Université Mohamed - KHIDER - BISKRA
Département de Génie Mécanique – MMC / Master – 2026/2027
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Travaux Dirigés (**Série n°5**)

Exercice N° 01 :

Let the stress tensor at a point P in a solid be defined with respect to the basis (e_1 , e_2 , e_3); its representative matrix is :

$$\Sigma = \begin{pmatrix} 14 & 0 & 10 \\ 0 & 24 & 0 \\ 10 & 0 & 18 \end{pmatrix} \quad \text{daN/mm}^2$$

1°) Determine the principal stress and principal directions of Σ in P.
2°) Determine the matrix associated with the strain tensor in the initial basis and in the principal basis.
3°) Consider a steel sphere with a diameter of one meter (1m) subjected to the stress field defined previously.

a) What happens to this sphere after deformation?
b) Determine its characteristic lengths and its final volume.

Material Characteristics : $E = 21500$ daN/mm^2 ; $\nu = 0.25$

Exercice N° 02 :

Let the stress tensor at a point P in a solid be defined with respect to the basis (e_1 , e_2 , e_3); its representative matrix is :

$$\Sigma = \begin{pmatrix} 9 & 12 & 0 \\ 12 & -9 & 0 \\ 0 & 0 & 5 \end{pmatrix} \quad \text{daN/mm}^2$$

1°) Determine the principal stress and principal directions of Σ in P.
2°) Determine the matrix associated with the strain tensor in the initial basis and in the principal basis.
3°) Consider a cylindrical bar with a circular cross-section, a diameter of 20 cm, and a length of two meters (2 m), with its axis oriented along the e_3 direction. This bar is subjected to the previously defined stress field.

a) Determine its new length, the principal dimensions of its cross-section
b) calculate the final volume of this bar.

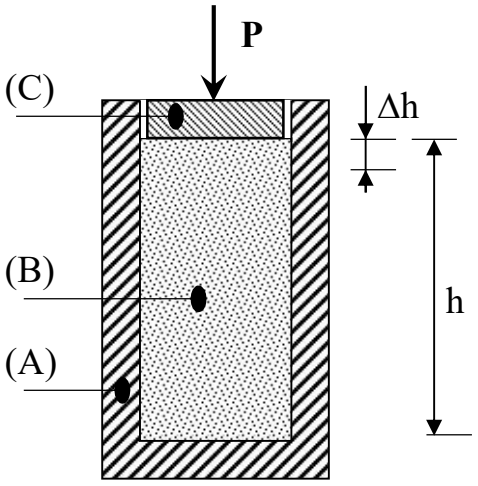
Material Characteristics: $E = 21000$ daN/mm^2 $\nu = 0.3$

Exercice N° 03 :

Consider a rigid (non-deformable) cylinder (A) containing a homogeneous, isotropic elastic material (B), which is compressed by means of a piston (C) with a cross-sectional area S. The compression (settlement) Δh of the material—which has an initial height h—is measured under the application of a load P.

The oedometer modulus, denoted as E*, is the characteristic constant of the material defined by the following relationship:

$$\frac{P}{S} = E^* \frac{\Delta h}{h}$$



1°) Determine the relationship between the oedometer modulus E* and Young's modulus E.
2°) Consider the case of a piston with a diameter of 20 cm; determine the load P required to achieve a settlement of 1 mm over a one-meter length from the medium (B).
For material (B), we are given:

Young's modulus E=10000 daN/mm^2

Poisson's ratio $\nu = 0.3$

3°) Determine the stress tensor present within medium (B).