NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
FACULTY OF INDUSTRIAL TECHNOLOGY
DEPARTMENT OF CIVIL AND WATER ENGINEERING
BACHELOR OF ENGINEERING (HONOURS) DEGREE
PART III FIRST SEMESTER EXAMINATIONS – APRIL 2009
STRUCTURAL ANALYSIS I TCW 3102

INSTRUCTIONS

Answer all questions. Each question carries equal marks.

Time: 3 hours
Total marks: 100

QUESTION 1

Calculate the end moments of the frame shown in Fig1.1. All members have the same flexural rigidity EI. Note that the member AB is fixed and CD is pinned to the ground. Draw the bending moment envelope of the frame for the loading shown in Fig 1.1. Use the moment distribution method. [25]

QUESTION 2

Determine the member and structure stiffness matrices for the frame shown in Fig 2.1. Assume node three is pinned and node one is fixed. Take E = 200GPa, I = 300 x 10^6 mm^4 and A = 21 x 10^3 mm^2. Determine also the support reactions at nodes one and three. [25]

QUESTION 3

(a) Fig 3.1 shows a structure of uniform cross sectional area and built of the same material. Construct the influence line diagram for the shear force at support A. Find also the maximum possible bending moment in the structure due to a series of point loads shown in Fig 3.2 traveling along the section A-B, from A to B. [12]

(b) A beam ABC is loaded as shown in Figure 3.3. C is pinned, A and B are roller supports. Determine the reactions at the supports. Use the flexibility method. Draw the shear force diagram for the structure. [13]

QUESTION 4

Fig 4.1 shows a simple frame ABCD whose members are of constant flexural rigidity i.e. EI is constant. Use the slope deflection method to determine the moments at the joints and supports and then draw the bending moment diagram for the frame. [25]

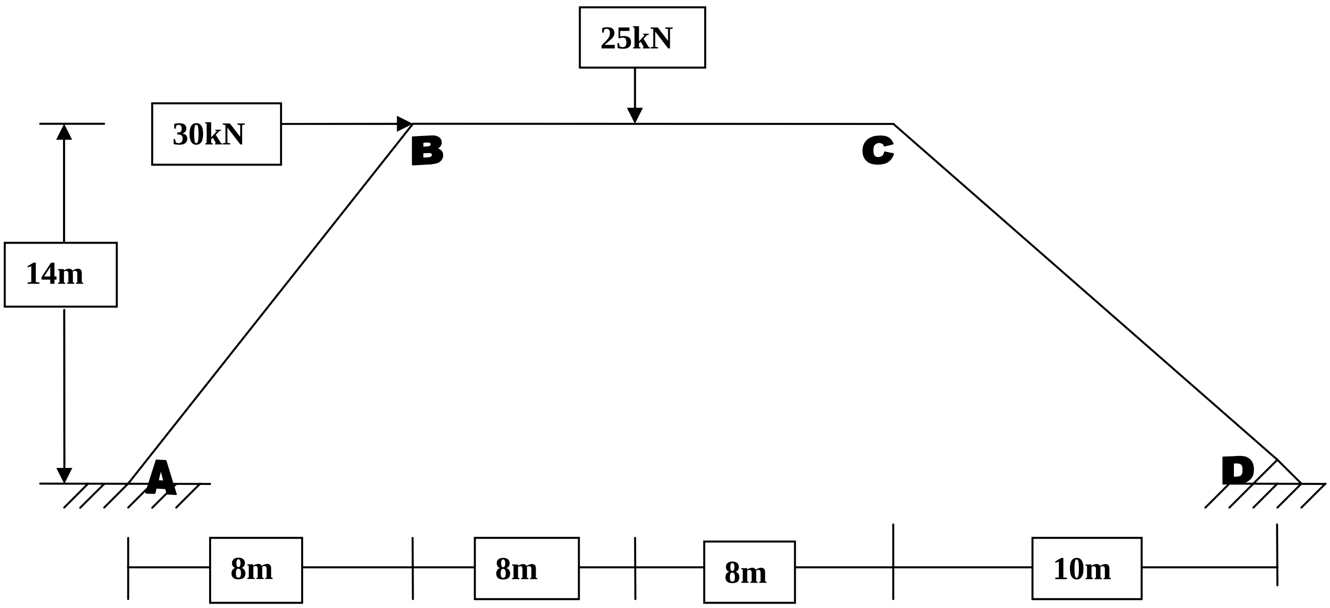

Fig 1.1

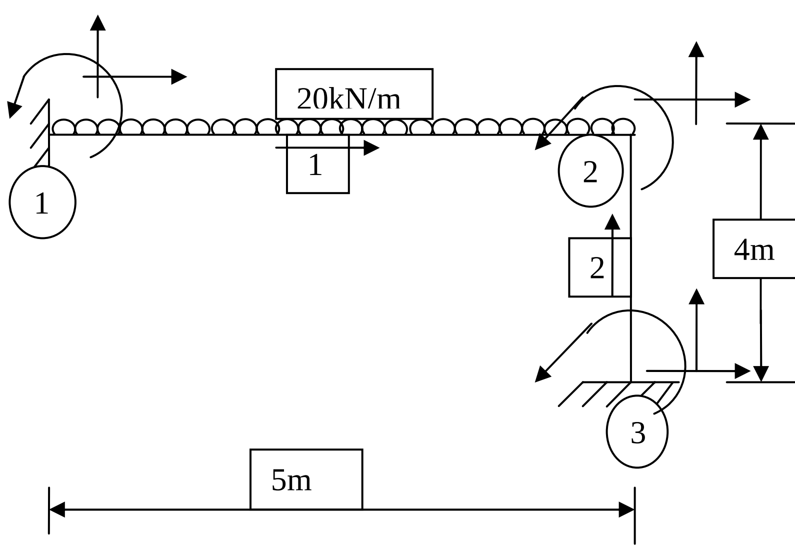

Fig 2.1

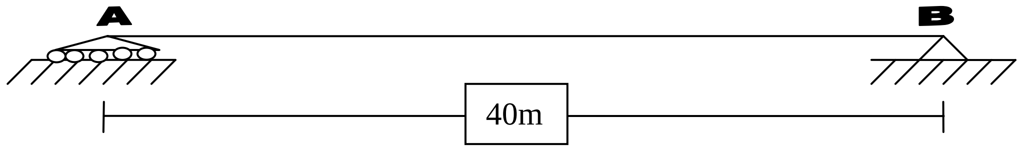

Fig 3.1

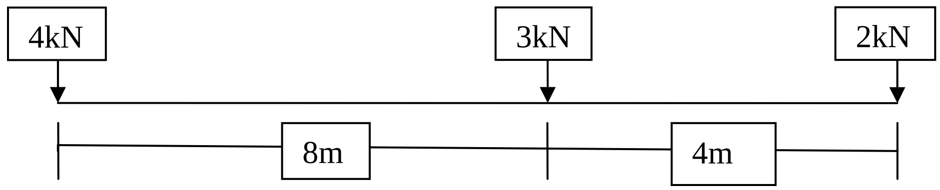

Fig 3.2

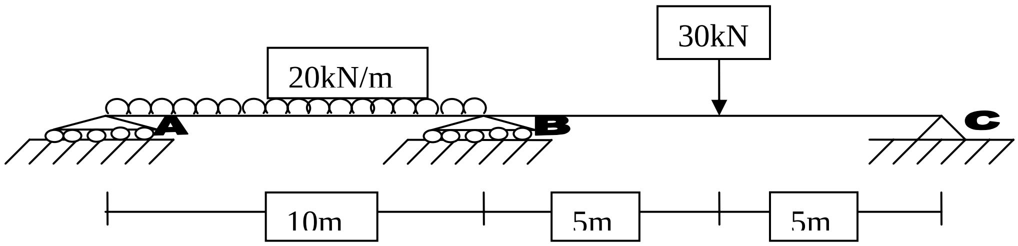

Fig 3.3

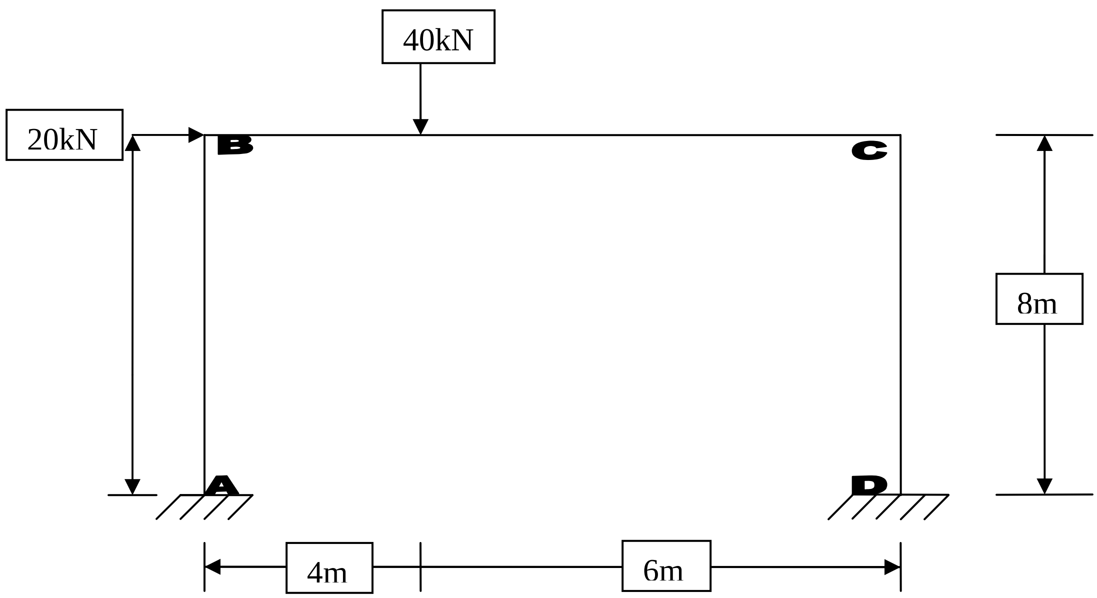

Fig 4.1

USEFUL FORMULAE

$$Vs = g\,\frac{\left(\rho_p - \rho\omega\right)}{18\mu}\,d^2 p$$

$$Vs = \sqrt{\frac{4gd\left(\rho_p - \rho_w\right)}{3C_d}}$$

$$C_d = \frac{18.5}{\mathrm{Re}^{0.6}}$$

$$C_d = \frac{24}{\mathrm{Re}} + \frac{3}{\sqrt{\mathrm{Re}}} + 0.34$$

$$V = \mathrm{Re} = \frac{\phi V_{s\rho d_p}}{\mu}$$

$$V_s = \sqrt{\frac{4gd}{3C_d}}\left(\rho_p - \rho_w\right)$$

$$t_c = \frac{1}{k_2 - k_1}\log\frac{k_2}{k_1}\left[1 - \frac{D_{0(k_2 - k_1)}}{L_0 k_1}\right]$$

$$D_c = \frac{k_1}{k_2}L_{10} - k_1 t_c$$

$$D_t = \frac{k_1}{k_2 - k_1}L_0\left(10^{-k_{1t}} - 10^{-k_{2t}}\right) + D_{o10}{}^{-k_2 t}$$

$$V = \sqrt{\frac{(8k)}{f}}\,g\left(R_d - 1\right)d$$

$$\log 10\left(\frac{N_t}{N_0}\right) = -kt^2$$

Particles shape factor,ϕ for spherical sand = 1.0, worn sand = 0.89 and angular sand =0.73.

$$\mathrm{N}e = \frac{N_1}{\left(1 + K_{B_{(T)}}\theta_a\right)\left(1 + K_{B_{(T)}}\theta_f\right)\left(1 + K_{B_{(T)}}\theta_m\right)^n}$$

$$KB(T) = 2.6(1.19)^{T-20}$$

$$h_f = \beta\left(\frac{wb}{b}\right)^{4/3}\frac{v^2}{2g}\sin\alpha$$

$$V = \left(\frac{\theta}{WH}\sin\alpha\right)\left(\frac{b+s}{s}\right)\left(\frac{1}{1 - f_c}\right)$$

$$K_T = K_{20}\left(1.047\right)^{T-20}$$

USEFUL FORMULAE

$$Vs = g\,\frac{\left(\rho_p - \rho\omega\right)}{18\mu}\,d^2 p$$

$$Vs = \sqrt{\frac{4gd\left(\rho_p - \rho_w\right)}{3C_d}}$$

$$C_d = \frac{18.5}{\mathrm{Re}^{0.6}}$$

$$C_d = \frac{24}{\mathrm{Re}} + \frac{3}{\sqrt{\mathrm{Re}}} + 0.34$$

$$\mathrm{Re} = \frac{\phi V_{s\rho d_p}}{\mu}$$

$$V_s = \sqrt{\frac{4gd}{3C_d}\left(\rho_p - \rho_w\right)}$$

$$t_c = \frac{1}{k_2 - k_1}\log\frac{k_2}{k_1}\left[1 - \frac{D_{0(k_2-k_1)}}{L_0 k_1}\right]$$

$$D_c = \frac{k_1}{k_2}L_{10} - k_1 t_c$$

$$D_t = \frac{k_1}{k_2 - k_1}L_0\left(10^{-k_{1t}} - 10^{-k_{2t}}\right) + D_{o10}{}^{-k_{2^t}}$$

$$V = \sqrt{\frac{(8k)}{f}g\left(R_d - 1\right)d}$$

$$\log 10\left(\frac{N_t}{N_0}\right) = -kt^2$$

$$h = 1.07\,\frac{l_{CD}V^2}{\phi_{gdf^4}}$$

Particles shape factor, ϕ for spherical sand = n 1.0, worn sand = 0.89 and angular sand = 0.73.

$$\frac{h}{l} = E\,\frac{\left(I - f\right)}{f^3}\,\frac{Vs^2}{gd\phi}$$

$$\frac{N_t}{N_0} = \left(1 + 0.23Ct\right)^{-3}$$

$$E = 150\left[\left(1 - f\right)/\mathrm{Re}\right] + 1.75$$

$$\frac{le}{ls} = \frac{1 - f}{1 - \left(\frac{vb}{vs}\right)}0.22$$