

DEPARTMENT OF CIVIL ENGINEERING, IIT DELHI

MINOR I :CEL717 ADVANCED STRUCTURAL ANALYSIS (2013-14)

Time allowed: 1 hour

Date: 29 August 2013

Venue: V 216

Max marks : 20

NOTE: (a) All questions are compulsory. (b) Draw neat and clear sketches wherever required.
(c) Assume suitable data if necessary. (d) Assume members as extensible unless otherwise stated.
(e) All answers must be supported by calculations/ justification to secure assigned marks.

Q1. How does the direct stiffness approach (involving digital computation) take care of the equilibrium and compatibility conditions **(5 marks)**

Q2. The structure, whose plan is shown in Fig. 1, is **five storeyed** and is to be analyzed using the direct stiffness approach with the aid of a **computer program**. The frame has a thick reinforced concrete slab at each floor.

- Justify why normal 3D analysis may be erroneous for seismic effects.
- 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} .

(1+1+3+2 = 7 marks)

Q3. The 3D structure shown in Fig. 2 is to be analyzed using the direct stiffness approach digitally. All members have same EI and have a length L . $EI/L = 100$, $EI/L^2 = 25$ and $EA/L = 50$ for all members. Joints 1 and 2 are numbered as shown, member numbers are indicated in squares

- Form the stiffness matrix of a member in local coordinates (local x axis is directed from left to right or bottom to top as the case may be).
- Form the matrix T for member 3.
- Obtain the 5th column of K_G for member 3.
- Derive the value of $K_{TS}(11,11)$ using the code number approach

(2+1+2+3= 8 marks)

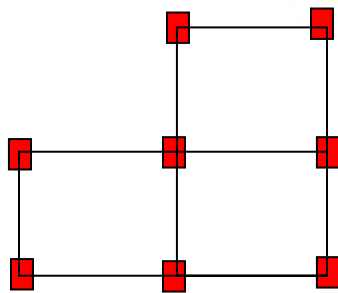


Fig. 1

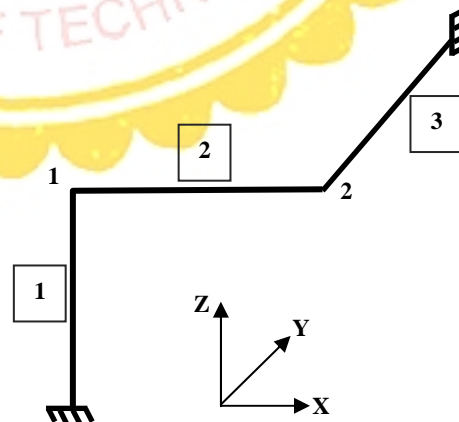


Fig. 2