Second Semester Examination
2021/2022 Academic Session

July/August 2022

EAS254 – Structural Analysis

Duration : 3 hours

Please ensure that this examination paper contains **SEVEN (7)** printed pages including appendix before you begin the examination.

Instructions: This paper contains **FIVE (5)** questions. Answer **ALL** questions.

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

1. **Figure 1** shows a frame subjected to a concentrated moment of *M* at point B, a uniformly distributed load of *w* acting vertically along span BC and a point load of *P* at mid-span of span AB. Use the virtual work method to determine the slope at A and displacement at C along the inclined plane BC (x-axis). Take *E* = 200 GPa and *I* = 100 × 10^6 mm^4. Ignore the axial work. The values of all applied loads are given in **Table 1**.

[20 marks]

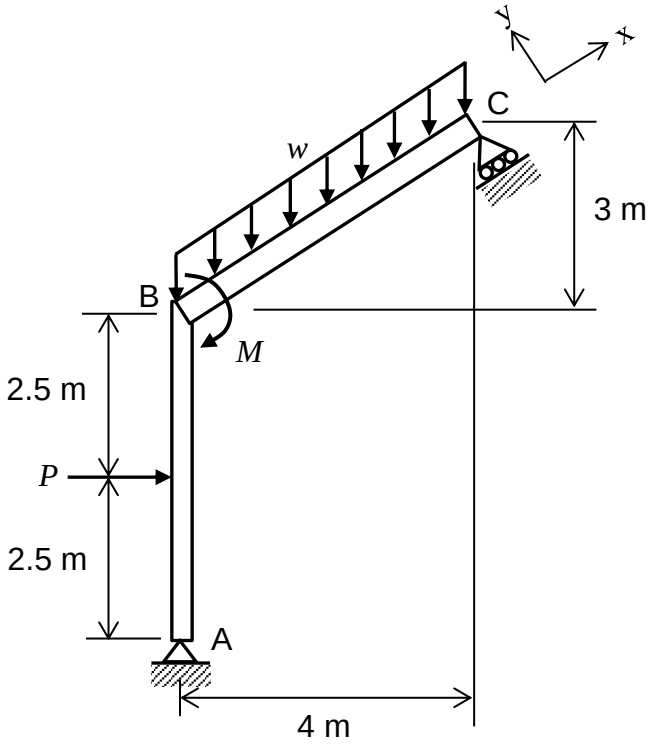


Figure 1

Table 1

Last digit of **index number**	*P* (kN)	*w* (kN/m)	Second last digit of **index number**	*M* (kNm)
0	25	7.5	0	20
1	30	8	1	22.5
2	35	8.5	2	25
3	40	9	3	27.5
4	45	9.5	4	30
5	42.5	10	5	32.5
6	37.5	10.5	6	35
7	32.5	11	7	37.5
8	27.5	11.5	8	40
9	22.5	12	9	40.5

*Note: If your **index number** is 50038, use P = 27.5 kN, w = 11.5 kN/m and M = 27.5 kNm.*

2. **Figure 2** shows a beam carrying a point load of 100 kN at spans AB, BC and DE acting at 30° and 150° with certain distance. Meanwhile, span BC carrying a uniform distributed load of 10 kN/m and span CD carrying a distributed load varying from 10 kN/m at C to 0 kN/m at D. Supports A and E are fixed, whereas supports B, C and D are pinned. *EI* is constant for the beam.

(a) Compute the internal moments at the joint of the beam by using Moment Distribution Method. Fixed end moment is given in the **Appendix**.

[15 marks]

(b) Draw the bending moment diagram and the qualitative deflected shape for the beam.

[5 marks]

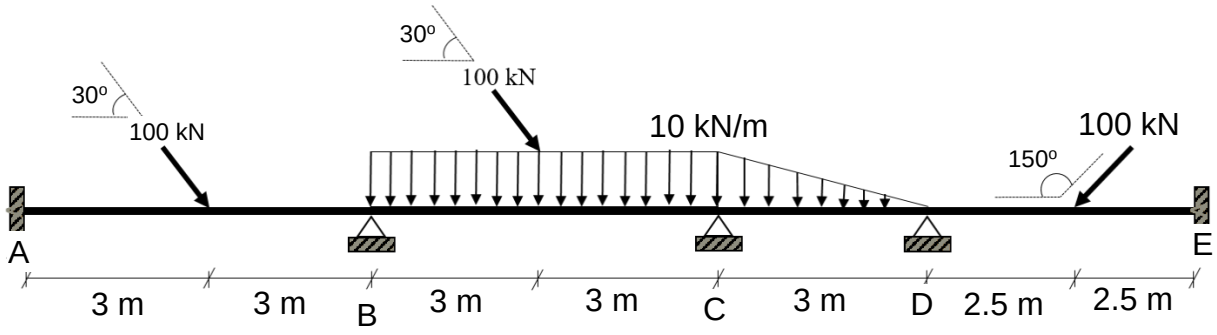


Figure 2

3. **Figure 3** shows a frame carrying a point load of 40 kN and 100 kN at the mid-span of AB and BC and an additional 20 kN/m of uniform distributed load at span AB. Meanwhile, span DE carrying a distributed load varying from 20 kN/m at midspan DE to 0 kN/m at D and E. A point load of 10 kN is loaded at overhang portion for span DG. Supports A, C and F are fixed and support E is pinned. *EI* is constant for the frame.

   Compute the internal moments at the joint of the frame by using Slope Deflection Method. Fixed end moment is given in the **Appendix**.

   [20 marks]

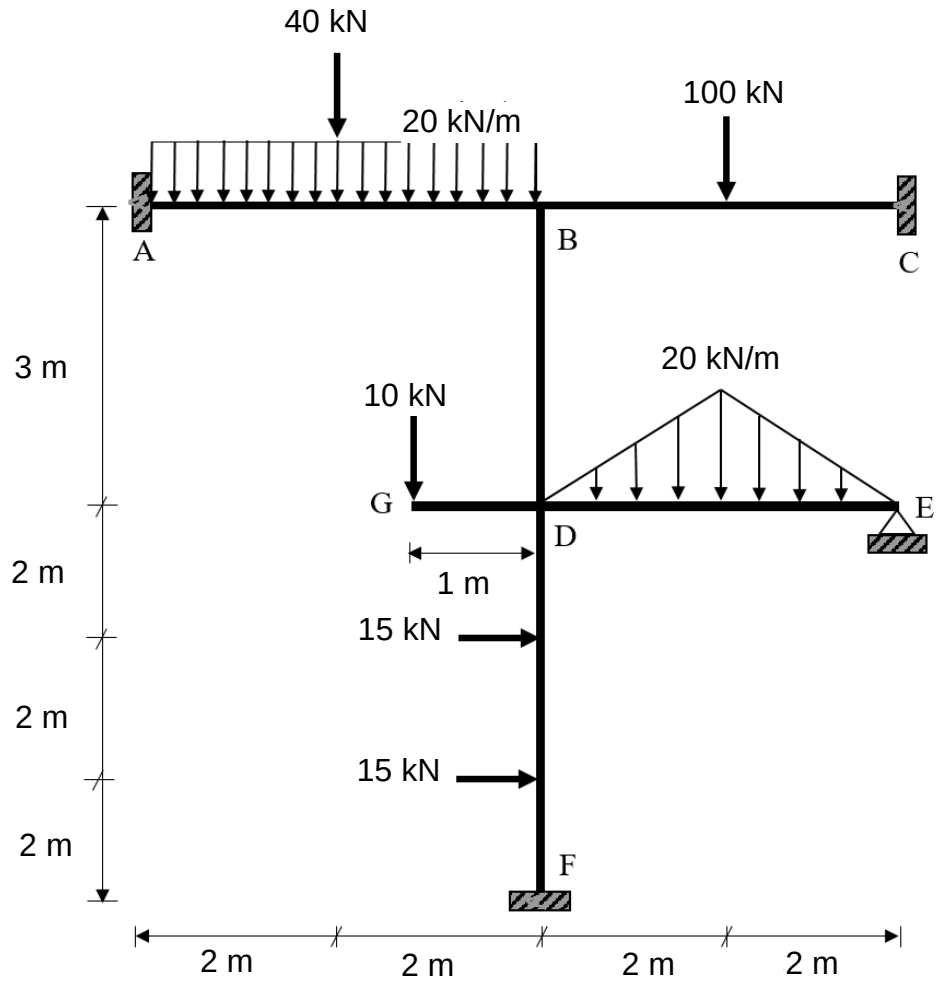


Figure 3

4. **Figure 4** shows a single overhanging concrete beam that supports a trapezoidal load with a minimum and maximum of 15 kN/m and 30 kN/m, respectively, along with span AB. In addition, the beam supports a uniformly distributed load of 15 kN/m along with span BC and a concentrated load of 20 kN at C. The beam is fixed at A and supported by a roller at B. EI of the beam is constant. Answer the following questions using the method of least work.

(a) Using a vertical reaction force at B as a redundant force, determine the reactions at supports A and B.

[17 marks]

(b) If a roller is placed at point C, state the analysis procedure to determine the reaction force at supports A, B, and C.

[3 marks]

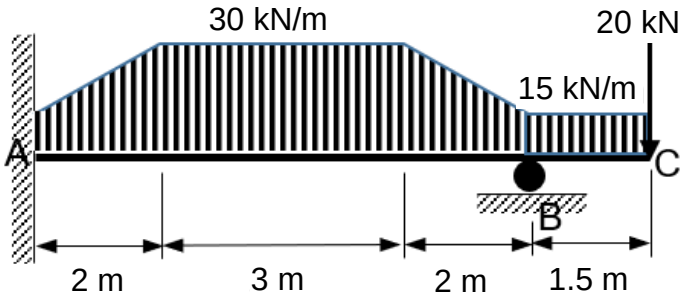


Figure 4

5. **Figure 5** shows a rigid-jointed frame is loaded with the working loads. Determine the value of M_p if the collapse load factor is 1.5. Consider all possible mechanisms.

[20 marks]

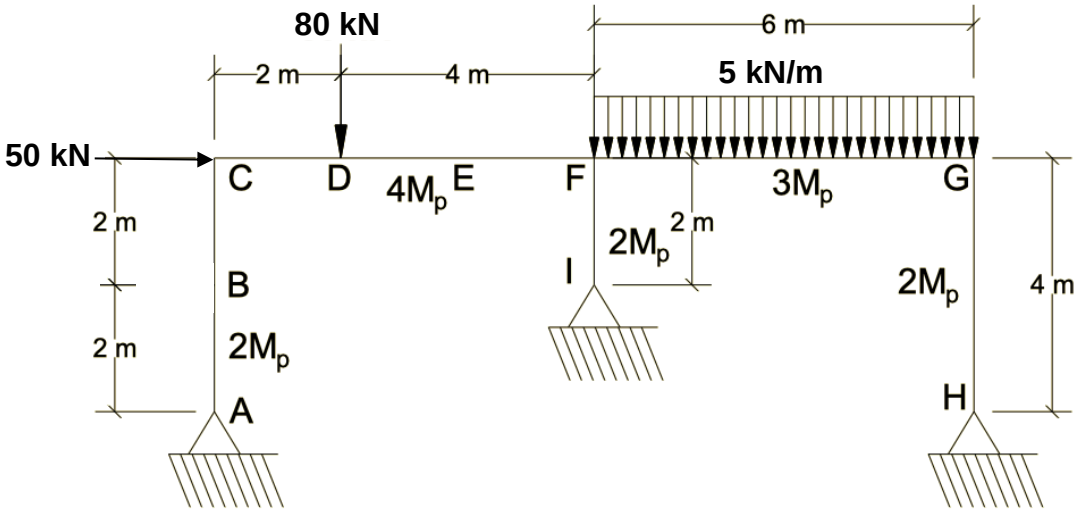
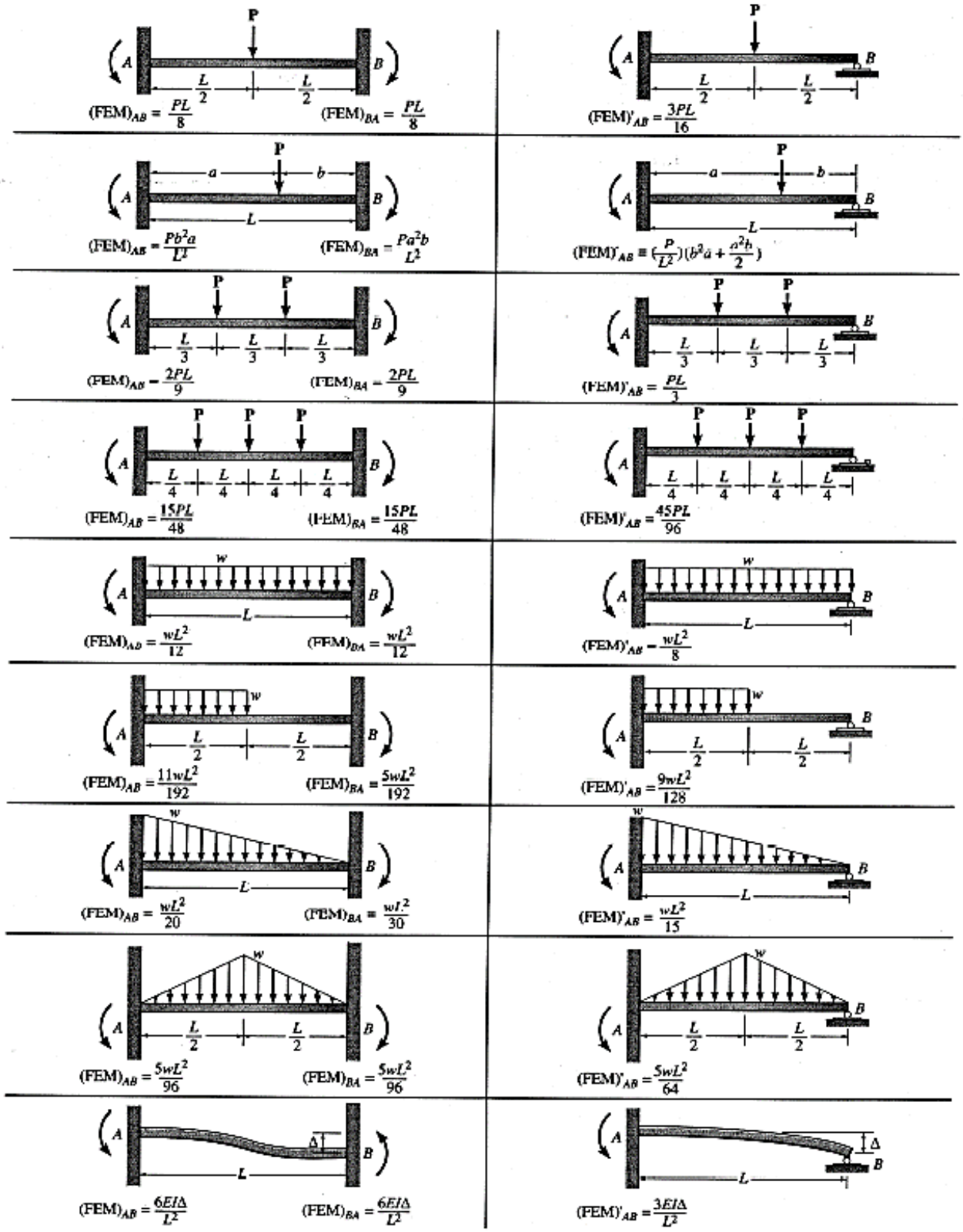


Figure 5

APPENDIX



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