surface of the body $\sigma = \frac{F}{A}$
strain	* Tensile strain: التغير النسبي The relative change in the Length. $\varepsilon = \frac{\Delta L}{L}$	* BULK strain: The relative change in the Volume $\varepsilon = \frac{-\Delta V}{V}$ (−) انضغاط، Compression	* shear strain: the relative change in the Layers الطبقات $\varepsilon = \phi = \frac{\Delta X}{h}$
Modulus of elasticity	* Young Modulus (Y): measures the resistance of a solid to change the Length. $Y = \frac{F/A}{\Delta L/L}$ N/m^2	* BULK modulus (B): measures the resistance of a solid to change the Volume. $B = \frac{F/A}{-\Delta V/V} = \frac{-\Delta P}{\Delta V/V}$	* Shear modulus (S): measures the resistance of body to motion of Layers. حركة الطبقات $S = \frac{F/A}{\Delta X/h}$

MCQ's

1- Stress can be measured in:

A. N/m^2 B. $N \cdot m^2$ C. N/m D. N·m E. none of these (it is unitless)

ans: A

2- Strain can be measured in:

A. N/m^2 B. $N \cdot m^2$ C. N/m D. N·m E. none of these

(it is unitless)

ans: E

3- Young's modulus can be correctly given in:

A. N·m B. N/m^2 C. N·m/s D. N/m E. joules

ans: B

4- Young's modulus is a proportionality constant that relates the force per unit area applied perpendicularly at the surface of an object to:

A. the shear B. the fractional change in volume C. the fractional

Prepared By
Eng/ Ismail Gomaa

change in length D. the pressure E. the spring constant

ans: C

5- Young's modulus can be used to calculate the strain for a stress that is:

A. just below the ultimate strength B. just above the ultimate strength

(C) well below the yield strength D. well above the yield strength

E. none of the above

ans: C

← لاستخدام Y يجب أن تكون في منطقة التناسب.

عينة

6- The ultimate strength of a sample is the stress at which the sample:

A. returns to its original shape when the stress is removed

B. remains underwater (C) breaks D. bends 180°

E. does none of these

ans: C

يتمدد ΔL

7- A certain wire stretches 0.90 cm when outward forces with magnitude F are applied to each end. The same forces are applied to a wire of the same material نفس المادة but with three times the diameter and three times the length. The second wire stretches:

Next Page

A. 0.10 cm B. 0.30 cm C. 0.90 cm D. 2.7 cm

E. 8.1 cm

ans: B

F L

8- A force of 5000 N is applied outwardly to each end of a 5.0-m long rod with a r Y 6 الاستطالة radius of 34.0 cm and a Young's modulus of 125 × 10 N/m2. The elongation of ΔL the rod is:

A. 0.0020 mm B. 0.0040 mm C. 0.14 mm D. 0.55 mm

E. 1.42 mm

ans: D

X A 4.0m long steel beam with a cross-sectional area of 1.0×10^{-2} m^2 and a Young's modulus of 2.0×10^{11} N/m^2 is wedged horizontally between two

7 $\Delta L_1 = 0.90\,cm$, $F_1 = F_2 = F$

same material $(Y_1 = Y_2)$

$D_2 = 3D_1$, $L_2 = 3L_1$

$\Delta L_2 = ??$

answer

$$\therefore Y = \frac{F/A}{\Delta L/L} = \frac{FL}{A\Delta L}$$

$$\because Y_1 = Y_2$$

$$\therefore \frac{F_1 L_1}{A_1 \Delta L_1} = \frac{F_2 L_2}{A_2 \Delta L_2}$$

$$\frac{F_1 L_1}{\pi (\frac{D_1}{2})^2 \Delta L_1} = \frac{F_2 (3L_1)}{\pi (\frac{3^2 D_1^2}{2}) \Delta L_2}$$

$$\frac{1}{\Delta L_1} = \frac{3^1}{9_3 \Delta L_2}$$

$$\therefore 3\Delta L_2 = \Delta L_1 \Rightarrow \Delta L_2 = \frac{\Delta L_1}{3} = \frac{90\,cm}{3}$$

$$= \boxed{30\,cm}$$

---

8 $F = 5000\,N$, $A = \pi r^2 = \pi (34 \times 10^{-2})^2 = 0.363\,m^2$

$L = 5\,m$, $Y = 125 \times 10^6\ N/m^2$, $\Delta L = ??$

"answer"

$$\Delta L = \frac{FL}{AY} = \frac{5000 \times 5}{0.363 \times 125 \times 10^6} = \boxed{0.55 \times 10^{-3}\,m}$$

Note:

* Prestressed Concrete:

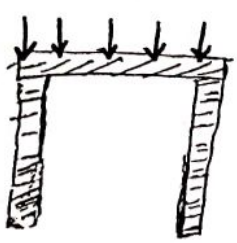
الخرسانة مسبقة الإجهاد: وهي تحتوى على حديد تعرض لإجهاد شد قبل تصنيع الخرسانة.

(1) If the stress on a solid object exceeds a certain value, the object fractures. إذا تخطى الإجهاد الواقع على الجسم الصلب حد معين فإن الجسم ينكسر

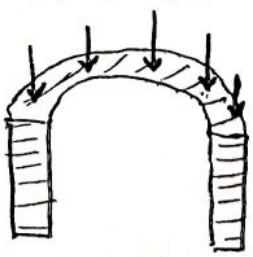
(2) The steel can be used to reinforce the concrete. يتم إستخدام الصلب لتدعيم الخرسانة

(3) The concrete is stronger under compression than under tension.

الخرسانة تتحمل إجهاد الضغط أكثر من الشد.



Post-and-beam (Greek) arch



semicircular (Roman) arch