Major- 2007

CEL 832-Design of Tall Buildings

Time 2hr. Max Marks 45

Attempt all the questions

Q1 Figure 4 shows a 20 storeyed shear wall building (storey height = 3.0 m) consisting of 8 planar shear walls of type A ($I=3m^4$) and one shear wall of type B ($I=5m^4$ about both axes) arranged symmetrically. The building is subjected to a loading of 30 kN/m, 5m from an axis of symmetry of the building. Determine the shear force and bending moment at the base of wall 8.

(8)

Q2 (a) Discuss in what manner is the age adjusted effective modulus method (AEMM) more accurate than the effective modulus method (EMM).

(3)

(b) A R.C. column is subjected to axial load . Using effective modulus method EMM, obtain the expression for stress in the concrete.

(5)

(b) The load on a R. C. column of cross section 60 cm x 60 cm with 1.2% steel of a 30 storey building (storey height = 3.0m) from each floor is 250 kN .Obtain the contribution to deflection at 29th floor of creep deformations in the 27th storey column resulting from (i) loading at 28th floor. Consider the effect of reinforcement.

Data:
Concrete mix: M25
Rate of construction = 1storey/week ε_c'(28 days) = 0.05×10^{-6} mm/mm/kN/m^2 λ_c =1.2

Loading age (weeks)	1	2	3	4	5	6	7	8
λ_a	1.38	1.20	1.08	1.0	0.94	0.89	0.84	0.80
λ_t	0.2	0.3	0.36	0.4	0.43	0.42	0.405	0.402

Assume the modulus of elasticity, E_c of the column of the 27th storey column when it receives the load from the 28th floor = 2.19N x 10^4 N/mm^2.

You may make use of the following equations.

$$\lambda_{rik} = \frac{F_{ik}}{pe_{cik} E_s}$$

$$e_{cik} = e_c'(28days)\lambda_{aik}\lambda_c$$

$$F_{ik} = 1 - \exp\left(\frac{-pn_{ik} e_{cik} E_{cik}}{1 + pn_{ik}}\right)$$

Symbols have usual meaning.

(8)

Q3 (a) Show that the stiffness coefficients for a beam (Fig. 2a) with rigid arms due to unit rotation at end A are given by

$$M_A = \frac{4(EI)_b}{L^3}(L^2 + 3aL + 3a^2)$$

$$M_B = \frac{2(EI)_b}{L^3}(L^2 + 3aL + 3bL + 6ab)$$

(5)

(b) A beam ABCD in a coupled shear wall has rigid arms AB and CD at the ends of lengths =1.5m and 1m respectively ; the flexible portion BC is of length 2 m and moment of inertia =100 x 10^{-4} m^4 . The ends A and D undergo rotations (clockwise) = O.5x 10^{-4} and 0.75x 10^{-4} respectively and also vertcal translations = 1x 10^{-4} m (up) and 1.5x 10^{-4} m (down) at ends A and D respectively. Obtain the bending moments at ends B and C owing to these imposed rotations and displacements. Take E = 2x 10^7 kN/m^2. Also obtain the fixed end moments at the end A owing to a vertical load =200kN in the portion BC.

(9)

(c) Fig. 2(b) shows a one storeyed coupled shear wall with vertical loading. Obtain the stiffness matrix and the load vector for the structure.

(7)

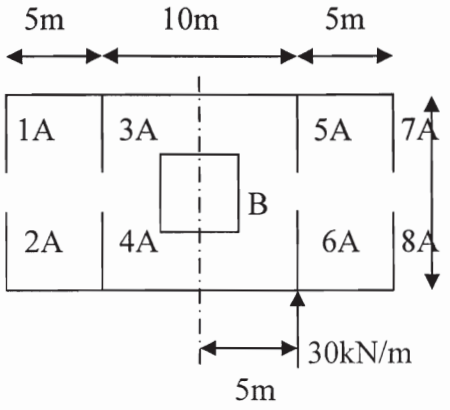

Fig. 1

Beam flexural rigidity = EI/10

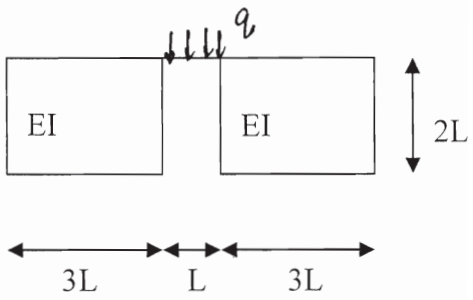

Fig. 2(b)

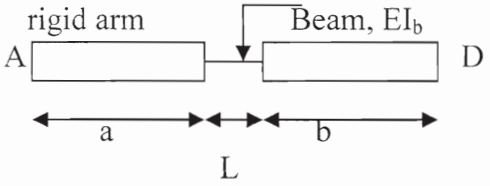

Fig. 2(a)