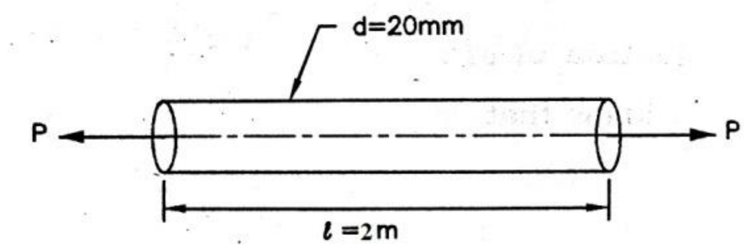
Uka Tarsadia University (Diwaliba Polytechnic)
Diploma in Mechanical Engineering
Assignment (Strength of Materials - 020020407)

Unit-1

Direct stress and strain

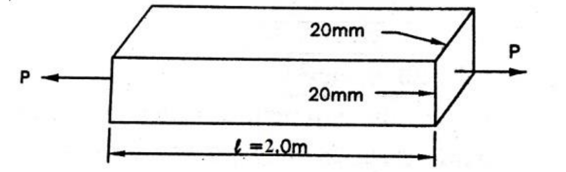
1. What is stress? Give example of stress and unit of stress.
2. What is strain? Give example of strain.
3. Explain Hook's law and define Modulus of Elasticity.
4. What is direct stress? Give types of direct stresses.
5. Define strain energy and give its equation.
6. What is Elasticity and Plasticity? Give examples.
7. What is modulus of Elasticity? Give equation of Modulus of Elasticity.
8. What is poison's ratio? Explain.
9. What is bulk modulus? Give equation of Bulk modulus.
10. What is shear stress? Give equation of shear stress.
11. What is shear strain? Give equation of shear strain.
12. A mild steel bar 2 m long and 20 mm diameter is subjected to an axial tensile force of 80 kN If modulus of elasticity $E = 2 \times 10^5$ N/mm^2, Find Following

    Stress, Strain, Elongation, Final length of bar

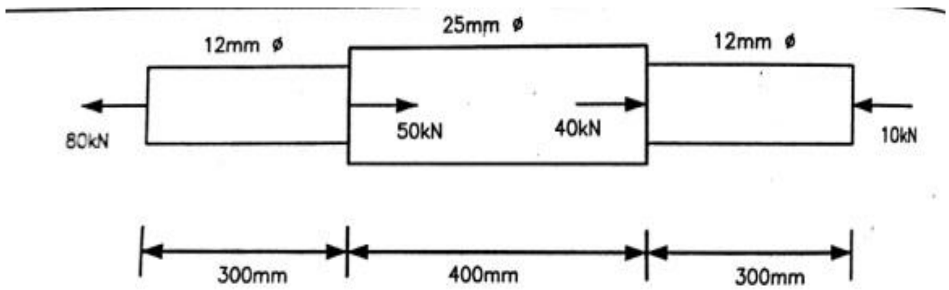


13. A steel rod of 24 mm diameter and 2 m length is subjected to an axial pull of 40 kN, If the elongation is 0.5 mm, find stress, strain and young's modulus.

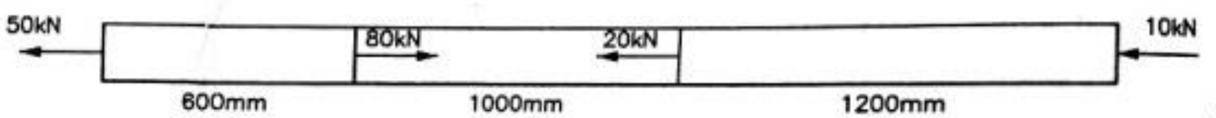
14. A rod of 2 m length and 20mm × 20mm in cross section is subjected to an axial pull of 10 kN, If elongation of the rod is 0.12 mm, Find the modulus of elasticity.



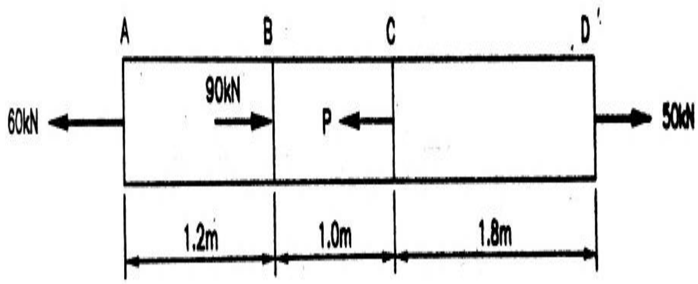
15. A mild steel bar 20 mm in diameter 3.0 m length is subjected to an axial pull of 40 kN. Calculate stress, strain and Final length of the bar. Take E = 210 kN/mm^2
16. A mild steel bar 50 mm in diameter 7.0 m length is subjected to an axial pull of 60 Kn. Calculate stress, strain and Final length of the bar. Take E = 210 Kn/mm^2
17. Find the change in length of a bar as shown in figure. Take E = 2 ×10^5 N/mm^2



18. Calculate change in length of a bar as shown in the figure. Take E = 2 ×10^5 N/mm$^{2.}$ Cross section of the area is 100 mm^2



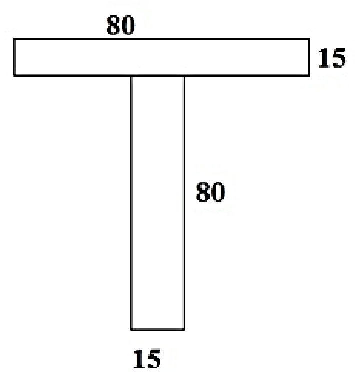
19. A mild steel bar of 25 mm diameter is acted upon by force as shown in figure. Find unknown force P and change in length of the bar. Take E = 2 ×10^5 N/mm^2



Unit-2

Moment of Inertia

1. What is moment of Inertia? Give its importance.
2. What is section modulus? Give its equation.
3. What is radius of gyration? Explain with equation.
4. What is radius of gyration? Give its equation.
5. Derive equation for Ixx and Iyy for Circular section.
6. Derive equation for parallel axis theorem.
7. Derive equation for perpendicular axis theorem.
8. Derive equation for Ixx and Iyy for Semicircular section.
9. Derive equation for Ixx and Iyy for Rectangular section.
10. What is radius of gyration? Explain with equation..
11. Derive equation for Zxx and Zyy for Triangular section.
12. What is section modulus? Give its equation.
13. Calculate Ixx and Iyy at CG for given section shown in figure.



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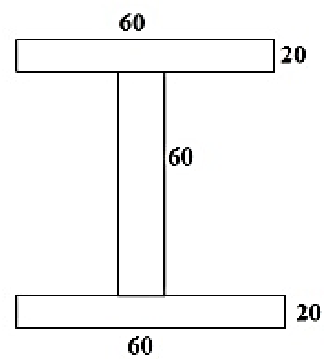

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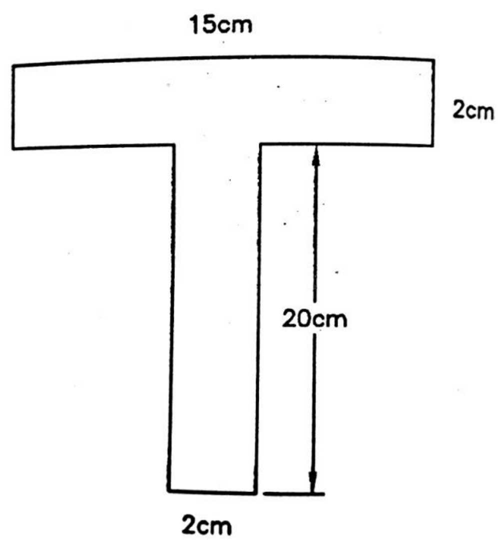

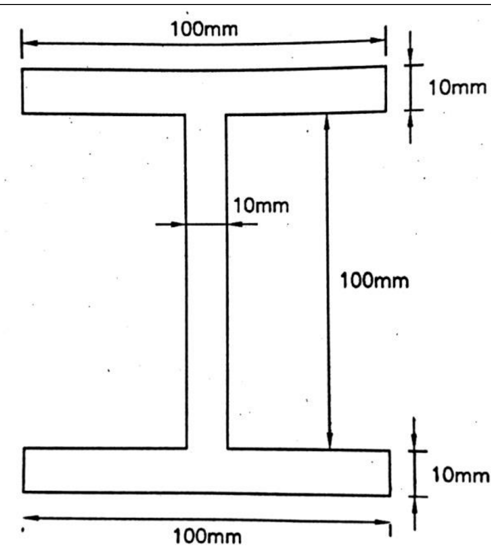

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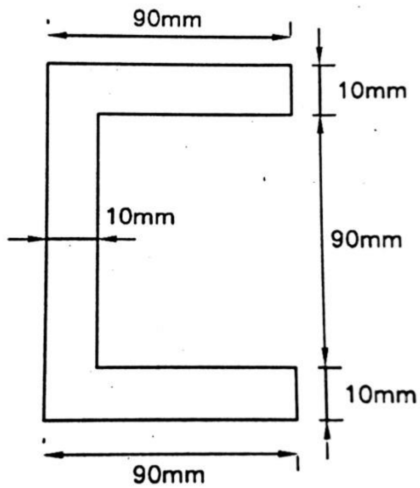
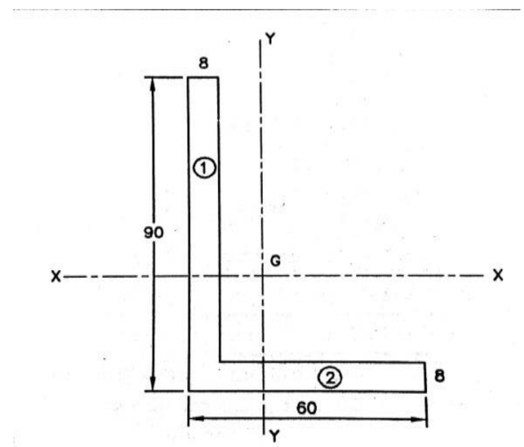
<tr><td></td><td></td></tr>
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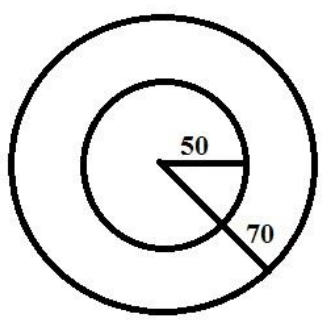
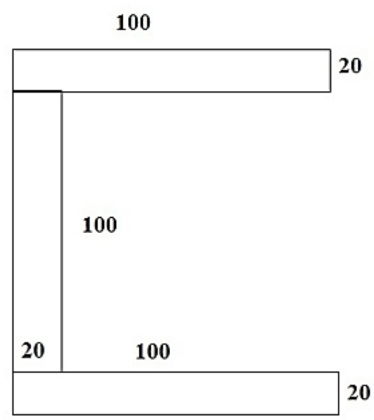
<tr><td></td><td></td></tr>
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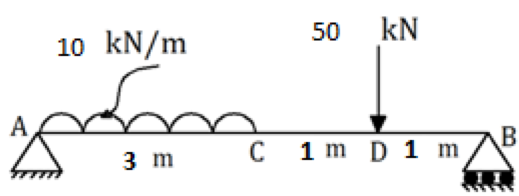
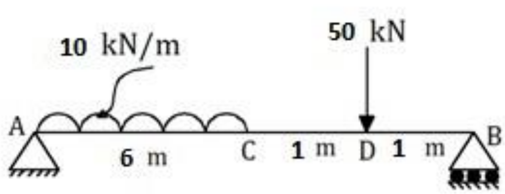
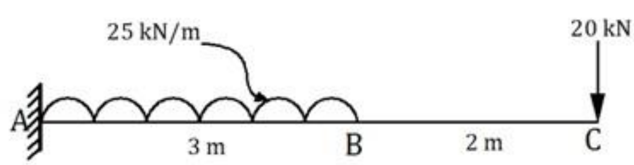
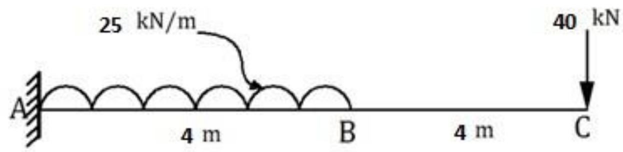
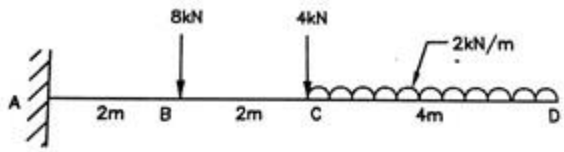
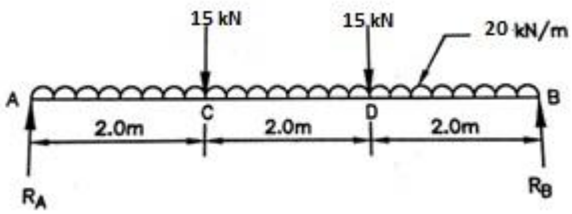
Unit-3

S F and B M in beam and torsion

1. List out types of beams and draw figures.
2. List out types of loads on beams and draw figures.
3. List out types of supports of beams and draw figures.
4. Explain determinate beams with example.
5. Explain indeterminate beams with example.
6. What is bending moment? Give example.
7. What is shear force? Give example.
8. List out types of beams and draw figures.
9. Draw a diagram of three equal span continues beam with all roller supports and a point load at center span at middle of beam.
10. List out types of supports of beams and draw figures.
11. Draw shear force and bending moment diagram for following beams.

(a)	
(b)	
(c)	

(d)	25 kN/m 40 kN A 4 m B 4 m C
(e)	8kN 4kN 2kN/m A 2m B 2m C 4m D
(f)	15 kN 15 kN 20 kN/m A C D B 2.0m 2.0m 2.0m RA RB

Unit-4

Bending stresses in beam and mechanical properties of materials

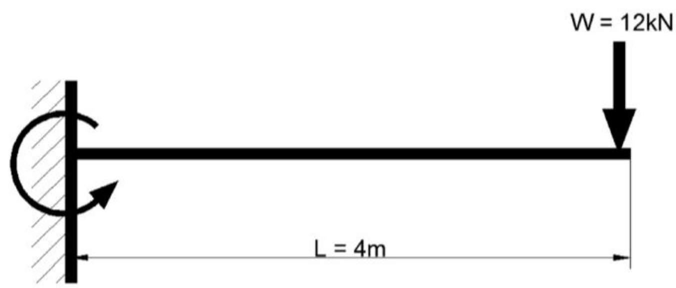
1. Draw the shear stress distribution diagrams for rectangle and circular section of beam.
2. Derive the equation f/y=E/R for bending stress..
3. Give classification of Metals.
4. Derive the equation M/I=f/y=E/R . Start from f/y=E/R.
5. Explain neutral layer and neutral axis with appropriate figure.
6. 90 kN.m moment is applied on beam having cross-section 200 mm x 300 mm. calculate
7. 70 kN.m moment is applied on beam having cross-section 230mm x 330 mm. calculate bending stress.
8. Prove that for rectangular section tmax=1.5 tave
9. 60 kN.m moment is applied on beam having cross-section 250 mm x 450 mm. calculate bending stress.
10. Give Differences: Charpy Impact test and Izod impact test.
11. Derive the equation M/I=f/y=E/R . Start from f/y=E/R.
12. A cast iron pipe of external diameter 50 mm and 8 mm thick is 6 m long and simply supported at ends. It carries a point load of 120 N at its centre. Calculate the maximum bending stress induced.
13. 2 m long cantilever beam carried UDL of 4 kN/mm on entire length. If maximum bending stress in the beam is 160 MPa. Then find diameter of circular section for the beam.
14. A rectangular beam 4 m span is simply supported and subjected to UDL of 20 kN/m on full length. If maximum bending stress developed is not exceeding 7.5 N/mm2 and if depth of beam is double it's width, find out depth and width of beam.
15. 75 mm wide and 12 mm thick steel flat is bent in a circular from of 16 m radius by applying couple at its ends. Determine the maximum stress developed and amount of couple. Take E= 200 GPa.
16. A rectangular section 400 mm deep is used as a simply supported beam of length 5.0 m. the beam carries a central point load of 100 kN Find maximum bending stress induced in the section. Take Ixx=1.33 x 109 mm2
17. A beam has cross sections of 200 mm × 300 mm. It is subjected to bending moment of 80 kN*m. Find maximum bending stress and draw bending stress diagram.
18. A hollow circular section of 120 mm internal diameter and 150 mm external diameter is used as a beam and is subjected to B.M of 2 KN*m . Find the value of maximum bending stress developed.
19. A rectangular beam of span 8 meter is simply supported at its end. The cross section of the beam is 200mm ×400 mm. It is loaded by central point load of 200 kN And a UDL of 10 kN/m. on entire span. Find maximum bending stresses developed at mid span. Draw stress diagram.
20. A simply supported beam of span 5m carries a central point load of 20 kN. The self-weight of beam is 4 kN/m. The size of beam cross section is 200 mm x 350 mm. find maximum stresses induced in the section. Also find bending stress on layer 5 cm from neutral axis above it on the same section. Draw stress distribution diagram.

21. A rectangular section 450 mm deep is used as a simply supported beam of length 8.0 m. the beam carries a central point load of 120 kN. Find maximum bending stress induced in the section. Take $Ixx=1.50 \times 10^9\ mm^4$.
22. A cantilever beam of span 3 m and 300 mm x 600 mm rectangular in cross section carries an uniformly distributed load of 25 kN/m throughout the span .Find maximum bending stress and draw stress distribution curves.
23. A rectangular section 400 mm deep is used as a simply supported beam of length 5.0 m. the beam carries a central point load of 100 kN. Find maximum bending stress induced in the section. Take $I_{xx}=1.33 \times 10^9\ mm^2$.
24. A hollow circular section of 120 mm internal diameter and 150 mm external diameter is used as a beam and is subjected to B.M of 2 KN.m . find the value of maximum bending stress developed.
25. A rectangle section of size 100 mm x 200 mm is used as a simply supported beam of 5.0 m length. It is subjected to a central point load of 250 KN. Find maximum bending stress in section.

Unit-5

Deflection of beams, Principal plane and Principal stress

1. Give slope-deflection equation for cantilever beam with central point load.
2. Explain principal plane and principal stress.
3. Find the slope and deflection at the free end of the cantilever beam shown in figure. Take EI = 1 x 10^{10} N-mm^2.



4. Determine the slope and deflection of a simply supported beam carrying a uniformly distributed load by Mohr's Theorem.
5. A rectangular block of material is subjected to a tensile stress of 100 Mpa on one plane and tensile stress of 48 Mpa on a plane at right angles, together with shear stresses of 65 Mpa on the same plane. Find: 1) The magnitude of principle stress. 2) Magnitude of greatest shear stress. 3) The direction of principle plane. 4) The normal and tangential stresses on a plane at 20º with the plane carrying greater stress.
6. Explain slope and deflection with sketches.
7. Explain Flexural rigidity.
8. Explain about the Macaulay's method and where it is used?
9. Determine: (i) slope at the left support, and (ii) deflection under the load of a simply supported beam of length of 5 m, which is carrying a point load of 5 kN at center. Take E=2x10^5 N/mm^2 and I= 1x10^8 mm^4.
10. A cantilever beam of spring 2 m is carrying a point load of 20 kN at its free end. Calculate the slope at the free end. Assume EI = 12x10^3 kN-m^2.
11. Give slope-deflection equation for cantilever beam with UDL on entire span.
12. A simply supported beam 3m span carries a point load W at centre. If slope at support due to this is 1 degree, then calculate maximum deflection of beam.
13. The principal stresses on two mutually perpendicular planes are 80 N/mm^2 both being tensile.
14. Find normal stress, tangential stress and resultant stress on a plane inclined at 20° with the horizontal.
15. A cantilever of length 4 m carries a uniformly distributed load 3 kN/m over its full length and a point load of 2 KN at the free end. Find the slope and deflection at the free end if E = 2.1 x 10^5 N/mm^2 and I = 6.667 x 10^7 mm4.

16. A short metallic column of 500 mm^2 cross-sectional area carries an axial compressive load of 100kN. For a plane inclined at 60º with the direction of load calculate: i) Normal stress ii) Tangential stress iii) Resultant stress iv) Maximum shear stress.
17. Give slope-deflection equation for simply supported beam with central point load.
18. Give different cases of stresses in materials.
19. Derive the expressions for maximum slope and deflection of a cantilever beam with a point load at free end.
20. A simply supported beam 5m long carries concentrated loads of 10 kN at center and 5 kN/m UDL over its length. Calculate: maximum slope and deflection of the beam and Slope and deflection under each load Take: EI = 1.2 x 10^4 kN-m^2.
21. At a point in a stressed body the principal stresses are 100 MN/m^2 (tensile) and 60 MN/m^2 (compressive). Determine the normal stress and the shear stress on a plane inclined at 50º to the axis of major principal stress. Also calculate the maximum shear stress at the point.
22. Give slope-deflection equation for cantilever beam with UDL on entire span.
23. A simply supported beam 3m span carries a point load W at centre. If slope at support due to this is 1 degree, then calculate maximum deflection of beam.
24. The principal stresses on two mutually perpendicular planes are 80 N/mm^2 both being tensile. Find normal stress, tangential stress and resultant stress on a plane inclined at 20º with the horizontal.
25. A cantilever of length 4 m carries a uniformly distributed load 3 kN/m over a length and a point load of 2 kN at the free end. Find the slope and deflection at the free end if E = 2.1 x 10^5 N/mm^2 and I = 6.667 x 10^7 mm^4.
26. A short metallic column of 500 mm^2 cross-sectional area carries an axial compressive load of 100kN. For a plane inclined at 60º with the direction of load calculate: i) Normal stress ii) Tangential stress iii) Resultant stress iv) Maximum shear stress.

Unit-6

Columns and Struts And Combined Direct And Bending Stresses

1. Determine Euler's load if E= 2x 10^5 N/mm^2, I= 11.78 x 10^4 mm^4, and effective length= 2000 mm.
2. Derive Rankine's formula.
3. Differentiate between column and struts.
4. Explain radius of gyration with figures.
5. Determine Rankine's load if fc=320 N/mm^2, A=940 mm^2, alpha= 1/1600 le=2000 mm and K=12.
6. Write assumptions of Euler's formula.
7. Define crushing load and crippling load.
8. Determine Euler's load if E= 2x 10^5 N/mm^2, I= 11.78 x 10^4 mm^4, and effective length= 2000 mm.
9. Write Euler's load formula and Rankine's load formula and explain each term.
10. Define radius of gyration and slenderness ratio.
11. Calculate slenderness ratio and radius of gyration if le=2500 mm, I=15.2x 10 ^{6} mm^4, A= 1200 mm^2.
12. Calculate slenderness ratio and radius of gyration if le=2500 mm, I=15.2x 10 ^{6} mm^4, A= 1200 mm^2
13. Explain different end condition of column and effective length with sketch.
14. An I-section having 4m length is used as a column with both ends fixed. Calculate load carrying capacity using
    i) Rankine formula
    ii) Euler's formula

Also find Euler's strength to rankine strength ratio (PE/PR), Ixx=2 x 10^8 mm^4, A=9200 mm^2, fc=300 N/mm^2Iyy=2.5 x10^7 mm^4, E=2 x 10^5 N/mm^2, alpha= 1/7500

15. A concrete column 230 mm x 350 mm size is 5.0 m long and fixed at both ends. Calculate buckling load by Euler's formula. E=0.14 x 10^5 N/mm^2, also calculate Rankine load, alpha= 1/1600 and fc= 330 N/mm^2
16. An I- section with one end fixed and other end is hinged is used as a column 5.0 m length to take safe load of 400 kN. If factor of safety =4, A=8025 mm^2, Ixx=1.30 x 10^8 mm^4, Iyy= 2.25 x 10 ^{7} mm^4, Alpha= 1/1600, calculate crushing stress fc in column.
17. A hollow circular section having external diameter 250 mm and 25 mm thickness, is used as a column with 4.5 m length and fixed at both ends, determine crippling load by
    a) Euler's formula
    b) Rankine formula

F.O.S= 3, fc=300 N/mm^2, alpha=1/1600, E=0.14 x 10^5 N/mm^2

18. A hollow steel tube having internal diameter 400 mm and 50 mm thickness is used as a column. If slenderness ratio (S.R)=90, Calculate critical load on the column. Rankine constant are fc=320 N/mm^2 and alpha=1/4800. If one end of column is fixed and other end is free, calculate length of the column.

19. An I-section has depth 260 mm and width of flange 120 mm. the thickness of flange and web is 10 mm. it is used as a column with one end fixed and other hinged. Calculate safe load by Euler's formula. E= 2×10^{5} N/mm^2, and F.O.S =3. Length of column=8m.
20. A concrete column 250 mm x 450 mm size is 7.0 m long and fixed at both ends. Calculate buckling load by Euler's formula. E=0.14×10^5 N/mm^2, also calculate Rankine load, alpha= 1/1600 and fc= 350 N/mm^2
21. An I-section having 6 m length is used as a column with both ends fixed. Calculate load carrying capacity using
    a. Rankine formula
    b. Euler's formula

    Also find Euler's strength to rankine strength ratio (PE/PR).

    Ixx=5×10^{8} mm^4, A=8400 mm^2, fc=400 N/mm^2

    Iyy=5.5×10^7 mm4, E=2×10^5 N/mm^2, alpha= 1/7500
22. A rectangular column has depth equal to twice the width. Length of column is 30 times the width. Calculate slenderness ratio of the column.
23. An I- section with one end fixed and other end is hinged is used as a column 8.0 m length to take safe load of 500 kN. If factor of safety =2, A=9000 mm^2, Ixx=1.50×10^8 mm^4, Iyy= 3.25×10^{7} mm^4 , Alpha= 1/1600, calculate crushing stress fc in column.