

DEPARTMENT OF CIVIL ENGINEERING, IIT DELHI

MAJOR : CVL 756 ADVANCED STRUCTURAL ANALYSIS (2023-24)

Time allowed: 120 mins

Date: 23 Nov 2023

Venue: LH 512

Max marks : 50

NOTE: (a) All questions are compulsory. (b) Draw neat and clear sketches wherever required.

(c) Assume suitable data if necessary. (d) Assume members as INEXTENSIBLE unless otherwise stated. (e) All answers must be supported by calculations/ justification to secure assigned marks. (f) This question paper has two printed pages (g) BEGIN ANSWER TO A QUESTION ON A FRESH PAGE

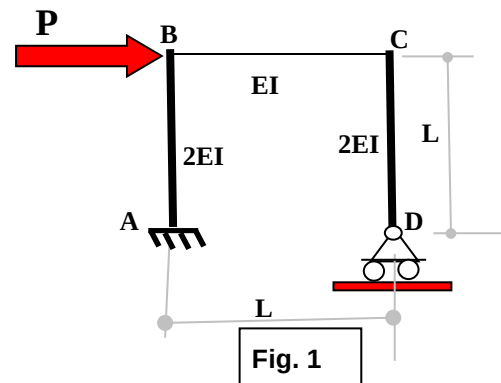
Q1. Starting from the expression of slope, derive the expression for curvature of a thin plate in any general direction at an angle α in plan.

(5 marks)

Q2.

For the structure shown in Fig. 1, determine the vertical reaction at D and the horizontal displacement at B using the matrix force method. EI values of each member are indicated in the figure.

(10 marks)

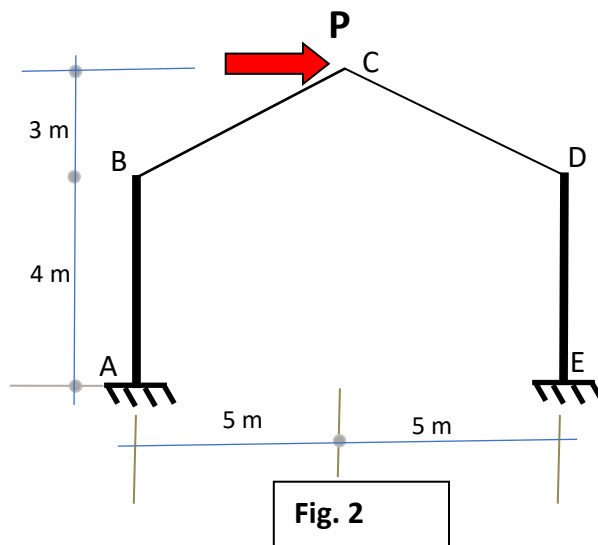


Q3.

The inclined portal frame shown in Fig. 2 has a plastic moment capacity of 300 kNm for columns and 200 kNm for beams. For this structure:

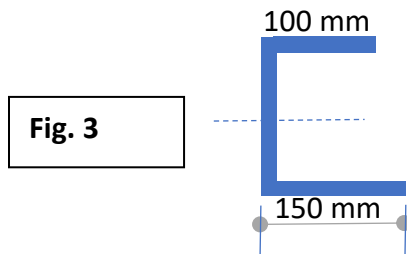
- Which mechanism is not possible at all? Establish it logically or mathematically.
- Draw the beam-column and combined mechanisms.
- Determine the failure load for the beam-column mechanism.
- Perform yield check at joint E and comment on the result.

(3+3+10+4 = 20 marks)



Q4. Determine the shape factor for the channel section shown in Fig. 3. Overall depth of the section is 300 mm and thickness of flange/ web equal to 10 mm.

(5 marks)



Q5. The structure, whose plan is shown in Fig. 4, is a **12 storeyed frame** which is to be analyzed using the direct stiffness approach with the aid of a **computer program**. It has a rigid slab at each floor level. All members should be considered extensible.

- Will simple plane frame analysis be able to provide realistic solution for lateral load analysis if the lateral load is eccentric? Why?
- Can slab effect be ignored if the lateral load does not act eccentrically? Give reasons for your answer.
- For 3D analysis with slab effect, how should the joints be numbered (horizontally or vertically) to attain smaller band width? Justify your answer.
- Determine the sizes of K_{JJ} and K_{FF} .
- Determine half band width of K_{JJ} .

(2+2+2+2+2 = 10 marks)

