MINISTERUL EDUCATIEI CERCETARII SI TINERETULUI
UNIVERSITATEA TEHNICA "GH. ASACHI" IASI
FACULTATEA DE CONSTRUCTII

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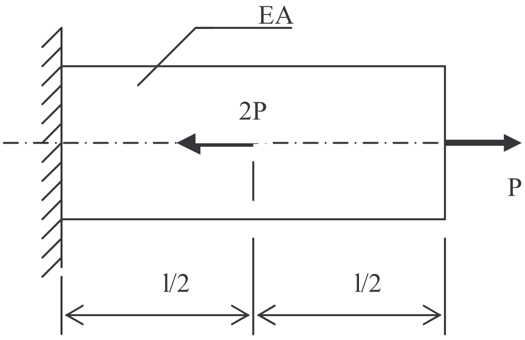
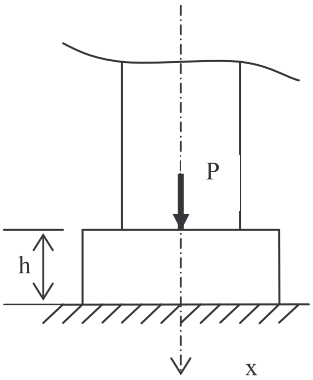
STRENGTH OF MATERIALS I

1. The axial displacement of the section from the free end of the structural element shown in the following figure is:



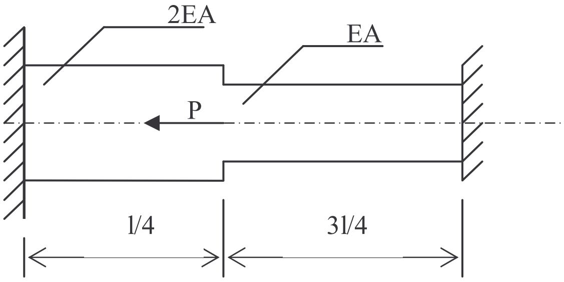
a. $\frac{Pl}{2EA}$ b. $\frac{Pl}{EA}$ c. $-\frac{2Pl}{EA}$ d. 0

2. The cross-sectional area of the foundation block for the column shown in the following figure, loaded by a force P, is determined by using the relation:



a. $A_{nec} = \frac{P}{\sigma_{0\,soil} - \gamma_{concrete}.h}$ b. $A_{nec} = \frac{P}{\sigma_{0\,concrete} - \gamma_{concrete}.h}$ c. $A_{nec} = \frac{P + \gamma_{concrete}.h}{\sigma_{0\,soil}}$ d. $A_{nec} = \frac{P + \gamma_{concrete}.h}{\sigma_{0\,concrete}}$

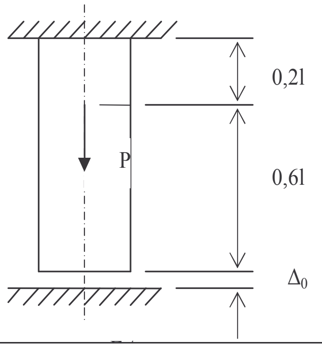
3. The maximum stress in the following element loaded by a force P is:



a. $\frac{P}{7EA}$ b. $\frac{6P}{14A}$ c. $\frac{P}{14A}$ d. $\frac{2P}{7EA}$

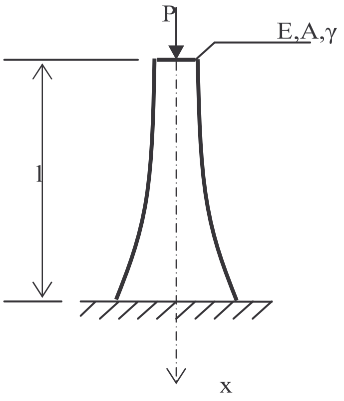
4. The maximum stress produced by the force P in the steel bar shown in the figure is given by the relation:

$$P > \frac{EA}{0{,}2l} \cdot \Delta_0$$



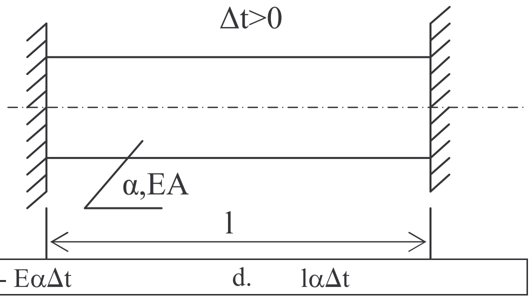
a.	$\sigma_x = \frac{0{,}2P}{A} - \frac{\Delta_0 E}{l}$	b.	$\sigma_x = \frac{0{,}2P}{l} + \frac{\Delta_0 E}{l}$	c.	$\sigma_x = \frac{0{,}8P}{A} + \frac{\Delta_0 E}{l}$	d.	$\sigma_x = \frac{0{,}8P}{A} - \frac{\Delta_0 E}{l}$

5. The normal stress, σ_x and axial displacement, u diagrams along a constant stress beam, when the own weight is considered, are:



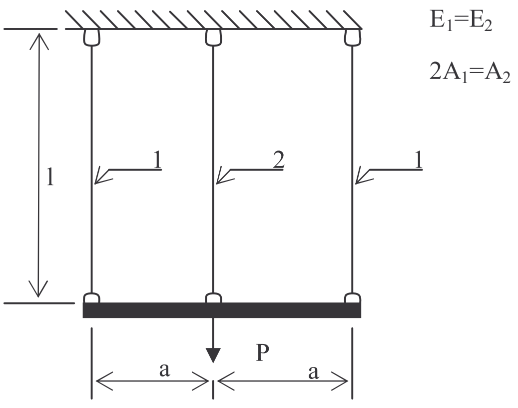
a.	constant for σ_x linear for u	b.	linear for σ_x constant for u	c.	linear for σ_x parabolic for u	d.	constant for σ_x parabolic for u

6. The normal stress in a bar of constant cross-section, subjected to an uniform temperature change $\Delta_t > 0$ is:



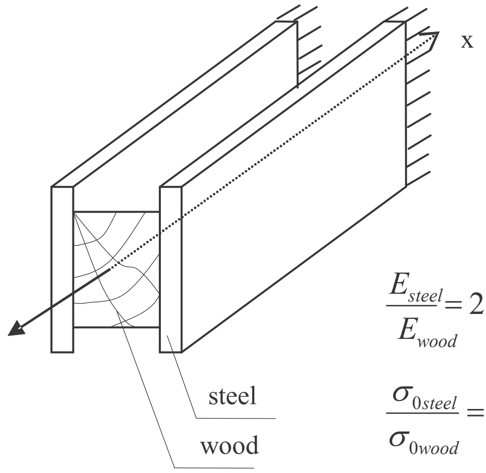
a.	- EAαΔt	b.	El αΔt	c.	- EαΔt	d.	lαΔt

7. The axial force in the bar 2 of the system shown in the figure is:



a.	$N_2 = \frac{P}{3}$	b.	$N_2 = \frac{P}{2}$	c.	$N_2 = \frac{2P}{3}$	d.	$N_2 = \frac{P}{4}$

8. The carrying capacity of the non-homogeneous element shown in the following figure is:



$$\frac{E_{steel}}{E_{wood}} = 20$$

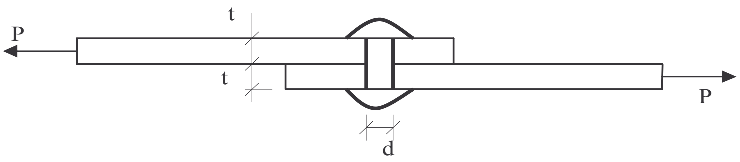
$$\frac{\sigma_{0steel}}{\sigma_{0wood}} = 16$$

a.	$N_{cap} = A_{wood}\sigma_{o\,wood} + A_{steel}\cdot\sigma_{o\,steel}$	b.	$N_{cap} = A_{steel}\sigma_{o\,steel} + A_{wood}\dfrac{\sigma_{o\,steel}}{20}$
c.	$N_{cap} = A_{wood}\sigma_{o\,wood} + A_{steel}\,20\sigma_{o\,wood}$	d.	$N_{cap} = A_{steel}\sigma_{o\,wood} + A_{wood}16\sigma_{o\,wood}$

9. The magnitude of the maximum principal stress, σ_1 and its direction, α_1 in case of pure shear are:

a.	$\sigma_1 = \tau$ $\alpha_1 = 0$	b.	$\sigma_1 = \tau$ $\alpha_1 = 45^0$
c.	$\sigma_1 = \dfrac{\tau}{2}$ $\alpha_1 = 45^0$	d.	$\sigma_1 = 2\tau$ $\alpha_1 = 90^0$

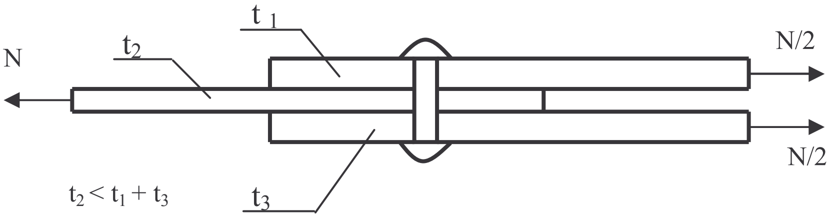
10. The maximum stress in the element presented in the following figure is obtained by using the relation:



$A_{br} = b \cdot t$

a.	$\sigma_{x\,max} = \dfrac{P}{A_{br} - \dfrac{\pi d^2}{4}}$	b.	$\sigma_{x\,max} = \dfrac{P}{A_{br} - 2dt}$
c.	$\sigma_{x\,max} = \dfrac{P}{A_{br} - dt}$	d.	$\sigma_{x\,max} = \dfrac{P}{A_{br} - db}$

11. The carrying capacity of a rivet in the connection shown in the following figure is:



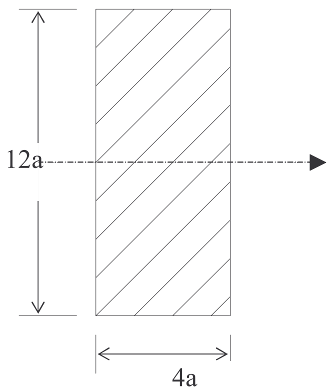
$t_2 < t_1 + t_3$

a.	$N_{1\,nit} = \min \left[\dfrac{\pi d^2}{4}\tau_{0rivet}, d(t_1 + t_2)\sigma_{0c}\right]$	b.	$N_{1\,nit} = \min \left[\dfrac{\pi d^2}{4}\tau_{0\,rivet}, d(t_1 + t_3)\sigma_{0c}\right]$
c.	$N_{1\,nit} = \min \left[\dfrac{\pi d^2}{4}\sigma_{0c}, dt_1\tau_{0rivet}\right]$	d.	$N_{1\,nit} = \min \left[\dfrac{\pi d^2}{2}\tau_{0rivet}, dt_2\sigma_{0c}\right]$

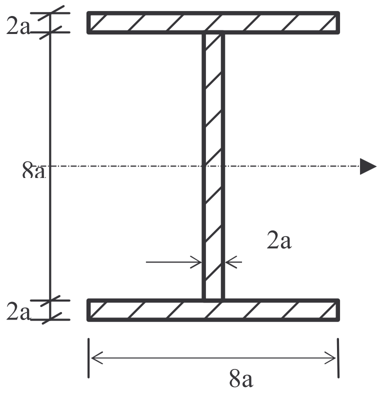
12. The density of strain energy in case of pure shear is:

a.	$U_s = \dfrac{1}{2}\dfrac{T^2}{GA^2}$	b.	$U_s = \dfrac{1}{2}\dfrac{T^2}{EA}$
c.	$U_s = \dfrac{T^2}{GA}$	d.	$U_s = \dfrac{T^2}{EI}$

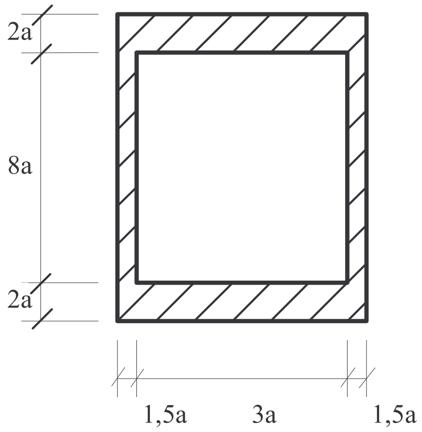
13. What is the most effective section in bending?



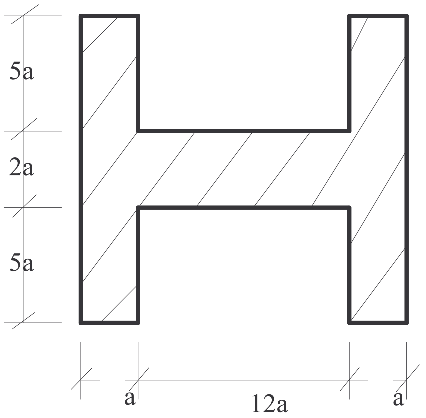
a)



b)



c)



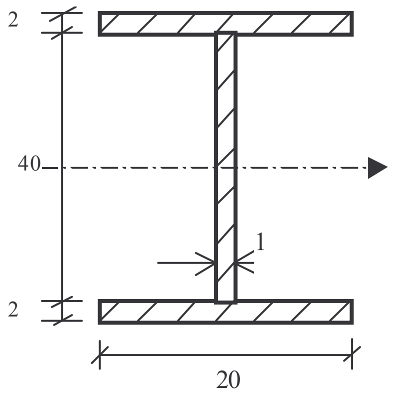
d)

a.	b.	c.	d.

14. The maximum shear stress on a rectangular section subjected to combined shear and bending is:

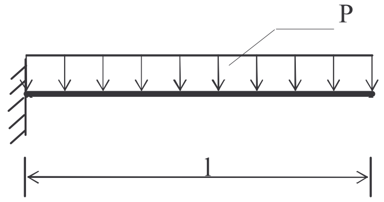
a. $\frac{3}{2}\frac{V}{A}$	b. $\frac{2}{3}\frac{V}{A}$	c. $\frac{4}{3}\frac{V}{A}$	d. $\frac{3}{4}\frac{V}{A}$

15. The arm of the internal resisting couple for the section shown in the following figure, subjected to bending, is:



a. 18cm	b. 24cm	c. 39cm	d. 52cm

16. The maximum defection for the beam shown in the figure is:



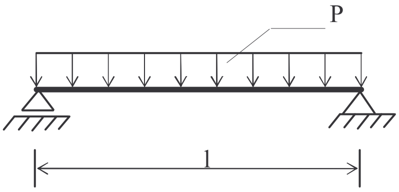
a. $\frac{pl^4}{4EI}$

b. $\frac{pl^4}{2EI}$

c. $\frac{pl^4}{16EI}$

d. $\frac{pl^4}{8EI}$

17. The rotation of the support sections for the beam shown in the following figure is:



a. $\frac{pl^3}{24EI}$

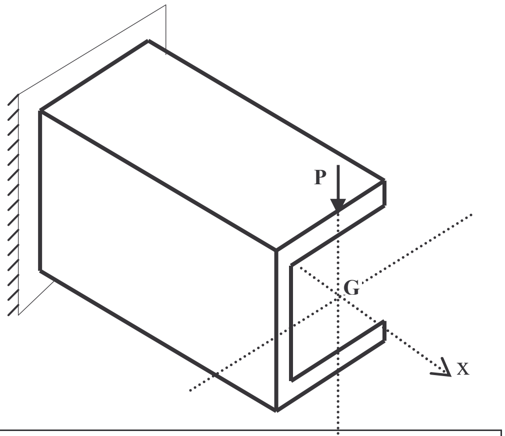
b. $\frac{pl^3}{48EI}$

c. $\frac{pl^4}{48EI}$

d. $\frac{pl^3}{12EI}$

18.

The state of loading for the beam shown in the figure is:



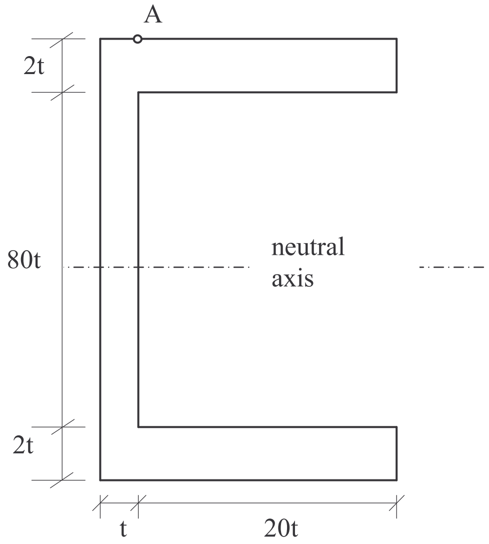
a. combined shear and bending

b. pure bending

c. combined shear, bending and torsion

d. pure shear

19.
The shear stress at point A belonging to the section shown in the following figure, subjected to combined shear and bending is:



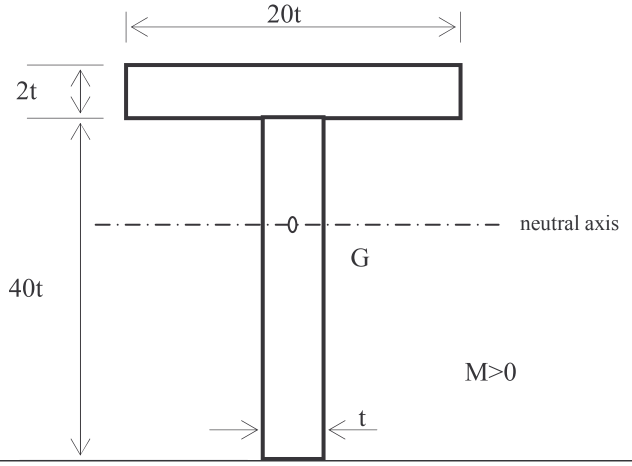
a. $\frac{V}{164t^2}$

b. $\frac{V}{224t^2}$

c. $\frac{V}{1640t^3}$

d. $\frac{V}{328t^2}$

20. The maximum normal stress on the following section subjected to bending is:



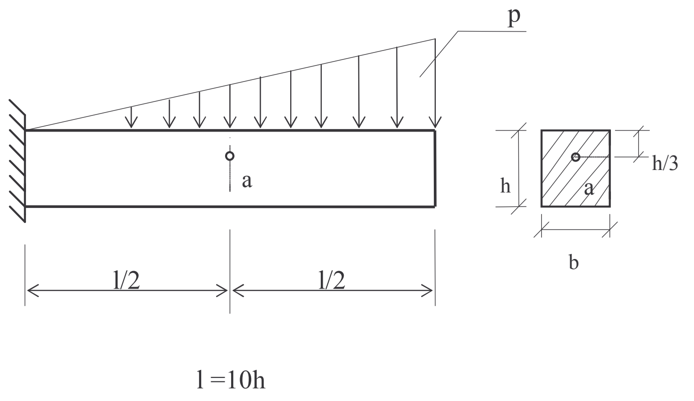
a. $\frac{M}{464t^3}$

b. $\frac{M}{1260t^3}$

c. $\frac{M}{842t^2}$

d. $\frac{M}{1654t^2}$

21. The maximum principal stress, σ_1, at point “a” belonging to the beam shown in the following figure, is:



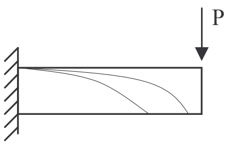
a. $\sigma_1 = 12\ \frac{p}{b}$

b. $\sigma_1 = 22\ \frac{p}{b}$

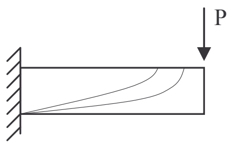
c. $\sigma_1 = 12\ \frac{p}{b^2}$

d. $\sigma_1 = 220\ \frac{p}{b}$

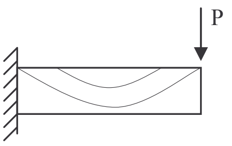
22. The stress trajectories of first kind (trajectories of principal stress σ_1) for the beam shown in the following figure have the shape:



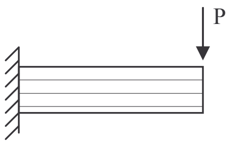
a)



b)



c)



d)

a.

b.

c.

d.

23. The strain energy stored by a structural element subjected to combined shear and bending is:

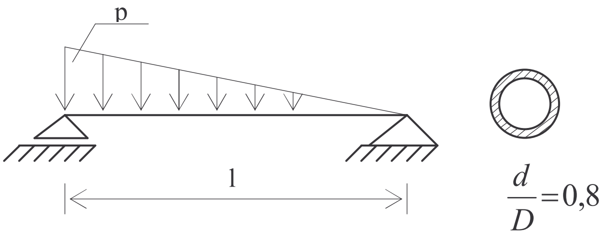
a. $U = \iiint_v \left(\frac{M^2}{EI}+\frac{K_V V^2}{GA}\right)d$

b. $U = \iiint_v \left(\frac{M^2}{GA}+\frac{K_V V^2}{EI}\right)$

c. $U = \iiint_v \left(\frac{M^2}{2EI}+\frac{K_V V^2}{2GA}\right)$

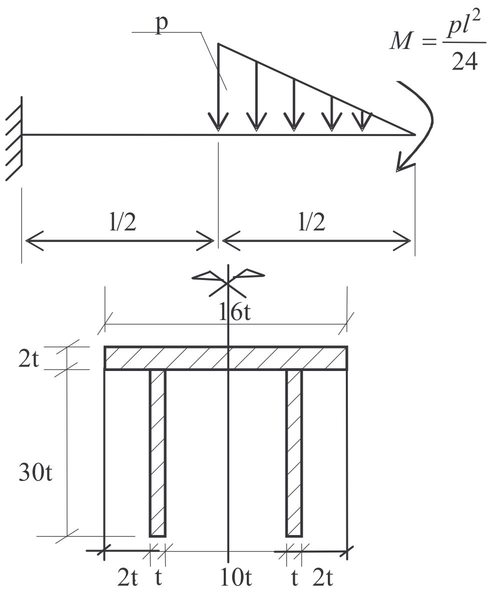
d. $U = \iiint_v \left(\frac{M}{2EI}+\frac{K_V V}{2GA}\right)^2$

24. The maximum normal stresses in the following beam are:



a.	$\sigma_{x\,max} = 2,08\,\frac{pl^2}{D^2}$	b.	$\sigma_{x\,max} = 1,107\,\frac{pl^2}{D^3}$	c.	$\sigma_{x\,max} = \frac{\pi pl^2}{D^3}$	d.	$\sigma_{x\,max} = \frac{pl^2}{225D^2}$

25. The maximum shear stresses in the following beam are:

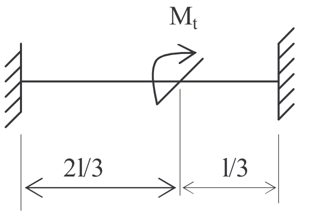


a.	$\tau_{max} = 0,5\,\frac{pl}{t^3}$	b.	$\tau_{max} = 0,5\,\frac{pl}{t^2}$	c.	$\tau_{max} = 20\,\frac{pl}{t^2}$	d.	$\tau_{max} = 0,005\,\frac{pl}{t^2}$

26. The shear stress distribution on a section subjected to torsion is:

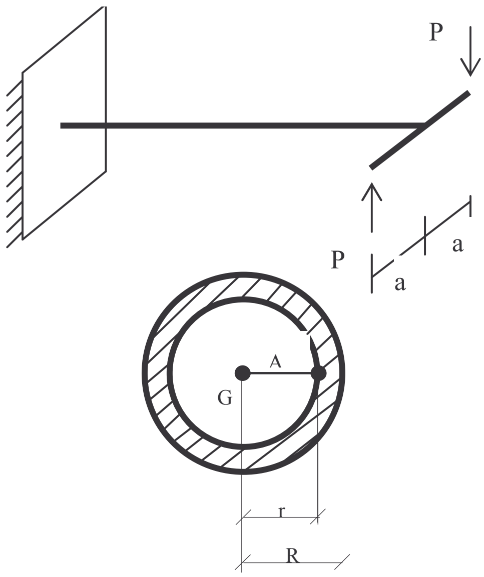
a.	parabolic, with maximum values at the section centroid and zero on the section boundaries	b.	linear, with maximum values on the section boundaries and zero at the section centroid	c.	uniform	d.	linear, with maximum values at the section centroid and zero on the section boundaries

27. The maximum twisting moment along the element shown in the following figure is:



a.	$\frac{2M_t}{3}$	b.	$\frac{M_t}{3}$	c.	$\frac{3M_t}{2}$	d.	M_t

28. The shear stress at point A of the following bar is determined by using the relation



a. $\tau = \dfrac{2Pa}{\dfrac{\pi R^4}{4}\left(1-\alpha^4\right)} r$

b. $\tau = \dfrac{Pa}{\dfrac{\pi R^4}{4}\left(1-\alpha^4\right)} r$

c. $\tau = \dfrac{2Pa}{\dfrac{\pi R^3}{4}\left(1-\alpha^4\right)}$

d. $\tau = \dfrac{2Pa}{\dfrac{\pi R^4}{4}\left(1-\alpha^2\right)} r$

29. The shear stress distribution on a thin-walled closed section is

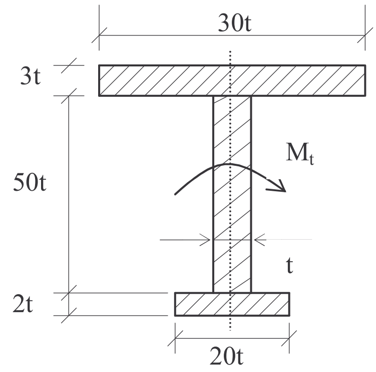
a. linear over the thickness of the section wall

b. constant, $\tau = \dfrac{M_t}{I_t} t$

c. parabolic over the section height

d. constant, $\tau = \dfrac{M_t}{2\Omega t}$

30. The maximum shear stress on the following section subjected to torsion by a twisting moment M_t is:



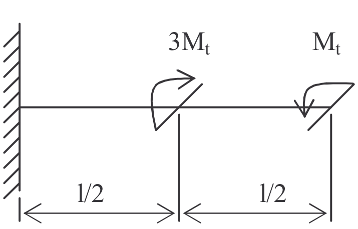
a. $\tau_{\max} = \dfrac{3M_t}{340t^3}$

b. $\tau_{\max} = \dfrac{M_t}{340t^3}$

c. $\tau_{\max} = \dfrac{M_t}{170t^3}$

d. $\tau_{\max} = \dfrac{3M_t}{170t^3}$

31. The twisting angle between the ends of the following bar, subjected to torsion, is:



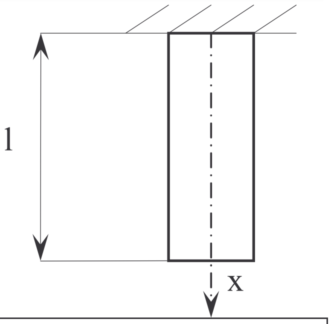
a. $\dfrac{2M_t \cdot l}{G \cdot I_t}$

b. $\dfrac{M_t \cdot l}{2G \cdot I_t}$

c. $\dfrac{M_t \cdot l}{G \cdot I_t}$

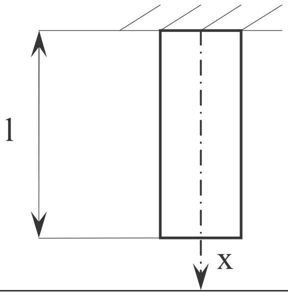
d. $\dfrac{2M_t \cdot l}{3G \cdot I_t}$

32. What is the elongation of the bar shown in the figure, due to its own weight, knowing the material specific weight, γ, the material longitudinal modulus of elasticity, E, the cross- sectional area, A and the bar length, l?



a.	$\frac{A\gamma l}{2}$	b.	$\frac{A\gamma l^2}{2E}$	c.	$\frac{\gamma l^2}{2E}$	d.	$\frac{\gamma l^2}{2EA}$

33. What is the maximum length of the following element, resulted from the strength requirement, when it is acted only by its own weight? There are given: the specific weight of the material, γ, the cross-sectional area, A, the bar length, l and the allowable stress in tension, σ_0.



a.	$\frac{\sigma_0}{\gamma}$	b.	$\frac{\sigma_0}{\gamma A}$	c.	$\frac{\gamma A}{\sigma_0}$	d.	$\frac{\gamma}{\sigma_0}$

34. The principal planes at a point of a deformable loaded body are:

a.	The planes on which the normal stresses are equal to zero	b.	The planes on which the shear stresses are equal to zero	c.	The planes on which both normal and shear stresses are equal to zero	d.	The planes on which both normal and shear stresses are different from zero

35. The stresses at a point of a deformable loaded body are: σ_x = 100 N/mm^2, σ_z = -100 N/mm^2 and τ_{xz} = 20 N/mm^2. Compute the normal stress on an inclined plane passing through the point, 45° apart with respect to the axes of the coordinate system xoz..

a.	200N/mm^2	b.	100N/mm^2	c.	-100N/mm^2	d.	20N/mm^2

36. Determine the maximum shear stress at a point of a deformable loaded body, knowing the principal stresses at that point: σ_1 = 50 N/mm^2 and σ_2 = -150 N/mm

a.	100N/mm^2	b.	50N/mm^2	c.	25N/mm^2	d.	200N/mm^2

37. At a point of a deformable loaded body, the stress tensor, expressed with respect to the coordinate system xoz, is $T_\sigma = \begin{bmatrix} 0 & 50 \\ 50 & 0 \end{bmatrix}$ (N/mm^2). The principal stress at the point, σ_1 is:

a.	100N/mm^2	b.	50N/mm^2	c.	25N/mm^2	d.	200N/mm^2

38. The stress state at a point is defined by the stress tensor $T_\sigma = \begin{bmatrix} 80 & 0 \\ 0 & 20 \end{bmatrix}$ (N/mm^2). The maximum shear stress at the point is:

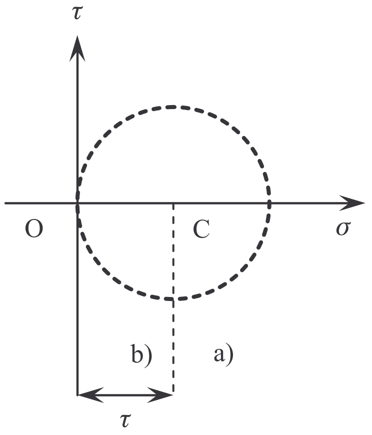
a.	100N/mm^2	b.	80N/mm^2	c.	30N/mm^2	d.	20N/mm^2

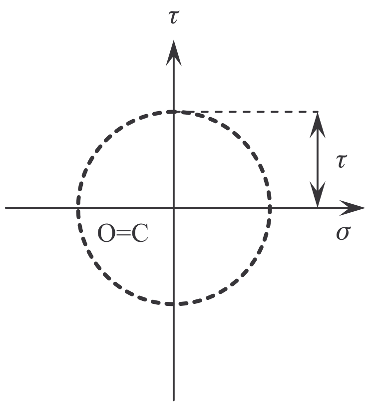
39. The stress tensor at a point of a deformable loaded body is $T_\sigma = \begin{bmatrix} -60 & 30 \\ 30 & 80 \end{bmatrix}$ (N/mm^2). The shear stress on a plane, inclined at 45° with respect to the orthogonal planes considered in the stress tensor, is:

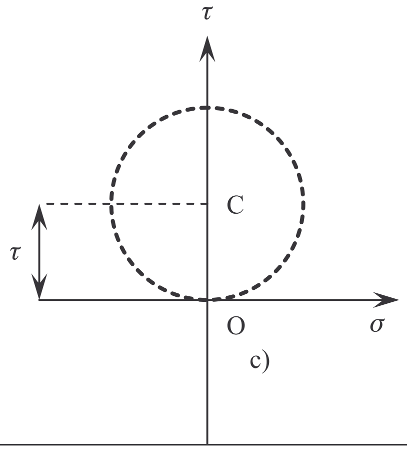
a.	90N/mm^2	b.	70N/mm^2	c.	140N/mm^2	d.	30N/mm^2

40.

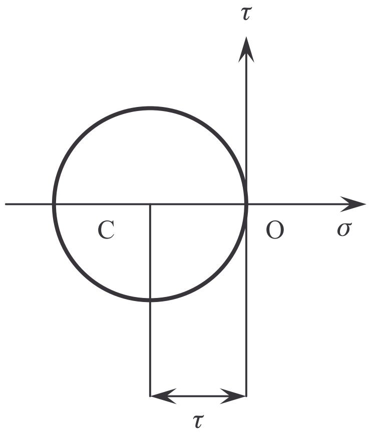
What is the graphical representation (Mohr's circle) which characterizes the stress state at a point, produced by pure shear?







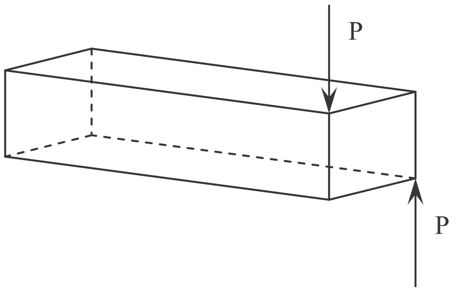
d)



a.	b.	c.	d.

41.

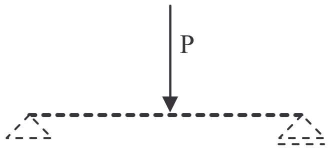
What is the bar state of loading?

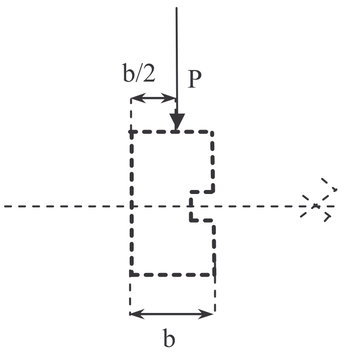


a.	combined torsion and bending	b.	pure torsion	c.	combined torsion, shear and bending	d.	combined torsion and shear

42.

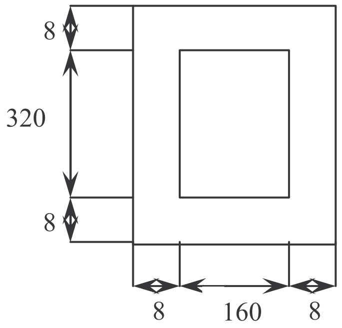
What is the bar state of loading?



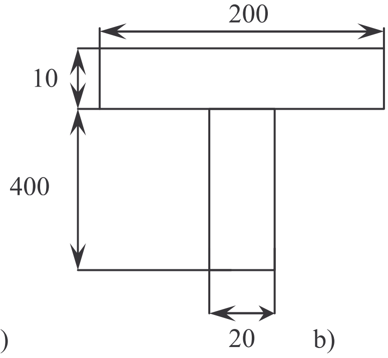


a.	combined torsion and bending	b.	pure torsion	c.	combined torsion, shear and bending	d.	combined torsion and shear

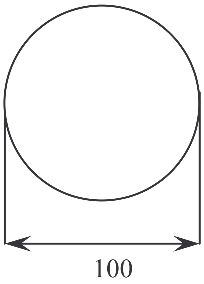
43. What is the most efficient section in case of pure torsion?



a)

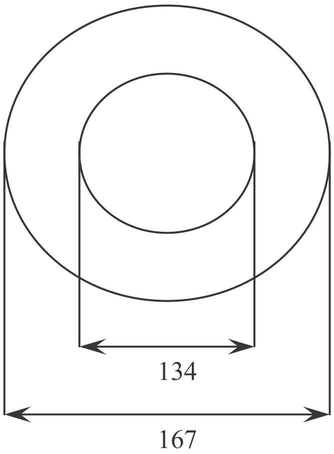


b)



c)

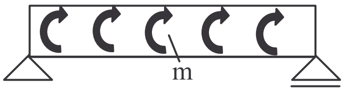
(mm)



d)

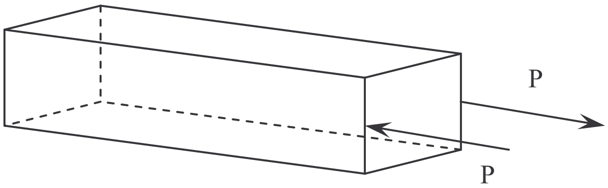
a.	b.	c.	d.

44. What is the bar state of loading?
(m – the intensity of the distributed bending moment)



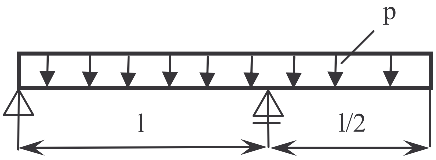
a.	pure bending	b.	pure shear	c.	combined torsion, bending and shear	d.	combined torsion and shear

45. What is the bar state of loading?



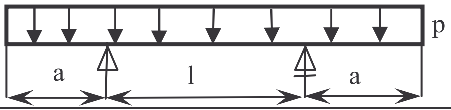
a.	pure torsion	b.	combined shear and bending	c.	pure bending	d.	Combined bending and compression or tension

46. The maximum bending moment (absolute value) along the following beam is:



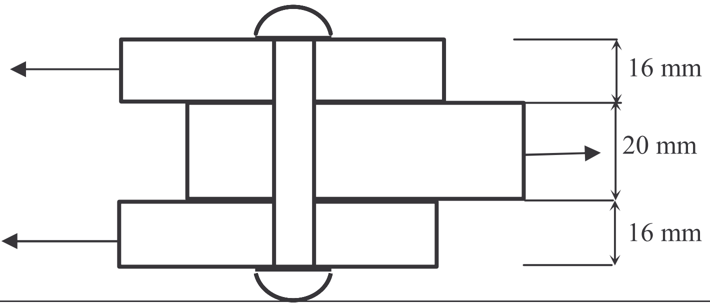
a.	$0.07pl^2$	b.	$0.125pl^2$	c.	$0.15pl^2$	d.	$0.25\ pl^2$

47. What is the length of the cantilevers, a, so that the maximum positive and negative bending moments to be equal in absolute value?



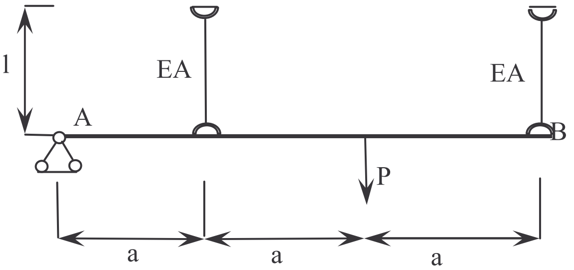
a.	$\frac{\sqrt{3}l}{2}$	b.	$\frac{\sqrt{3}l}{4}$	c.	$\frac{l}{4\sqrt{3}}$	d.	$\frac{l}{2\sqrt{3}}$

48. The carrying capacity of the rivet Φ 20, from the connection shown in the following figure, is:
$\tau_a^{rivet} = 1200$ daN/cm^2,
$\tau_{ag}^{rivet} = 3200$ daN/cm^2



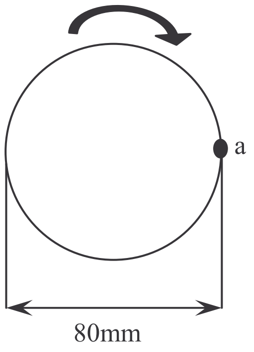
a.	12800 daN	b.	6500 daN	c.	7540 daN	d.	9450 daN

49. The maximum axial force in the deformable bars of the following system is:
(bar AB is a rigid one)



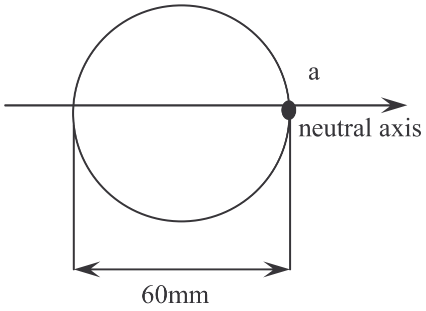
a.	$\frac{2P}{5}$	b.	$\frac{P}{5}$	c.	$\frac{P}{10}$	d.	P

50. The principal stress, σ_1 at point “a” of the following section subjected to torsion by a twisting moment T = 5KNm is:



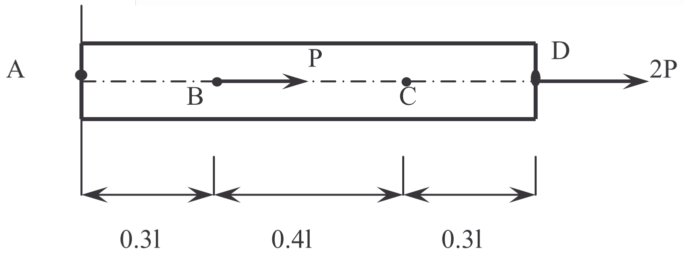
a.	38.4N/mm^2	b.	49.7N/mm^2	c.	54.6N/mm^2	d.	63.9N/mm^2

51. The principal stress, σ_1 at point “a” of the following section subjected to combined shear and bending (M_y = 80KNm; V_z = 20KN) is:



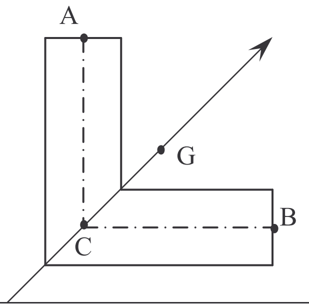
a.	9.4N/mm^2	b.	14.1N/mm^2	c.	3.5N/mm^2	d.	22.9N/mm^2

52. Determine the load parameter P, so that, the length change of the portion BC to be 2mm. There are given:
$l = 2$m,
$E = 10^4$N/mm^2,
$A = 10$cm^2.



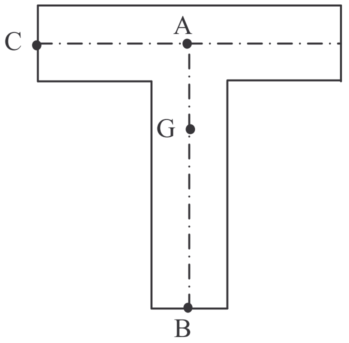
a. 25KN	b. 37.5KN	c. 12.5KN	d. 50KN

53. The shear center of the following section is:



a. A	b. B	c. C	d. G

54. The shear center of the following section is:



a. A	b. B	c. C	d. G