KSCP Examination
2020/2021 Academic Session

September 2021

EAS253 – Theory of Structures

Duration : 2 hours

Please ensure that this examination paper contains **SIX (6)** printed pages before including appendix before you begin the examination.

Instructions: This paper contains **THREE (3)** questions. Answer **ALL** questions.

All questions **MUST BE** answered on a new page.

...2/-

1. (a). **Figure 1** shows a member CD is added to join Part A and Part B of a structure. Joints C and D after joining are of rigid and hinged type, respectively. Supports A, E are of pinned type while supports B, F are of roller type.

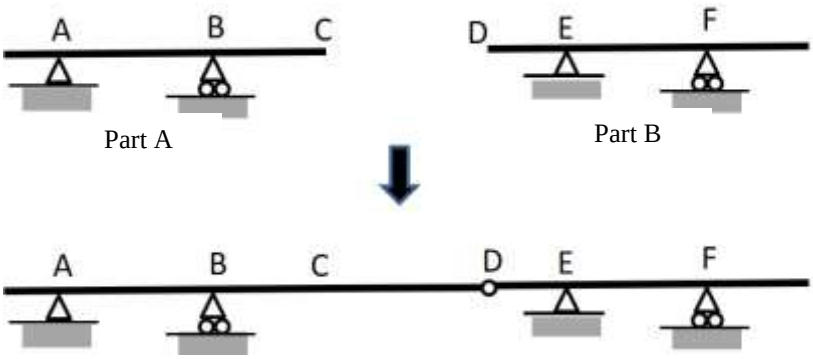
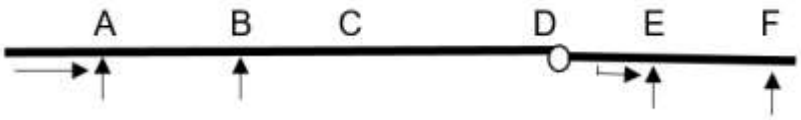


Figure 1

The following calculation for checking of statical determinacy of the structure after joining has been presented:



no. of unknown force, α=6
no. of equilibrium equation, β=3x1 =3
.: $\alpha > \beta$, =>statically indeterminate, *i* =3

Verify if the checking is correct. If it is not correct, show the correct calculation for checking.

[5 marks]

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(b). **Figure 2** shows a frame with pinned supports at A and D with internal hinge at C. Horizontal member BC is subjected to uniformly distributed load of 15 kN/m while inclined member CD is subjected to a vertical uniformly distributed load 10 kN/m. A horizontal load 50 kN acts at joint B.

(i). Draw shear force and bending moment diagrams of the frame.

(ii). Determine axial force in member AB.

(iii). Sketch qualitative deflected shape of the frame.

[30 marks]

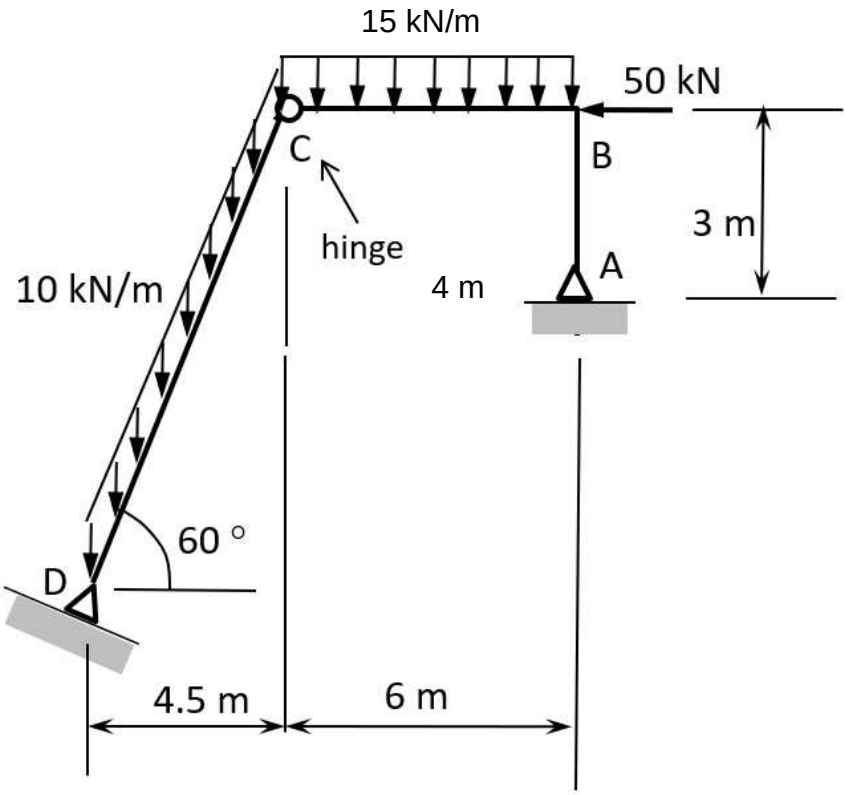


Figure 2

2. (a). **Figure 3** shows a plane truss for a pedestrian bridge deck. Check the statical determinacy of the truss. Support J is pinned and support A is roller. All member connections are pinned. Find the reactions at both supports and identify zero force members, if any. Determine forces in members EF, DG and DF by using section method and forces in members AC, AB and BC by using joint method. State whether they are in tension or compression.

[25 marks]

(b). If the arrangement of the members DF and FG in the truss shown in **Figure 3** is rearranged to become members EF and FH as shown in **Figure 4**, determine the changes of the forces in horizontal members EH and DF.

[10 marks]

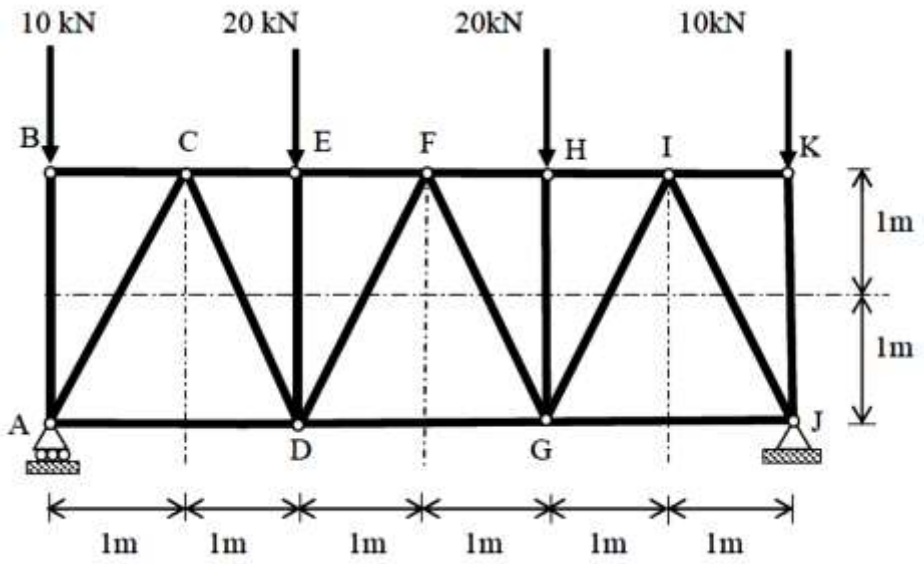


Figure 3

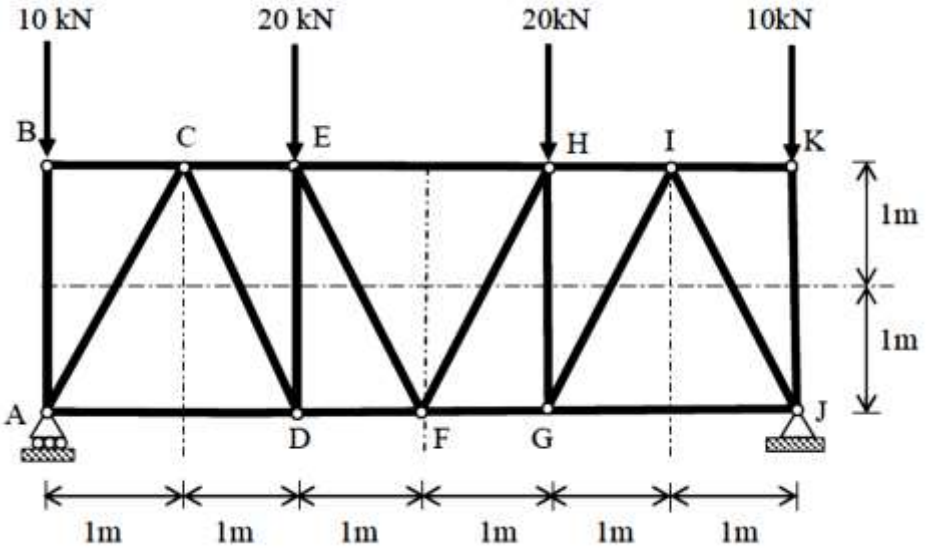


Figure 4

3. (a). A beam as shown in **Figure 5** is subjected to two point loads of 50 kN and 30 kN at points B and C, respectively, and a concentrated moment of 7.5 kNm at point A. Using E = 210 GPa and I = 175 x 10^6 mm^4, calculate the slope and deflection at mid span of the beam. Use either moment-area method or conjugate-beam method.

[21 marks]

(b). Based on the answer in part [a], calculate the slope and deflection at mid span of the beam if the moment of inertias for segments AB and CD are increased to 2I.

[9 marks]

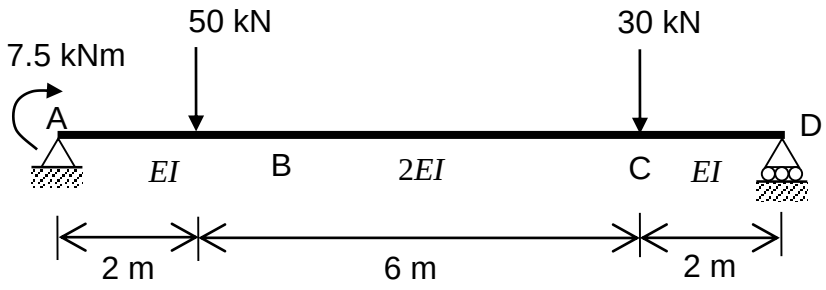
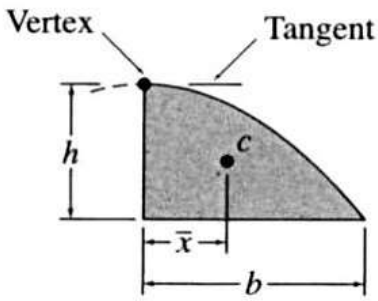
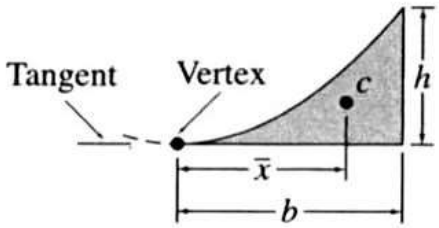
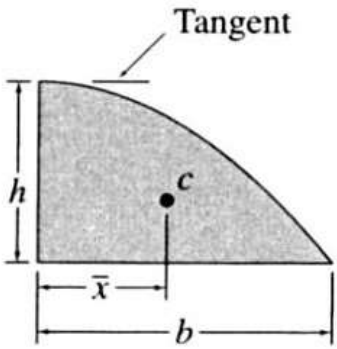
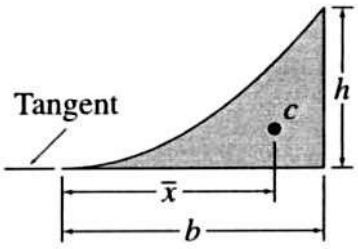


Figure 5

APPENDIX

Areas and Centroids of Geometric Shapes

Shape	Area	Centroid
Semi-parabola 	$A=\frac{2bh}{3}$	$\bar{x}=\frac{3b}{8}$
Parabolic spandrel 	$A=\frac{bh}{3}$	$\bar{x}=\frac{3b}{4}$
Cubic 	$A=\frac{3bh}{4}$	$\bar{x}=\frac{2b}{5}$
Cubic spandrel 	$A=\frac{bh}{4}$	$\bar{x}=\frac{4b}{5}$

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