MINISTERUL EDUCATIEI CERCETARII SI TINERETULUI
UNIVERSITATEA TEHNICA "GH. ASACHI" IASI
FACULTATEA DE CONSTRUCTII
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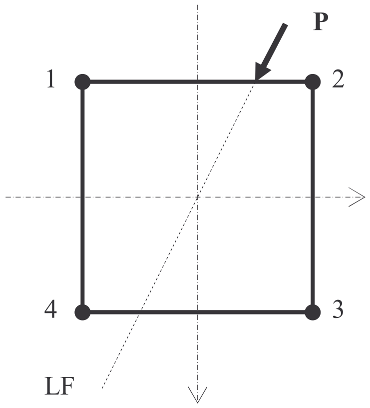
STRENGTH OF MATERIALS II

1. The following relation exists between the neutral axis and the load trace in case of skew bending:

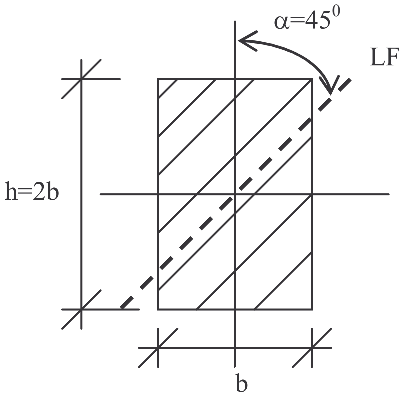
a. the neutral axis passes through the cross–section centroid and through the other two quadrants than the load trace;
b. the neutral axis passes through the cross-section centroid and through the same quadrants as the load trace;
c. the neutral axis does not pass through the cross-section centroid and is perpendicular to the load trace;
d. the neutral axis does not pass through the cross-section centroid and intersects the load trace under an angle $\alpha < \frac{\pi}{2}$.

2. On the section shown in the figure, belonging to a cantilever subjected to skew bending by the force P, the maximum positive stress occurs at point:



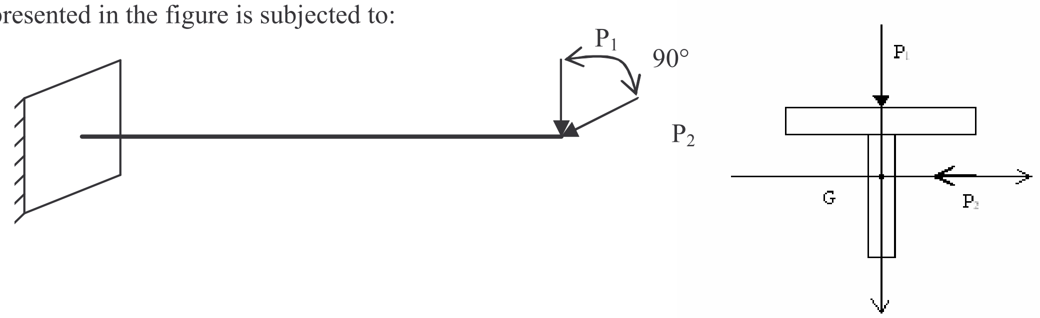
a. 1 b. 2 c. 3 d. 4

3. The rectangular section shown in the following figure is subjected to skew bending. The angle between the principal centroidal axes of the section and the load trace is $\alpha = 45^{o}$. What is the maximum normal stress, when the bending moment produced by the loads at this section is M?



a. $\frac{2\sqrt{2}}{b^3}M$ b. $\frac{4\sqrt{2}}{b^4}M$ c. $\frac{8\sqrt{2}}{b^3}M$ d. $\frac{9\sqrt{2}}{4b^3}M$

4. The beam presented in the figure is subjected to:



a.	combined bi-axial bending, shear and torsion	b.	bi-axial bending	c.	combined bi-axial bending and shear	d.	combined bi-axial bending and torsion

5. The eccentric compression produced by a normal force to the element cross-sectional plane, that has the point of application on one of the section principal centroidal axes is equivalent to:

a. combined bending, shear and concentric compression;
b. combined bi-axial bending and concentric compression;
c. combined bending and concentric compression;
d. combined bi-axial bending, shear and concentric compression.

6. When the eccentric compressive or tensile force point of application is located on one of the principal axes of the element cross-section, the neutral axis is:

a.	perpendicular to this axis	b.	parallel to this axis	c.	coincident to this axis	d.	inclined with respect to this axis under an angle $\alpha \neq \frac{\pi}{2}$

7. In case of eccentric tension or compression, when the neutral axis rotates around a fixed point, the force point of application moves along a line:

a.	that does not pass through the centroid of the element cross-section	b.	that passes through the centroid of the element cross-section	c.	that coincides to one of the cross-section principal axes	d.	that is tangent to the section

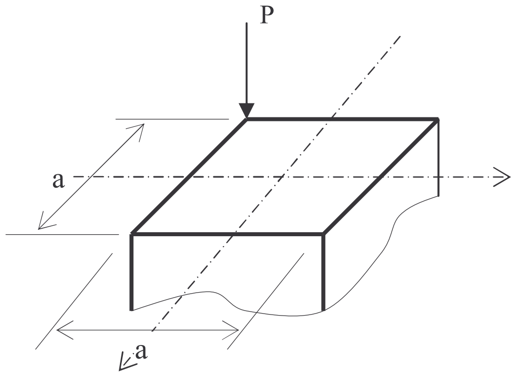
8. When the eccentric compressive force acts inside the contour of the section central core, the neutral axis

a.	intersects the cross-section, but does not pass through its centroid	b.	does not intersect the cross-section	c.	is tangent to the cross-section boundary	d.	intersects the cross-section and passes through its centroid

9. The contour of the central core for a circular cross-section, D in diameter, is a circle with the diameter:

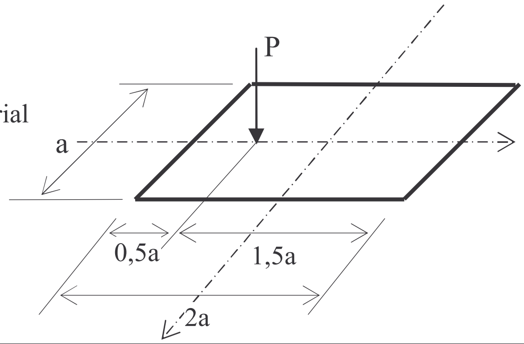
a.	$\frac{D}{2}$	b.	$\frac{D}{8}$	c.	$\frac{D}{16}$	d.	$\frac{D}{4}$

10. On the following section the maximum stress (absolute value) is:

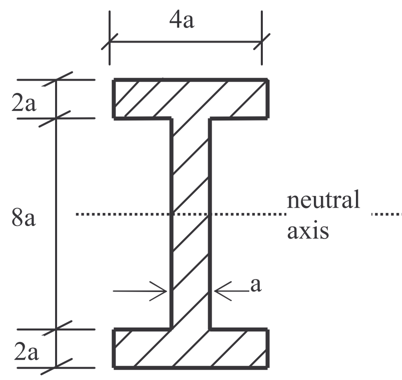


a. $\frac{4P}{a^2}$	b. $\frac{5P}{2a^2}$	c. $\frac{7P}{a^2}$	d. $\frac{8P}{a^2}$

11. The section presented in the figure is made of a material that cannot resist tension.
What is the maximum stress (absolute value) on the section?



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



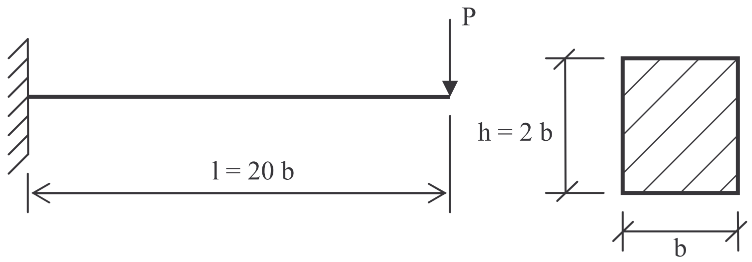
12. The modulus of section for bending in the plastic range, W_p, of the following section is:

a. $96a^3$	b. $108a^3$	c. $48a^3$	d. $64a^3$

13. At the moment when a section subjected to bending is entirely plasticized, the neutral axis divides the section in two parts characterized by

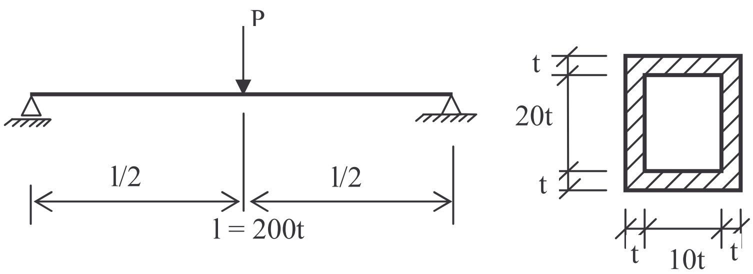
a.	equal areas	b.	equal first moments of area with respect to the neutral axis	c.	equal moments of inertia with respect to the neutral axis	d.	equal heights

14. The elastic load, P_e, for the beam presented in the figure, is:



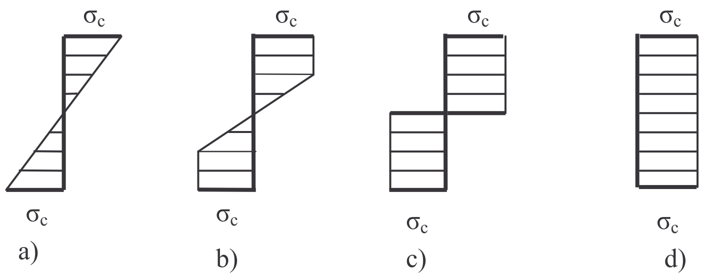
a.	$\frac{b^2\sigma_c}{15}$	b.	$\frac{b^2\sigma_c}{120}$	c.	$\frac{b^2\sigma_c}{30}$	d.	$\frac{2b^2\sigma_c}{15}$

15. The ultimate load, P_u, for the beam shown in the figure, is:



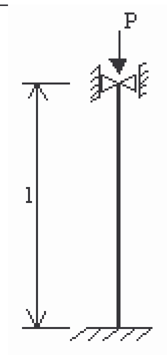
a.	$150t^2\ \sigma_c$	b.	$20{,}5t^2\ \sigma_c$	c.	$50t^2\ \sigma_c$	d.	$9{,}04t^2\ \sigma_c$

16. The stress distribution adopted in the plastic design of beams subjected to bending, at a section where a plastic hinge occurs, has the following shape:



a.		b.		c.		d.	

17. The effective length for a bar subjected to concentric compression is:

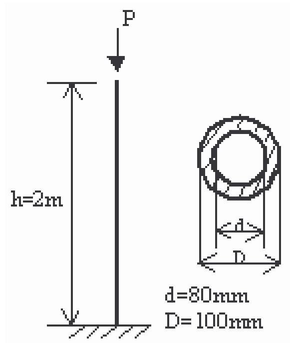


a.	0,7l	b.	0,7l	c.	l	d.	2l

18. The buckling of a member subjected to concentric compression occurs when:

a. $\lambda < \lambda_e = \pi\sqrt{\frac{E}{\sigma_e}}$	b. $\lambda > \lambda_e = \pi\sqrt{\frac{E}{\sigma_e}}$	c. $\lambda < \lambda_e = \pi\sqrt{\frac{\sigma_e}{E}}$	d. $\lambda > \lambda_e = \pi\sqrt{\frac{\sigma_e}{E}}$

19. The slender coefficient for the member with circular hollow section, shown in the figure, is approximately equal to:



a. 84	b. 56	c. 125	d. 197

20. The buckling coefficient, φ is:

a. lower than unity and increases with element slenderness increasing;
b. greater than unity and increases with element slenderness increasing;
c. lower than unity and increases with element effective length increasing;
d. lower than unity and decreases with element slenderness increasing.

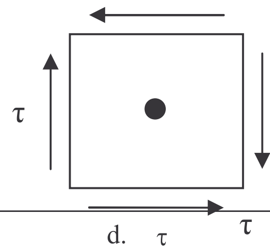
21. The allowable buckling load for a member subjected to concentric compression is:

a. $P_{af} = \varphi\, \sigma_{ac} \cdot A$	b. $P_{af} = \sigma_{ac} \cdot A$	c. $P_{af} = \sigma_c \cdot A$	d. $P_{af} = \varphi\, \sigma_c\, A$

22. According to the maximum distorsional strain energy theory, the equivalent stress, σ_{eq} at a point of a beam subjected to combined bending and shear is:

a. $\sigma_{ech} = \sqrt{\sigma^2 + 3\tau^2}$	b. $\sigma_{ech} = \frac{1}{2}\sqrt{\sigma^2 + 4\tau^2}$	c. $\sigma_{ech} = \frac{\sigma}{2} + \frac{1}{2}\sqrt{\sigma^2 + 4\tau^2}$	d. $\sigma_{ech} = \frac{\sigma}{2} - \frac{1}{2}\sqrt{\sigma^2 + 4\tau^2}$

23. According to the maximum normal stress theory, the equivalent stress, σ_{eq} at a point of an element subjected to torsion is:



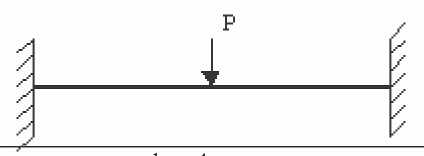
a. 2τ	b. $\tau(1+\nu)$	c. $\tau\sqrt{3}$	d. τ

24. The stress state at a point is defined by the following stress tensor: $T_\sigma = \begin{bmatrix} \sigma_0 & 0 \\ 0 & 2\sigma_0 \end{bmatrix}$

What is the equivalent stress, σ_{eq} at the point, according to the maximum distorsional strain energy theory?

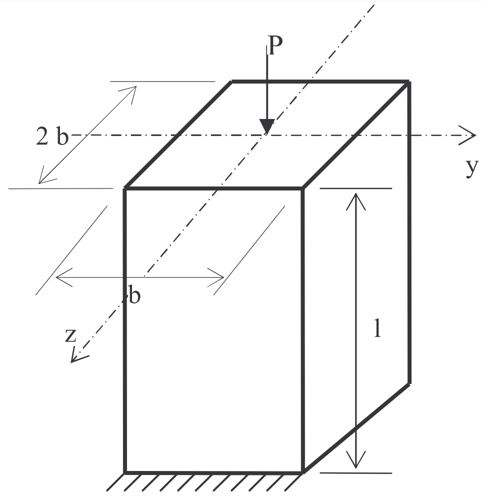
a. $\sigma_0\sqrt{2}$	b. $\sigma_0\sqrt{3}$	c. σ_0	d. $\frac{\sigma_0}{2}$

25. What is the number of plastic hinges that determine the occurrence of the collapse mechanism for the beam shown in the figure:



a. 1	b. 2	c. 3	d. 4

26. The critical load for the column presented in the figure is:

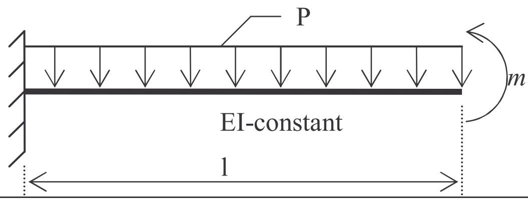


a. $P_{cr} = \frac{\pi^2 EI_z}{l^2}$	b. $P_{cr} = \frac{\pi^2 EI_z}{4l^2}$	c. $P_{cr} = \frac{\pi^2 EI_y}{l^2}$	d. $P_{cr} = \frac{\pi^2 EI_y}{4l^2}$

27. The second order differential equation of the deflection curve for a beam is:

a. $\frac{d^2w(x)}{dx^2} = -\frac{M(x)}{EI}$	b. $\frac{d^2w(x)}{dx^2} = -\frac{M\phi}{EI}$	c. $\frac{d^2w(x)}{dx^2} = \frac{p(x)}{EI}$	d. $\frac{d^2w(x)}{dx^2} = -\frac{V(x)}{EI}$

28. What should the magnitude of the concentrated moment, m be, so that, the deflection of the section from the free end of the beam to equal zero?



a. $m = \frac{pl^2}{2}$	b. $m = \frac{pl^2}{4}$	c. $m = pl^2$	d. $m = \frac{pl^2}{8}$

29. What is the conjugated beam of an overhanging beam:

a. a simply supported beam	b. a cantilever	c. a Gerber system	d. an overhanging beam

30. What is the maximum shear stress value at a point where the stress tensor is:

$$T_\sigma = \begin{bmatrix} 100 & 0 & 0 \\ 0 & 50 & 0 \\ 0 & 0 & -50 \end{bmatrix} N/mm^2$$

a. $25N/mm^2$	b. $50N/mm^2$	c. $100N/mm^2$	d. $75N/mm^2$

31. At a point of a deformable loaded body, the principal stresses are known.
$\sigma_1 = 100N/mm^2$; $\sigma_2 = 50N/mm^2$; $\sigma_3 = 0$;
The characteristic equation is:

a. $\sigma^3 - 150\sigma^2 + 5000\sigma = 0$
b. $\sigma^3 - 150\sigma + 5000 = 0$
c. $\sigma^3 - 5000\sigma^2 + 150\sigma = 0$
d. $\sigma^3 - 1500\sigma^2 + 5000 = 0$

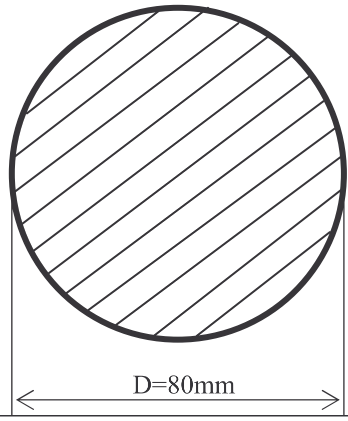
32. The stress state at a point of a deformable loaded body is:
$\sigma_x = 100N/mm^2$; $\sigma_y = 150N/mm^2$; $\sigma_z = 20N/mm^2$; $\tau_{xz} = \tau_{zx} = -20N/mm^2$.
What is the value of the principal stress σ_1?

a. 250N/mm^2	b. 170N/mm^2	c. 150N/mm^2	d. 220N/mm^2

33. At a point of a section subjected to combined shear and bending, the normal stress is $\sigma_x = 100N/mm^2$ and the shear stress $\tau_{xz} = 30N/mm^2$. The equivalent stress σ_{ech} at the considered point, according to the maximum shear stress failure theory, is:

a. 124N/mm^2	b. 117N/mm^2	c. 135N/mm^2	d. 129N/mm^2

34. The circular solid section shown in the following figure is subjected to tension by an axial force N=500KN and to torsion by a twisting moment T=1KNm.
What is the equivalent stress, σ_{ech}, according to the distorsional strain energy failure theory (Von Mises – Hencky), at the most loaded point of the section?

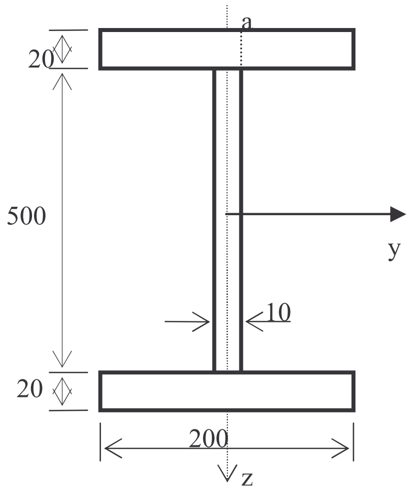


a. $1010\dfrac{daN}{cm^2}$	b. $1100\dfrac{daN}{cm^2}$	c. $1000\dfrac{daN}{cm^2}$	d. $950\dfrac{daN}{cm^2}$

35. The stresses at a point of a deformable loaded body are:
$\sigma_x = -100N/mm^2$; $\sigma_z = 100N/mm^2$; $\tau_{xz} = \tau_{zx} = 30N/mm^2$.
The equivalent stress, σ_{ech} at the considered point, according to maximum normal stress failure theory, is:

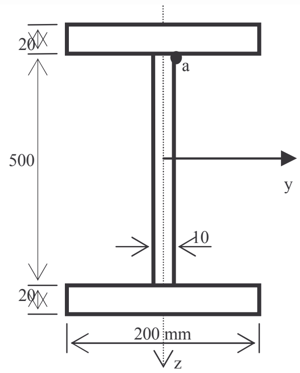
a. 100N/mm^2	b. 104,4N/mm^2	c. 109,2N/mm^2	d. 150,5N/mm^2

36. The equivalent stress, σ_{ech}, according to the distorsional strain energy failure theory, at point "a" of the section shown in the figure, subjected to combined shear and bending (M_y = 80KNm; V_z = 20KN) is:



a. $\sigma_{ech} = 335\dfrac{daN}{cm^2}$	b. $\sigma_{ech} = 475\dfrac{daN}{cm^2}$	c. $\sigma_{ech} = 355\dfrac{daN}{cm^2}$	d. $\sigma_{ech} = 415\dfrac{daN}{cm^2}$

37. The equivalent stress, σ_{ech}, according to the distorsional strain energy failure theory, at point "a" of the section shown in the figure, subjected to combined shear and bending (M_y = 80KNm; V_z = 20KN) is:



a. $\sigma_{ech} = 315\dfrac{daN}{cm^2}$ b. $\sigma_{ech} = 340\dfrac{daN}{cm^2}$ c. $\sigma_{ech} = 365\dfrac{daN}{cm^2}$ d. $\sigma_{ech} = 385\dfrac{daN}{cm^2}$

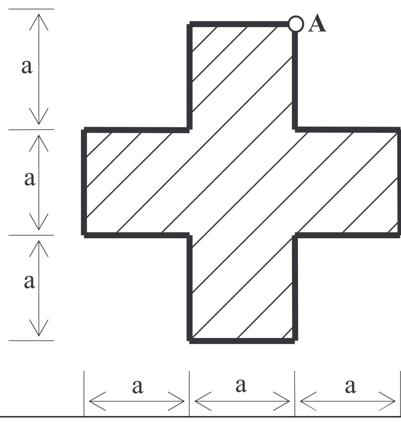
38. The equivalent stress at a point of a section made of a material with different strengths in tension and compression, according to Mohr's theory, is:

a. $\sigma_{ech} = \sigma_1 - \dfrac{\sigma_{ot}}{\sigma_{oc}}\sigma_3$ b. $\sigma_{ech} = \sigma_3 - \dfrac{\sigma_{ot}}{\sigma_{oc}}\sigma_1$ c. $\sigma_{ech} = \sigma_3 + \dfrac{\sigma_{ot}}{\sigma_{oc}}\sigma_1$ d. $\sigma_{ech} = \sigma_1 + \dfrac{\sigma_{ot}}{\sigma_{oc}}\sigma_3$

39. The central core of a rectangular section (60x30) cm^2 is:

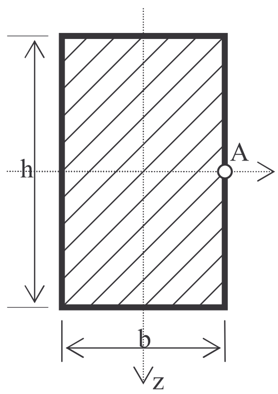
a. a rhomb, having the greater half-axis 10cm in length b. a rectangle, having the greater side 10cm in length c. a rhomb, having the greater half-axis 20cm in length d. a rectangle, having the greater side 15cm in length

40. The normal stress, σ_x, at the centroid of the section shown in the figure, subjected to eccentric compression by a force P, that acts at point A, is:



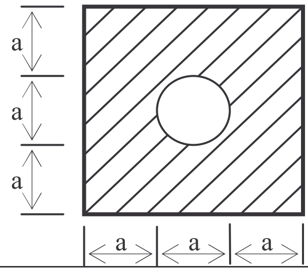
a. $\sigma_x = \dfrac{P}{4a^2}$ b. $\sigma_x = \dfrac{P}{a^2}$ c. $\sigma_x = \dfrac{P}{5a^2}$ d. $\sigma_x = \dfrac{1,5P}{a^2}$

41. The maximum stress (absolute value) on the section pictured in the figure, acted by a compressive force at point A is:



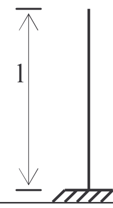
a. $\dfrac{2P}{h^2b}$ b. $\dfrac{2P}{hb^2}$ c. $\dfrac{2P}{hb}$ d. $\dfrac{4P}{hb}$

42. The central core of the following section is:



a.	a rhomb with the greater half-axis 0,77a in length	b.	a square with the side 0,77a in length	c.	a circle with the radius 0,77a in length	d.	a square with the side 0,54a in length

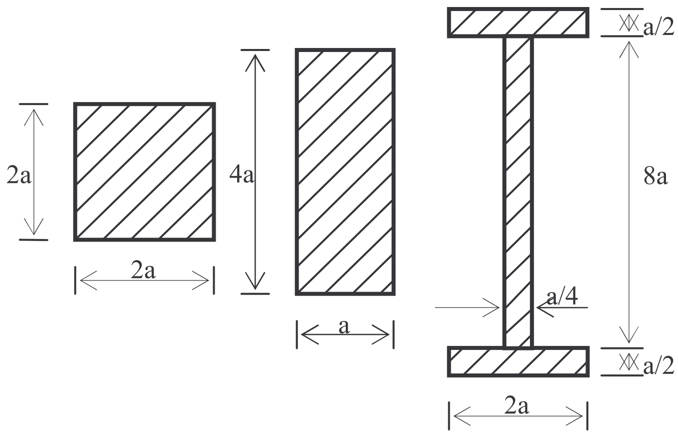
43. The effective length of the following bar is:



a.	0,5 l	b.	2 l	c.	0,7 l	d.	l

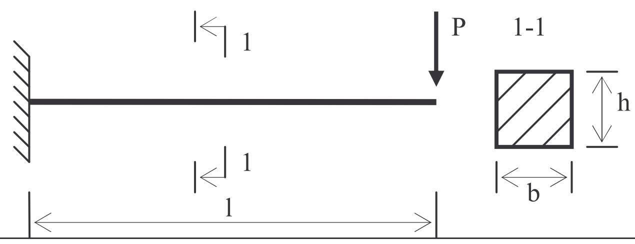
44. A column that buckles in the elastic range is considered. Its section is conceived in the following three variants.

The critical load value is:



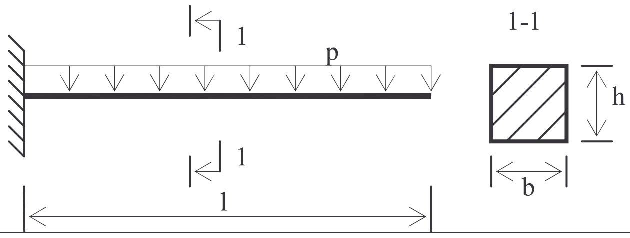
a.	minimum for the square section	b.	minimum for the rectangular section	c.	minimum for the double T section	d.	equal for all considered sections

45. The elastic load, P_{el}, for the following beam is:



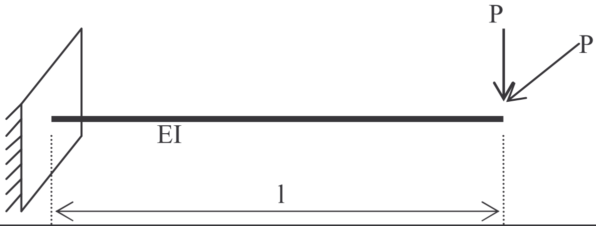
a.	$P_{el}=\frac{\sigma_c bh^2}{6l}$	b.	$P_{el}=\frac{\sigma_c b^2 h}{6l}$	c.	$P_{el}=\frac{\sigma_c bh^2}{12l}$	d.	$P_{el}=\frac{\sigma_c bh^3}{12l}$

46. The ultimate load, P_{lim}, for the beam presented in the figure, is:



a. $p_{\lim} = \dfrac{\sigma_c b^2 h}{2l^2}$ b. $p_{\lim} = \dfrac{\sigma_c b^2 h}{4l^2}$ c. $p_{\lim} = \dfrac{\sigma_c b h^2}{2l^2}$ d. $p_{\lim} = \dfrac{\sigma_c b h^2}{4l^2}$

47. The total linear displacement of the free end of the following beam with square section is:



a. $\dfrac{2\sqrt{2}Pl^3}{3EI}$ b. $\dfrac{\sqrt{3}Pl^3}{4EI}$ c. $\dfrac{\sqrt{3}Pl^3}{2EI}$ d. $\dfrac{\sqrt{2}Pl^3}{3EI}$

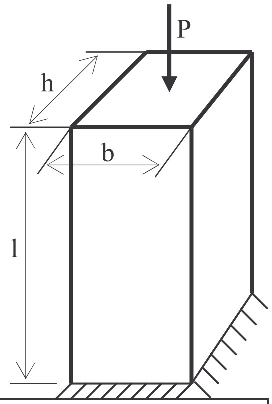
48. The critical stress, σ_{cr}, formula is:

a. $\sigma_{cr} = \dfrac{\pi^2 E}{l_f^2}$ b. $\sigma_{cr} = \dfrac{\pi^2 E}{\lambda^2}$ c. $\sigma_{cr} = \dfrac{\pi^2 EI}{\lambda^2}$ d. $\sigma_{cr} = \dfrac{\pi^2 EA}{l_f^2}$

49. The slenderness ratio, λ, relation is:

a. $\lambda = \dfrac{i}{l_f}$ b. $\lambda = \dfrac{l_f}{I}$ c. $\lambda = \dfrac{l_f}{i}$ d. $\lambda = \dfrac{l_f}{A}$

50. The critical load for the following column having $\lambda \succ \lambda_0$ is:



a. $\dfrac{\pi^2 Eh^2 b}{4l^2}$ b. $\dfrac{\pi^2 Ehb^2}{4l^2}$ c. $\dfrac{\pi^2 Ehb^2}{48l^2}$ d. $\dfrac{\pi^2 Eh^2 b}{48l^2}$