Unit No:	**1**	**Fundamentals of Statically Determinate Structures**	
Date:	**20 /03/2021**		
Sub Code	**3140603**	**Title of Subject**	**Structural Analysis-I**

#	Questions
	BASICS AND FRAMED STRUCTURES
1	Indeterminate structures are better than determinate structures" Comment on the statement.
2	Differentiate between stable and unstable structure.
3	Differentiate static and kinematic indeterminacy. Also explain these terms with respect to fixed beam.
4	State and Explain Principle of Superposition.
5	Explain and prove Maxwell's reciprocal theorem
6	Find static indeterminacy and kinematic indeterminacy of structures given in Figure – 1.
7	Analyze the rigid jointed portal frame shown in the Figure – 2. Draw shear force diagram, bending moment diagram and axial force diagram
8	Analyze the grid shown in the Figure – 3 and draw shear force, bending moment and twisting moment diagrams.
9	For the portal shown in the Figure – 4, find out moment at B, shear and axial force in member AB.
10	Find out SI and KI of the structures shown in the Figure – 5.
11	Find SI and KI of structures shown at Figure – 6.
	ARCHES, CABLES
12	A symmetrical three hinged parabolic arch of span 40 m and rise 8m carries uniformly distributed load of 30 kN/m over the left half of the span. The hinges are provided at the support and center of the arch. Calculate the bending moment, radial shear and normal thrust at a distance of 10m from the left support. Refer Figure - 7
13	A three hinged parabolic arch has a span of 30.0 m and central rise of 5.0 m. It carries two vertical loads of 250 kN at 4.0 m on either side of the central hinge. Calculate the maximum and the minimum bending moments and their position. Also draw BMD.

14	Prove that bending moment at any section will be equal to zero for a parabolic three hinged arch subjected to UDL over its entire span.
15	A cable of span 200.0 m and dip 20.0 m carries a load of 6 kN/m on horizontal span. Determine the maximum tension in the cable and its inclination at the supports if both the supports are at same level. Estimate the load transferred on the supporting tower if cables are passing over the smooth rollers. The back anchor cables are inclined at 45°.
16	Determine the tension in each segment of the cable shown in Figure - 8. Also, find the dimension 'h'.
THIN CYLINDER	
17	A cylindrical vessel closed with plane ends is made of a 4 mm thick steel plate. Its external diameter is 250 mm and length is 750 mm. It is subjected to an internal fluid pressure of 3 N/mm^2, calculate the longitudinal and hoop stresses in the shell plate. Also calculate change in diameter, length and volume of the cylinder. Take E = 2.1 x 10^5 N/mm^2, Poisson's ratio = 0.3.
18	Derive the expression for longitudinal stress for a thin cylindrical vessel subjected to internal fluid pressure p.
19	A cylindrical boiler to generate internal steam pressure 2 N/mm^2, is to be fabricated using 12 mm thick plate having a limiting tensile stress of 120 N/mm^2. If the efficiencies of the longitudinal and circumferential joints are 75% and 40 % respectively, find the safe diameter of the boiler.

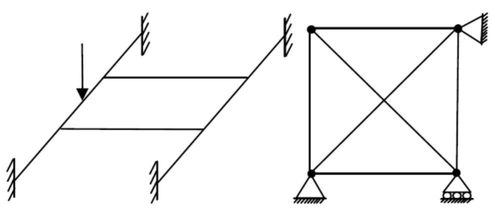


Figure - 1

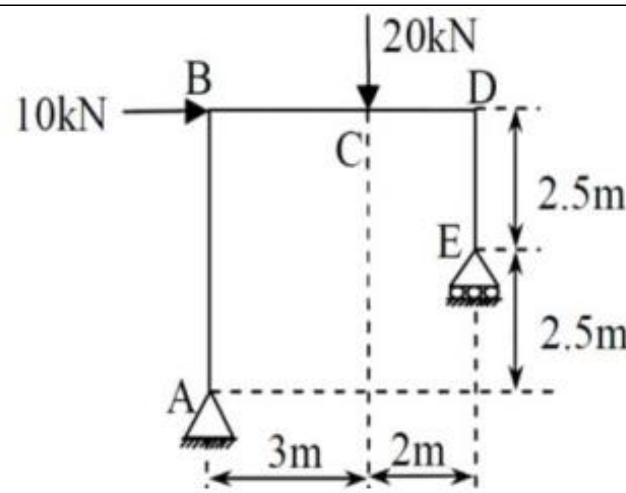


Figure - 2

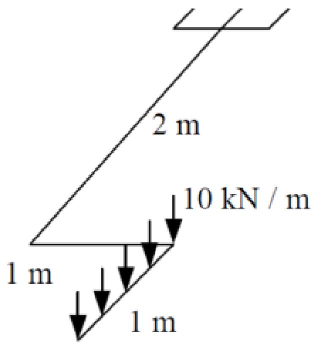


Figure – 3

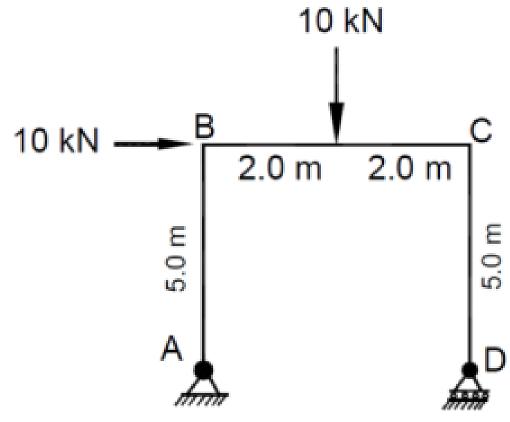


Figure - 4

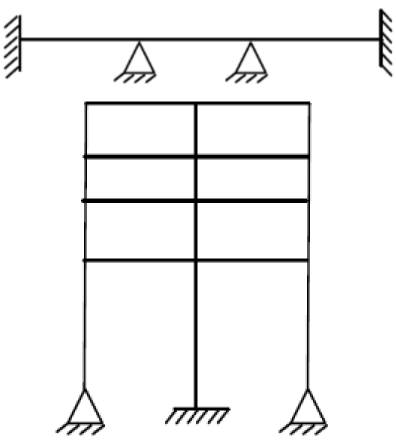
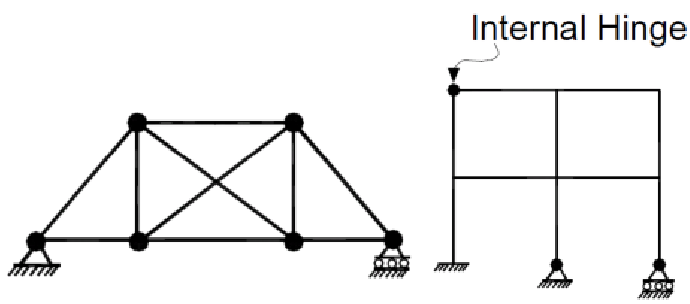


Figure - 5



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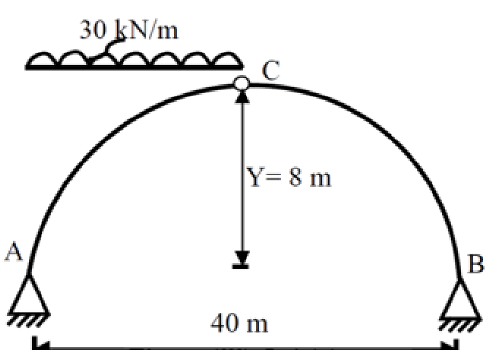

Figure - 7

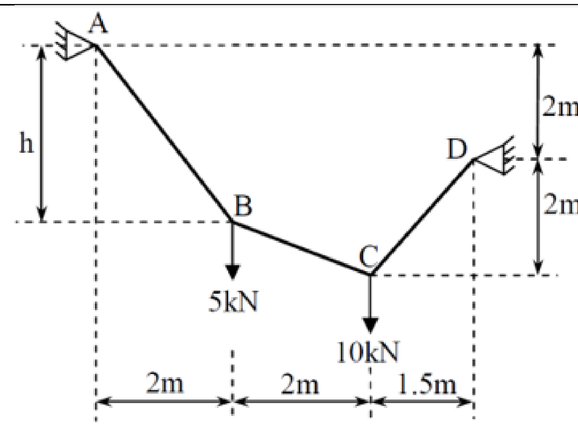

Figure - 8

UNIT No:	**02**	**STRAIN ENERGY & DISPLACEMENT OF STATICALLY DETERMINATE STRUCTURES**	
Date:	**20/03/2021**		
Sub Code	**3140603**	**Title of Subject**	**Structural Analysis - I**

#	Questions
	STRAIN ENERGY
1	Derive the equation for strain energy stored in an element due to bending. Also find the deflection at the free end of a cantilever beam subjected to a point load at the free end with constant EI by this method.
2	A steel bar of 3.0 m length and 1000 mm^2 in cross section suddenly loaded with an axial pull of 20 kN. Find maximum instantaneous stress, maximum instantaneous elongation and strain energy. Take E = 2 X 10^5 N/mm^2.
3	A simply supported beam of span 6.0 m carries uniformly distributed load of 10 kN/m over its entire span. Find the strain energy stored due to bending in the beam. Take E = 2 X 10^5 N/mm^2, I = 1.5 X 10^6 mm^4.
4	A bar of diameter 20 mm and length of 2.2 m is attached with a collar at bottom. If the maximum stress developed is to be limited up to 180 N/mm^2, calculate the maximum value of weight that can be allowed to fall on the collar from 0.2m height. Assume E = 2 X 10^5 N/mm^2.
	DISPLACEMENT
5	Differentiate between the real beam and conjugate beam
6	Derive an expression of slope at supports for the simply supported beam subjected to point load at the center of the beam.
7	For the simply supported beam subjected to UDL, derive the expressions for slope at support and deflection at the mid span using moment area method.
8	Find the slope and deflection at the free end B of a cantilever beam AB as shown in Figure – 1 by moment area method. Take I = 2 X 10^8 mm^4, E = 2 X 10^5 N/mm^2.
9	Find the slope and deflection at the center C of a simply supported beam AB as shown in Figure – 2 by moment area method. Take I = 2 X 10^8 mm^4, E = 2 X 10^5 N/mm^2.
10	Find the deflection and slope for a cantilever beam shown in Figure – 3, using moment area method.
11	A simply supported beam of 3 m span carries two point loads of 120 kN and 80 kN at a distance of 0.6 m and 2 m from the left support. If for the beam I = 16 X 10^8 mm^4 and E = 2.1 X 10^5 N/mm^2, Calculate the deflection under loads using Macaulay's method. Refer Figure – 4.

12	A cantilever 2 m long is loaded as shown in Figure – 5. Find slope and deflection at free end using Macaulay's method. Take E = 200 GPa and I = 160 X 10^6 mm^4.
13	For the beam shown in figure – 6, determine the deflection and slope at C using Macaulay's method.
14	Find the slope at A and deflection under B for the beam shown in the Figure – 7 using Macauly's method. Take EI = 3000 kN m^2
15	Determine the horizontal deflection and vertical deflection at D, of a truss shown in Figure – 8. Using unit load method. AE is same for all members.
16	For the truss shown in figure – 9, calculate horizontal deflection at C by unit load method. Area of member AB is 400 mm^2. Area of AC and BC is 600 mm^2.
17	Find out slope and deflection at C for the beam shown in Figure – 10 by conjugate beam method.
18	Find the slope and deflection at point A and B for the beam shown in the Figure – 7 using conjugate beam method. EI = 3000 kN m^2
19	Find the deflection and slope under load 100 kN using conjugate beam method. Refer Figure – 11. Take E = 200 GPa and I = 150 X 10^6 mm^4.
20	Find the slope and deflection at point B and C for the beam shown in the Figure – 12. Take EI = 3000 kN m^2
21	Find the slope at A and deflection under C for the beam shown in the Figure – 13. Take EI = 3000 kN m^2

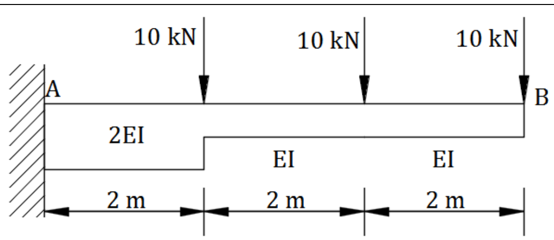

FIGURE – 1

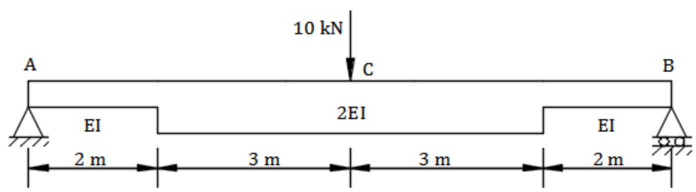

FIGURE – 2

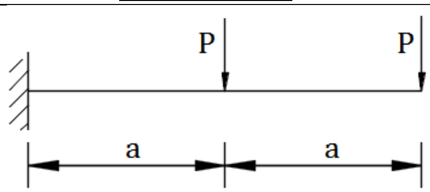

FIGURE – 3

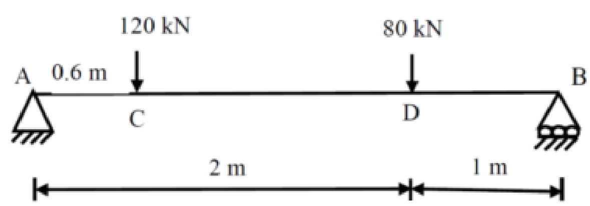

FIGURE – 4

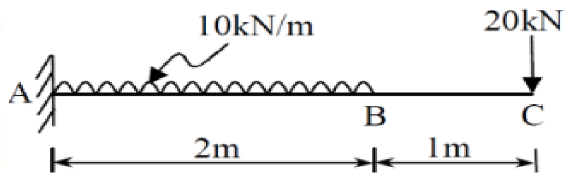

FIGURE – 5

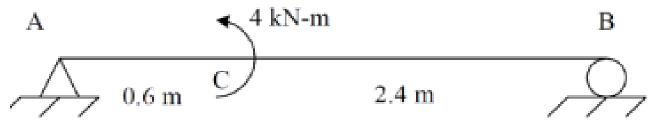

FIGURE – 6

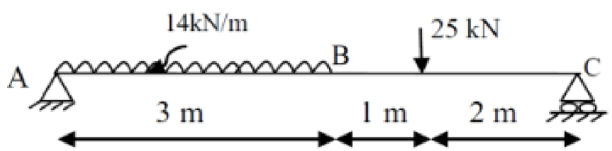

FIGURE – 7

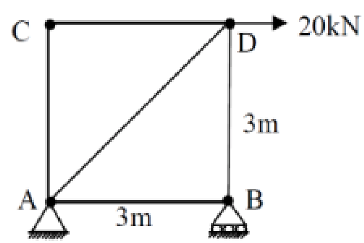

FIGURE – 8

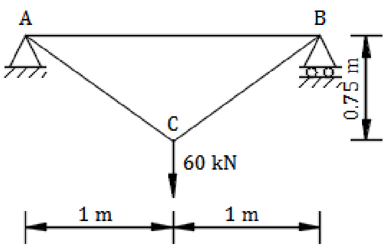

FIGURE – 9

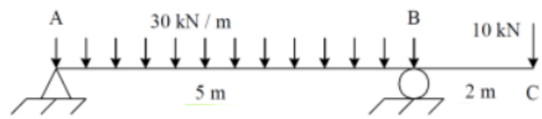

FIGURE – 10

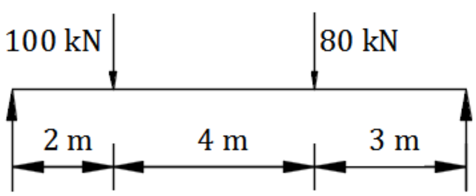

FIGURE – 11

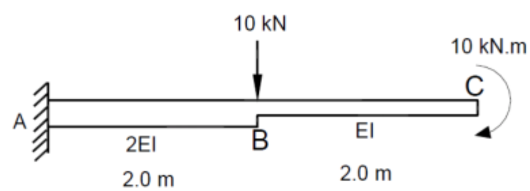

FIGURE – 12

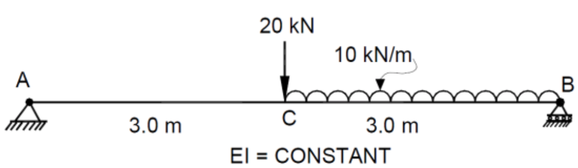

FIGURE – 13

Unit No:	**03**	**DIRECT AND BENDING STRESSES + COULMN & STRUTS**	
Date:	**20 /03/2021**		
Sub Code	**3140603**	**Title of Subject**	**Structural Analysis - I**

#	Questions
	DIRECT AND BENDING STRESSES
1	A rectangular pier of size 300 mm X 300 mm is subjected to a compressive load of 900 kN at one of the corner. Find the stress intensities at all four corners of the pier and draw stress distribution diagram. If the load is acting at the center of the pier, also draw the stress distribution diagram. Refer **Figure – 1.**
2	A concrete dam of trapezoidal section has a top width 2 m, bottom width of 6 m and height 12 m. It retains water up to 10 m on vertical side. Determine the maximum and minimum stress intensities at the base of the section. The density of the material used is 24 kN/m^3 and density of water as 10 kN/m^3. Refer **Figure – 2.**
3	A masonry chimney 20 m high is of circular section, the external diameter and internal diameter of the section being 6 m and 4 m respectively. The chimney is subjected to horizontal wind pressure of 1.2 kN/m^2 of projected area. Find the maximum and minimum stresses at the base. Take unit weight of masonry as 20 kN/m^3.
4	A short column has a square section 300 mm X 300 mm with a square hole of 150 mm X 150 mm as shown in **Figure – 3**. It carries an eccentric load of 1500 kN, located as shown in figure. Determine the maximum and minimum stresses across the section.
5	A masonry retaining wall is 6 m high, 0.75 m wide at top and 2 m wide at bottom. The wall is retaining soil up to top. The face of the wall on soil side is vertical. The lateral pressure due to soil varies from zero at top to 3.2 kN/m^2 at bottom. Specific weight of masonry is 24 kN/m^3. Draw stress distribution at base of wall due to self-weight of wall alone and due to self-weight of wall and soil pressure, and shear force at section under load. Draw BMD.
6	For a trapezoidal masonry dam as shown in the **Figure – 4**, plot the stress distribution at the base. Take density of masonry = 20 kN/m^3.
	COULMN & STRUTS
7	Write the equations for Euler's crippling load for different end conditions of a long column.
8	Write down any four assumptions made for derivation of Euler's crippling load formula.
9	Derive an expression for crippling load when one end of column is fixed and the other end is free.

10	A column one meter long has cross sectional area of 9 cm^2. Find the slenderness ratio if the section is (a) circular, (b) square and (c) hollow circular with inner radius half the outer radius.
11	A hollow cast iron column has outside diameter 200 mm and thickness of 20 mm. It is 4.5 m long and fixed at both ends. Calculate the safe load and ratio of Euler's and Rankine's critical load. For cast iron F_c = 550 N/mm, α = 1/1600 and E = 0.8 X 10^5 N/mm^2.
12	A hollow cylindrical cast iron column is 4 m long with both ends fixed. Find the minimum diameter of the column if it has to carry a safe load of 250 kN with a factor of safety of 5. Take internal diameter as 0.8 times the external diameter. Take σc = 500 MPa and Rankine's constant α = 1/1600.
7	A 2.5 m long pin ended column of square cross section is made up of timber. Using Euler's formula, find out size of the column with a factor of safety 2 for 250 kN axial load. Consider E = 12.5 GPa, Allowable stress in axial compression = 12 MPa.

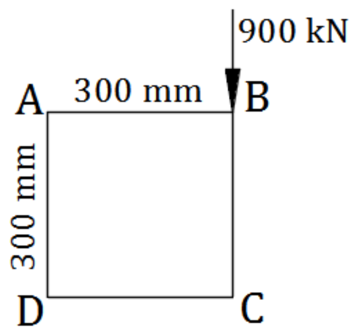

Figure – 1

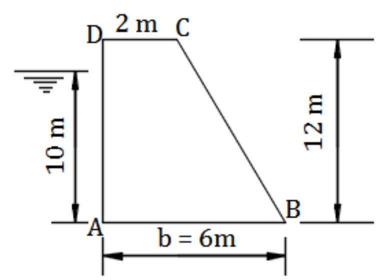

Figure – 2

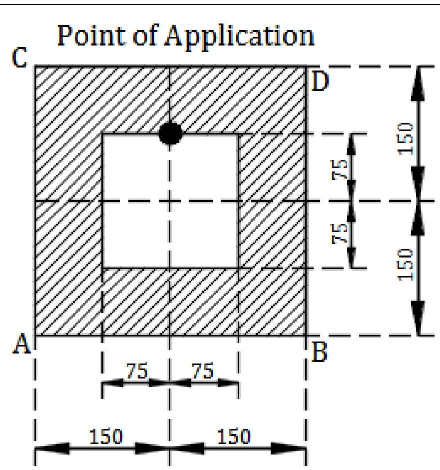

Figure - 3

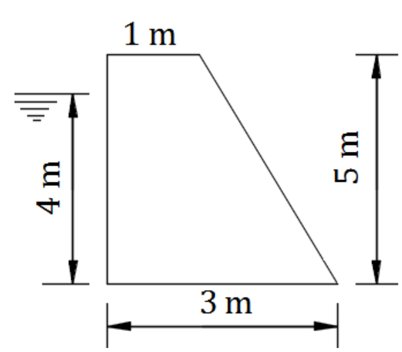

Figure – 4

Unit No:	**4**	**Statically Indeterminate Beams**	
Date:	**20 /03/2021**		
Sub Code	**3140603**	**Title of Subject**	**Structural Analysis-I**

#	Questions
1	Find the fixed end moments if one of the supports of fixed beam settles by δ.
2	A Fixed Beam of 7.0 m span carries a uniformly distributed load of 10 kN/m from left end for 3.0 m. Analyze the beam and draw Bending Moment Diagram (BMD) showing important values.
3	Calculate the support moments and reactions of fixed beam shown in Figure – 1.
4	Determine fixed end moments for the fixed beam loaded as shown in Figure – 2. Take EI = constant.
5	Draw the bending moment diagram for the beam shown in Figure – 3. Use consistent deformation method.
6	Analyze the beam shown in Figure – 4 by consistent deformation method. Draw shear force and bending moment diagram. Assume constant EI.
7	Using the method of consistent deformation compute all reactions and draw shear force and bending moment diagram for the beam as shown in Figure – 5.

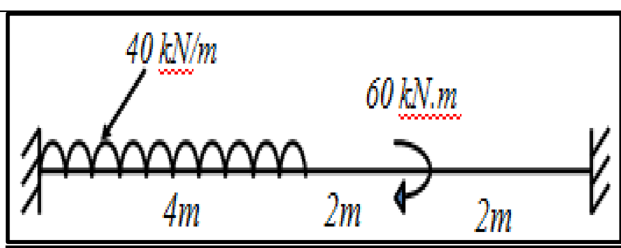

Figure - 1

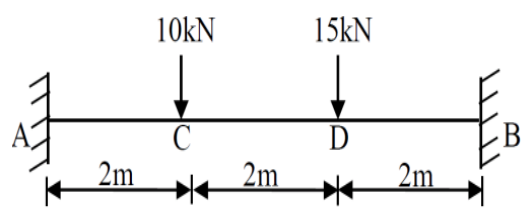

Figure - 2

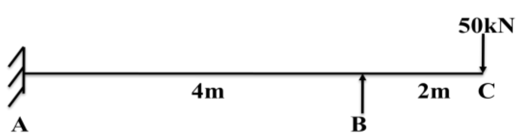

Figure – 3

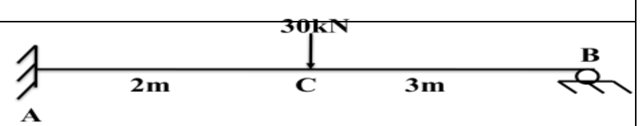

Figure - 4