Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV (NEW) - EXAMINATION – SUMMER 2017

Subject Code: 2144002 **Date: 06/06/2017**

Subject Name: Fundamentals of Structural Analysis

Time: 10:30 AM to 01:00 PM **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

MARKS

Q.1 **Short Questions** **14**

1 Under what condition will the bending moment in an arch be zero throughout?

2 The number of simultaneous equations to be solved in the slope deflection method is equal to _____

3 Write any one difference between stable and unstable structure.

4 Enlist advantages of Fixed beam.

5 What is the difference between the basic action of an arch and a suspension cable?

6 Define Static indeterminacy?

7 What is the degree of static indeterminacy of proper cantilever beam having internal hinge at middle of the span?

8 Define degree of freedom.

9 What do you mean by stiffness?

10 Define flexural rigidity.

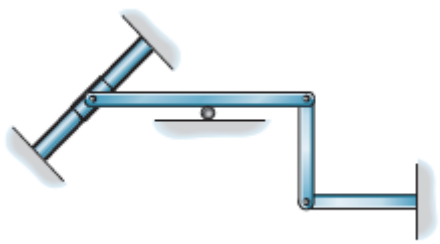
11 What is the basic difference between truss and frame?

12 Why moment area method is more useful, when compared with double integration method?

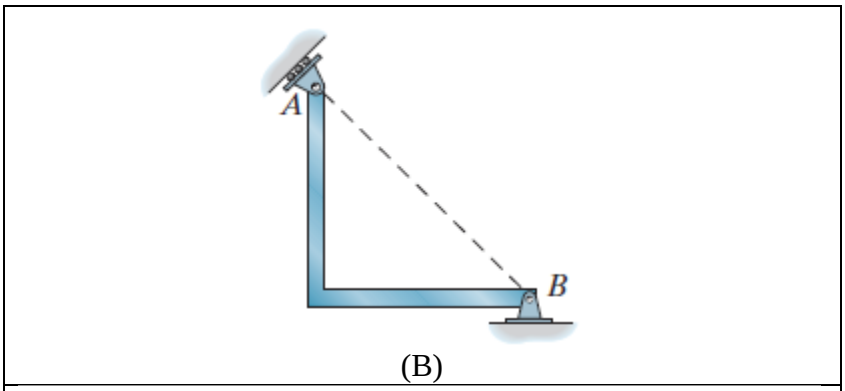
13 List out the different method used for finding the slope and deflection of a beam.

14 Define Principle of superposition.

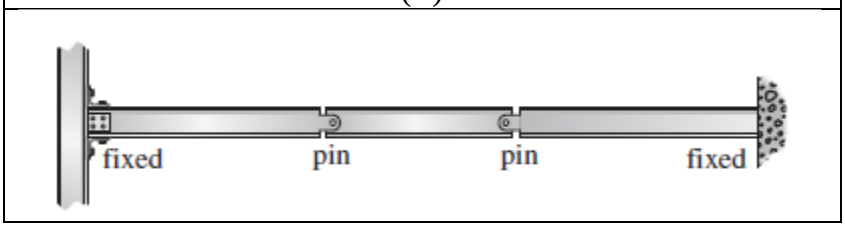
Q.2 **(a)** Classify the status of beam on the basis of SI for the following beams. **03**



(A)

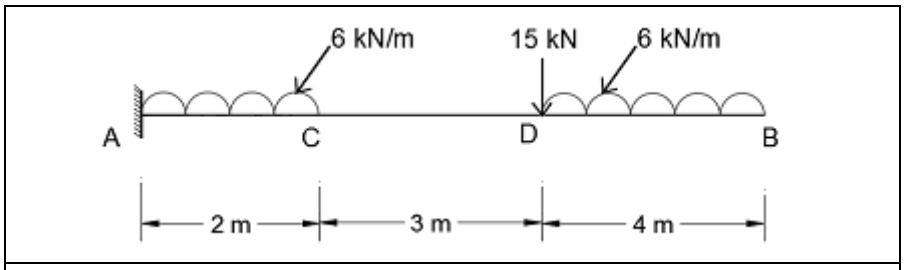


(B)

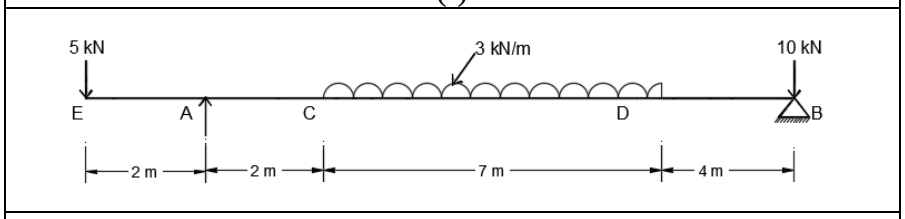


(C)

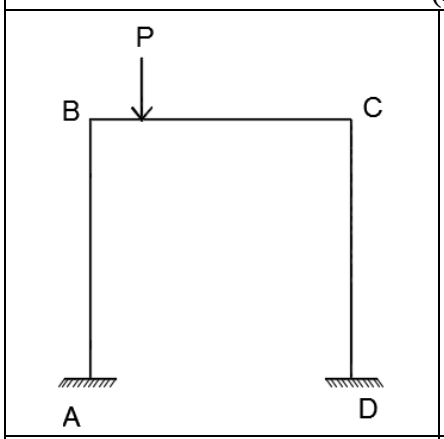
(b) Draw deflection shape of structures shown below. **04**



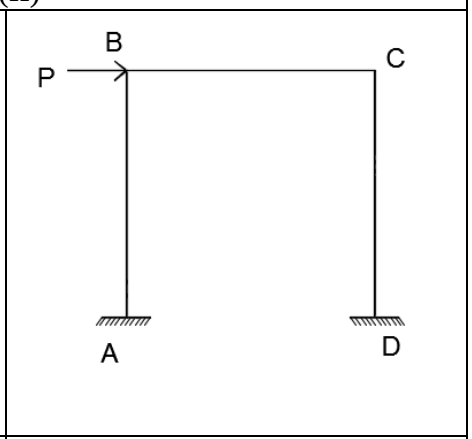
(I)



(II)

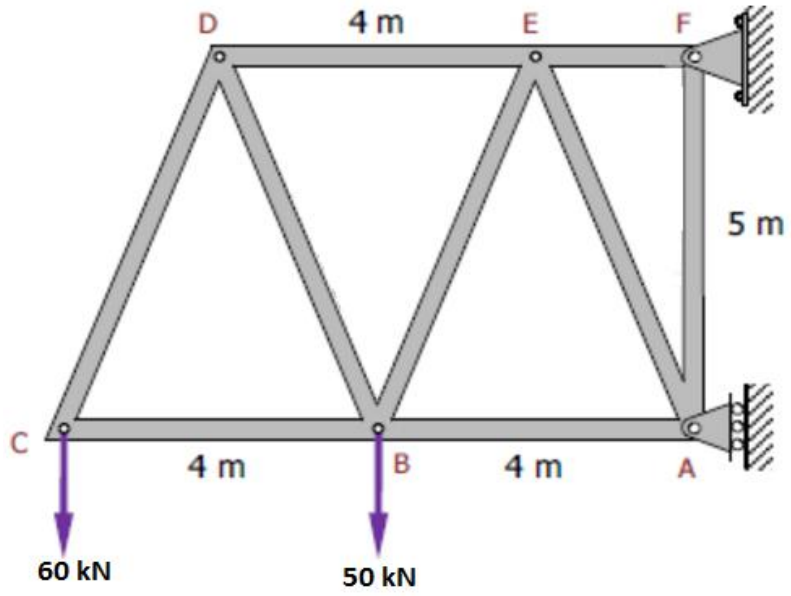


(III)



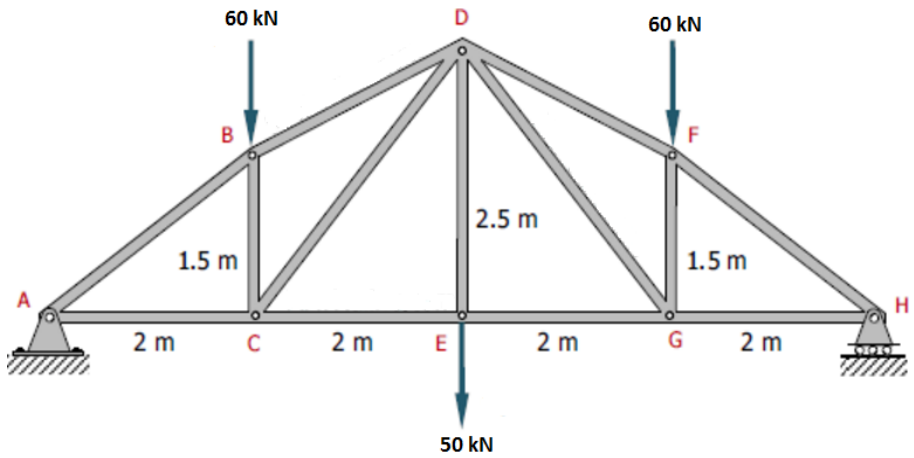
(IV)

(c) Determine the force in each member of the loaded truss by Method of Joints. **07**



OR

(c) Determine the force in each member of the loaded truss by Method of Sections. **07**

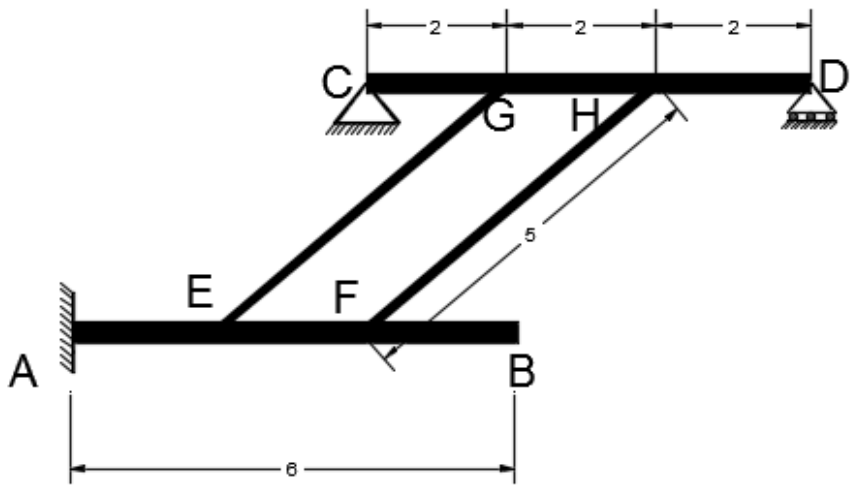


Q.3 **(a)** Relate human body with buildings and evaluate similarities. **03**

(b) A 400mm× 140mm I section is simply supported over a span of 7 meters and carries a point load of 150 kN at 1.50meters from one support. Find the position and amount of maximum deflection by moment area method. **04**

Ix for the section = 20458 cm^4; E = 2×105 N/mm^2.

(c) Beam EG is loaded with a UDL 5 kN/m and beam FH is loaded with a UDL 7 kN/m. Beam EG & FH are simply resting on beams AB & CD. Find the deflection of point B. **07**

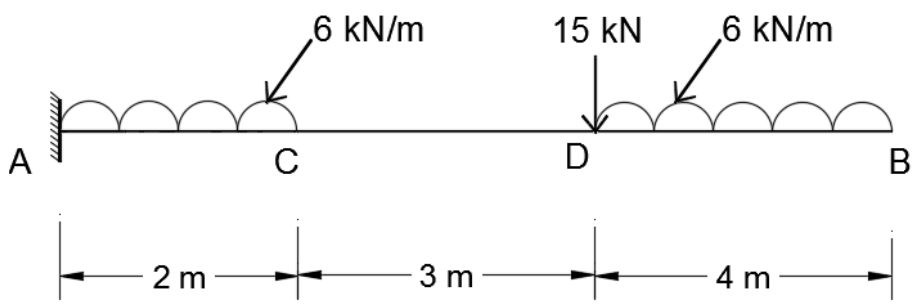


OR

Q.3 **(a)** Define shear failure & bending failure? How to avoid shear failure & bending failure of beam? **03**

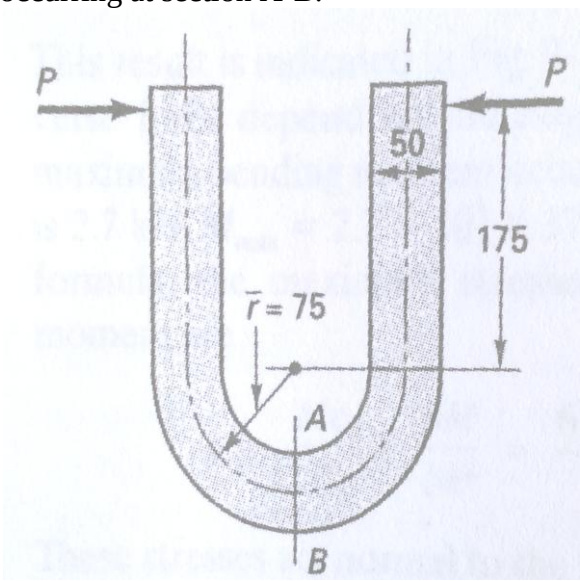
(b) Derive the equation of slope and deflection at the midpoint and at the end of hinged supported beam fully loaded UDL of intensity w kN/m. **04**

(c) Find the deflection and slope at the point B & D for the figure shown below. **07**

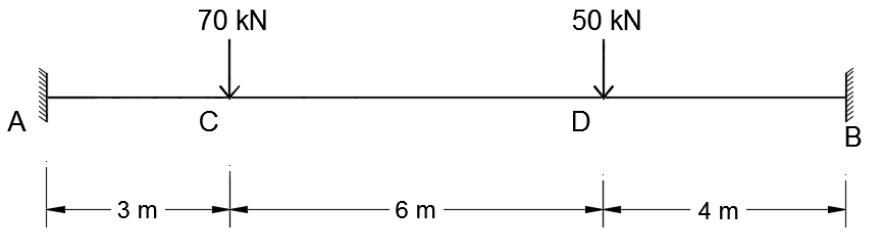


Q.4 **(a)** What is P- δ effect in terms of bending? Under which circumstances this effect will give considerable impact? **03**

(b) A 50-by-50mm elastic bar bent into a U shape, as shown in figure, is acted upon by two opposing forces P of 8.33KN each. Determine the maximum normal stress occurring at section A-B. **04**



(c) A fixed beam is loaded shown in fig. support B sinks down by 25 mm and support A rotates clockwise by 3°. Draw S.F and B.M diagrams. $I=4\times10^6$ mm^4. $E=2\times10^5$ N/mm^2. **07**

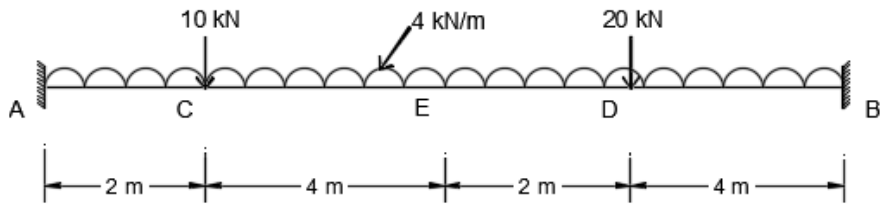


OR

Q.4 **(a)** What is determinate and indeterminate beam? Which are two approaches available for the solution of indeterminate beam. Which method is having more suitability with structural analysis software? Justify your answer. **03**

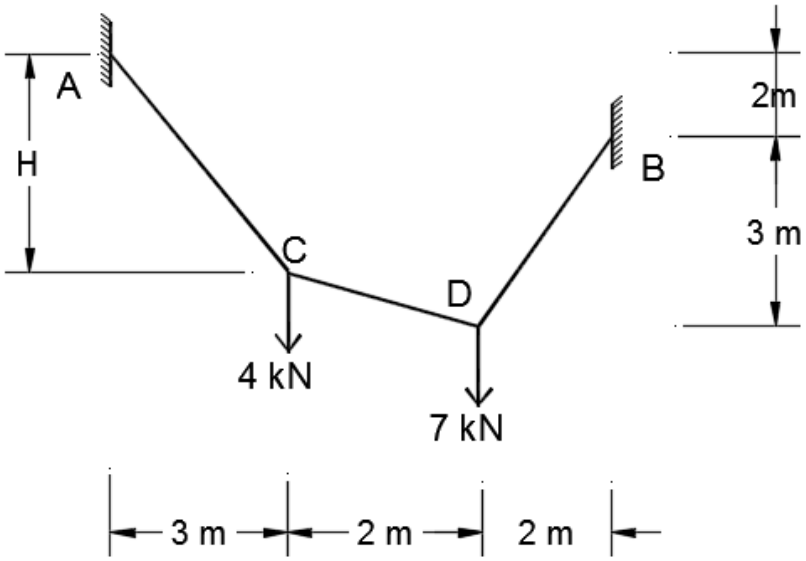
(b) A masonry dam 8 m high, 1.5 m wide at the top and 5 m wide at the at the base retains water to a depth of 7.5 m, the water face of the dam being vertical. Find the maximum and minimum stress intensities at the base. The weight of water 9810 N/m^3. While the weight of masonry is 22000 N/m^3. **04**

(c) A beam fixed at each end is located as shown in fig. Neglecting the weight of the beam, find the values of the fixing end moments and the reactions at the ends and the position and magnitude of the maximum deflection, given E = 200 kN/mm^2 and $I = 6\times10^7$ mm^4. **07**

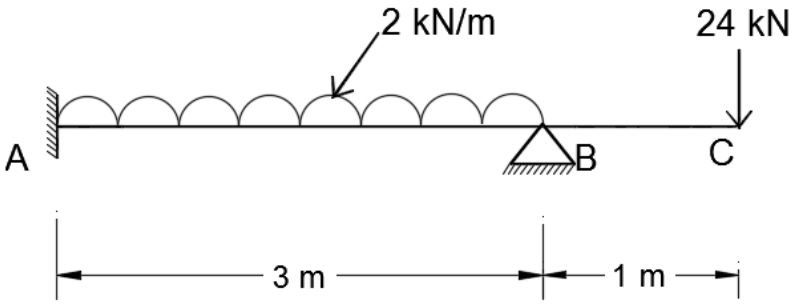


Q.5 **(a)** A cantilever beam was designed for gravity loads and of balanced quality. Looking to its dynamic performance deficiency, one additional support was provided after complete construction. Give your comments on this beam performance for any future earthquake. **03**

(b) Determine the tension in each segment of the cable shown in Figure. Also what is the value of height H? **04**



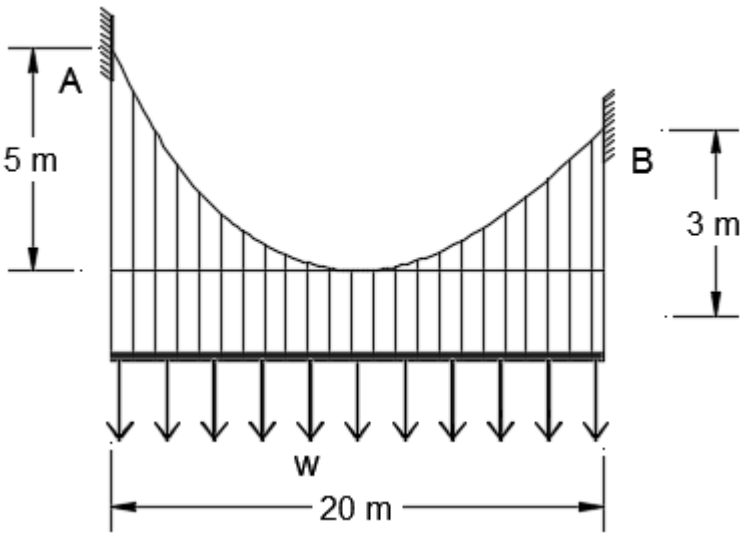
(c) Determine the moments at A and B, then draw the moment diagram for the beam shown in figure by slope & deflection method. Take EI constant. **07**



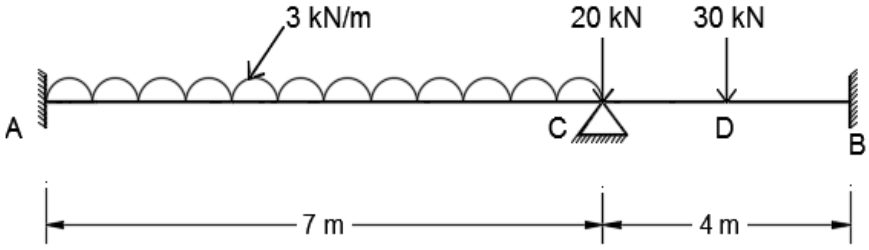
OR

Q.5 **(a)** How a thin cylinder differentiate with thick cylinder in terms of behavior under different types of loadings. List our different applications of thin cylinder in practical field. **03**

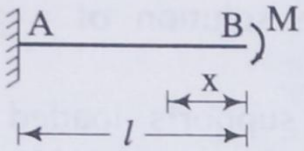
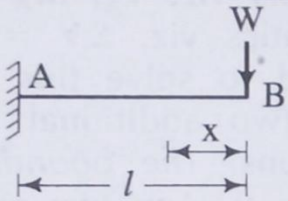
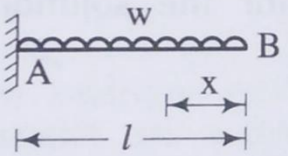
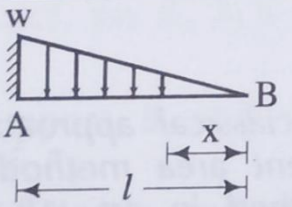
(b) Determine the maximum uniform load w the cable can support if the maximum tension the cable can sustain is 300 kN. **04**

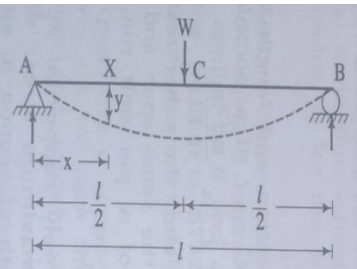
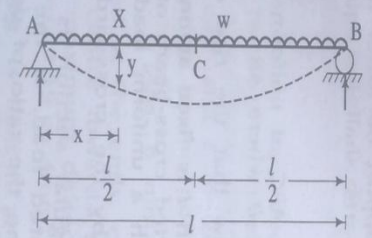
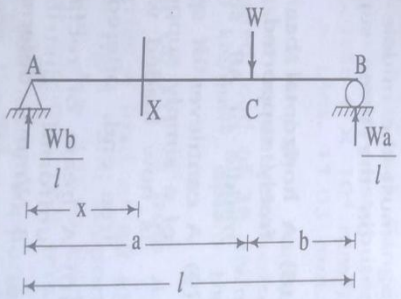


(c) Determine the moments at A, B and C, then draw moment diagram for the beam shown in figure by slope & deflection method.. Take E constant. I of span AC is double than span CB. **07**



Reference Equations

No.	Loading case	Moment equation	n	M	$EI\,\theta_B$	$EI\,\delta_B$
1		$M_x = M = Mx^0$	0	M	$\frac{Ml}{1}$	$\frac{Ml^2}{2}$
2		$M_x = Wx$	1	Wl	$\frac{Ml}{2}$	$\frac{Ml^2}{3}$
3		$M_x = \frac{wx^2}{2}$	2	$\frac{wl^2}{2}$	$\frac{Ml}{3}$	$\frac{Ml^2}{4}$
4		$M_x = \frac{wx^3}{6l}$	3	$\frac{wl^2}{6}$	$\frac{Ml}{4}$	$\frac{Ml^2}{5}$

6		$\theta_A = -\theta_B = \frac{Wl^2}{16\,EI}$	$EIy = \frac{Wx}{48}(3l^2 - 4lx^2)$	$\delta_B = \frac{Wl^3}{48\,EI}$
7		$\theta_A = -\theta_B = \frac{wl^3}{24\,EI} = \frac{Wl^2}{24\,EI}$	$EIy = \frac{wx}{24}(l^3 - 2lx^2 + x^3)$	$\delta_B = \frac{5}{384} \times \frac{wl^4}{EI} = \frac{5\,Wl^3}{384\,EI}$
8		$\theta_A = \frac{Wb(l^2 - b^2)}{6\,EIl}$ $\theta_A = \frac{-Wa(l^2 - a^2)}{6\,EIl}$	$EIy = \frac{Wbx}{6l}(l^2 - b^2 - x^2)$ for $0 < x < a$ $EIy = \frac{Wb}{6l} \times \left[\frac{l}{b}(x-a)^3 + (l^2 - b^2)x - x^3\right]$ for $a < x < l$	$\delta_{max} = \frac{Wb\,(l^2 - b^2)^{3/2}}{9\sqrt{3}\,EIl}$ at $x = \sqrt{\frac{l^2 - b^2}{3}}$ $\delta_C = \frac{Wa^2b^2}{3\,EIl}$

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