University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2013
Program: MCE (Civil)

Course Title: Analysis and Design of Tall Buildings — Course Code: CE 6111
Time: 3 Hours — Full Marks: 100

Answer all the questions. The figures in the right margin indicate full marks.

Part - A (Closed Book: 30 min.)

1. (a) Define tall building from structural engineer's point of view. (02)

(b) Write down the assumptions of continuous medium method for the analysis of coupled shear walls. (05)

(c) Discuss the advantages and disadvantages of suspended structure as a lateral load resisting system. (05)

(d) Write down the significance of relative stiffness parameter ***kαH*** in the analysis of coupled shear wall structure. (03)

(e) How does the behavior of shear wall-frame structure under lateral load differ from those of shear walls and frames? Describe with neat sketches. (10)

Part - B (Open Book: 2 hrs. 30 min.)

2. The plan and elevation of a shear wall structure are shown in Fig. 1 and Fig. 2, respectively. The structure is 70 m high (20 stories, each of 3.5 m height). The five shear walls include two symmetrical pairs (Types 1 and 2) and a central core (Type 3). Two change levels, A and B, divide the structure into three regions. The wall dimensions and inertias are given in Table 1. Determine the bending moment in wall Type 2 at change level B due to uniform wind pressure of 1.5 kN/m^2. Assume reasonable values of missing data, if any. (25)

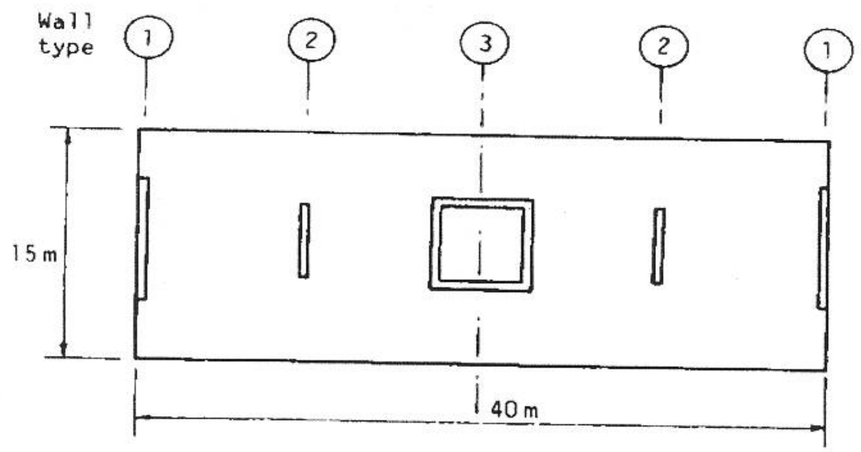


Fig. 1: Plan of a shear wall structure

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2013
Program: MCE. Engineering

Course Title:Soil Mechanics I | Course Code: CE 6401
Time: 3 hours | Full Marks: 100

Section A
Answer any Four Questions.

(4x12=48 marks)

1. a) Draw a typical shear stress-shear strain curve for dense and loose sands. Show point of failure, peak strength and residual strength on the diagram. 4
b) Discuss on three types of tri-axial test based on the drainage condition during the test. 6
c) Draw the Mohr circle of unconfined compressive strength test. 2

2. a) Write the Mohr-Coulomb failure criterion in terms of total and effective stresses for sand and clay. 4
b) A sample of stiff clay was tested in a triaxial shear test and found to have a cohesion c of 200 kPa and angle of shearing resistance of 37°. What will be its effective compression strength if a horizontal hole is made with zero confining stress and a water pressure of 220 kN/m^2? 8

3. A boring log reveals that a thin layer of silty clay exists at a depth of 15 m below the natural ground surface. The soil above this layer is silt having dry unit weight of 15.5 kN/m^3 and moisture content of 28%. The groundwater table is found to exist approximately near the ground surface.

Triaxial shear tests on the undisturbed silty clay samples give the following results:

c_{cu} =48.3 kN/m^2, φ_{cu} = 13° and $c_{cd'}$ = 41.4 kN/m^2, $\varphi_{cd'}$ =23°

Draw the soil profile and Estimate the shearing resistance of the silty clay on a horizontal plane at depth 15 m from the ground level: (i) when the shear stress builds up rapidly and (ii) when the shear stress builds up very slowly. 12

4. a) Write short notes on stress-controlled test and strain-controlled test. 4
b) A specimen of fine dry sand, when subjected to a triaxial compression test, failed at a deviator stress of 400 kN/m^2. It failed with a pronounced failure plane with an angle of 24° to the axis of the sample. Compute the confining pressure acting on the specimen . 8

5. a) Discuss with sketch: Volume change behaviour with shear strain for dense and loose sands during a direct shear test. 4
b) Samples of a dry sand are to be tested in triaxial and direct shear tests. In the triaxial test, the sample fails when the major and the minor principal stresses are 980 and 280 kN/m^2, respectively. What shear strength would be expected in the direct shear test when the normal stress is 240 kN/m^2? 8

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2013
Program: Masters in Civil Engineering (MCE)

Course Title : Earthquake Resistant Design	Course Code: CE 6713
Time: Three Hours	Full Marks: 200

This question paper has two sections (**Section A** and **Section B**). Use separate answer script for **Section A** and **Section B**.

Answer <u>ALL</u> questions from **Section A** and **Section B**. The figures in the right margin indicate the marks of the questions.

Section A - 1 Hour (**Closed Book Part**)

1. **(a)** Define magnitude of an earthquake. Explain the key factors related to the magnitude of earthquake. 10

(b) Explain the steps to draw the response spectra for various damping ratio. 10

2. **(a)** Briefly discuss the factors that you will consider for earthquake resistant design from planning to the completion of a project. 10

(b) Explain different forms of ductility. Also, explain the importance of ductility in earthquake resistant design of structures. 10

3. **(a)** Explain TLD and TMD. Also explain the concept of control of structures by base isolation. 10

(b) Explain some main causes of damage of structures due to an earthquake. 10

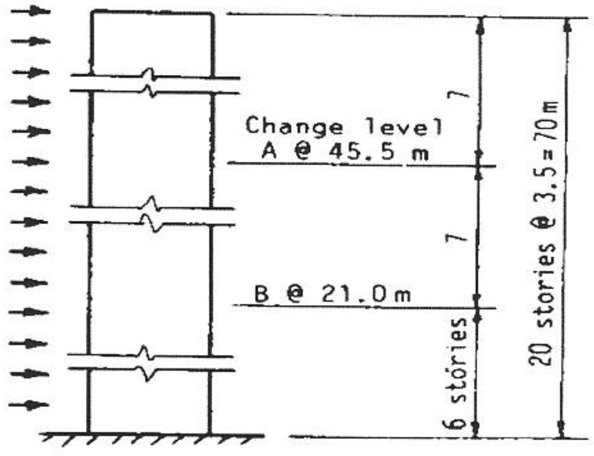


Fig. 2: Elevation of the shear wall structure

Table 1: Wall dimensions and inertias

	Wall 1		Wall 2		Wall 3		
	Dimensions (m)	Inertia I_1 (m^4)	Dimensions (m)	Inertia I_2 (m^4)	Dimensions (m)	Total Inertia I_3 (m^4)	Half Inertia $I_3/2$ (m^4)
Top region, 45.5–70 m	8 × 0.2	8.533	5 × 0.2	2.083	Outside 6 × 6, walls 0.2 m thick	26.046	13.023
Middle region, 21–45.5 m	8 × 0.3	12.800	5 × 0.3	3.125	Outside 6 × 6, walls 0.2 m thick	26.046	13.023
Bottom region, 0–21 m	8 × 0.45	19.200	7 × 0.5	14.292	Outside 6 × 6, walls 0.4 m thick	47.070	23.535

3. Figure 3 shows the floor plan of a cross wall structure. The shear walls are interconnected through beams (300 mm × 400 mm). The building is 105 m high (30 stories, each of 3.5 m height). The bases of the walls are fixed. A uniform wind load of 1.75 kN/m^2 acts on the building parallel to the short direction. Calculate the stresses due to wind load at the base of each wall in an interior panel. Use the continuous medium method and graphs prepared by Coull and Choudhury. (25)

Given: $\nu = 0.17$, $\lambda = 1.2$, $E = 36 \times 10^6$ kN/m^2.

Assume reasonable values of missing data, if any.

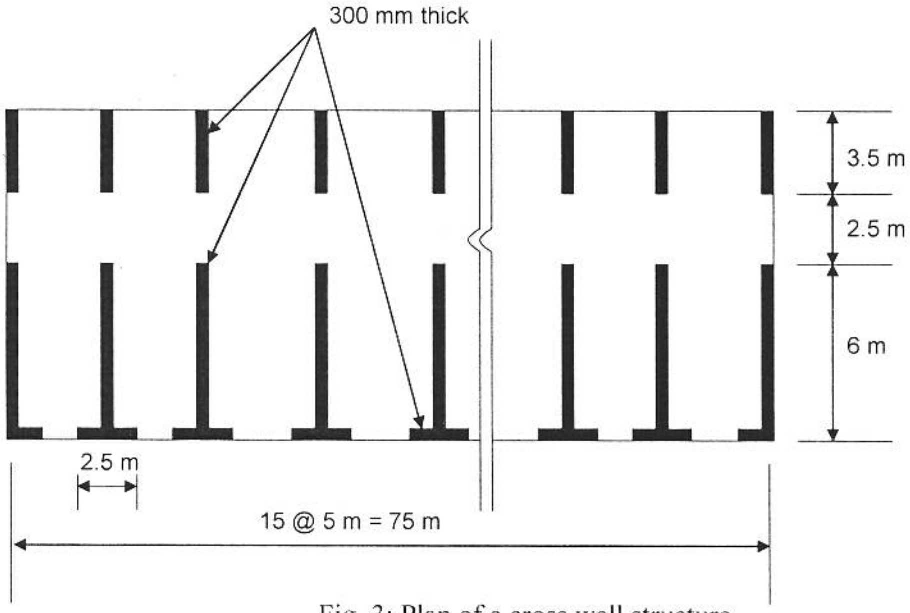


Fig. 3: Plan of a cross wall structure

4. Figure 4 shows the floor plan of a reinforced concrete shear wall-frame structure. The horizontal resistance to wind acting on its long side is provided by six rigid frame bents and a central core. Calculate the bending moment at the base of the core wall and shear force at the base of the frames. Neglect the effect of openings in the concrete wall. Use the charts prepared by Heidebrecht and Stafford Smith. The relevant data are given below: (25)

Number of stories: 40
Story height: 3.5 m.
Columns: 600 mm × 600 mm
Beams: 300 mm × 400 mm (for all stories)
Lateral load: 1.5 kN/m^2 UDL.
Wall thickness: 375 mm
$E = 2.0 \times 10^7$ kN/m^2.

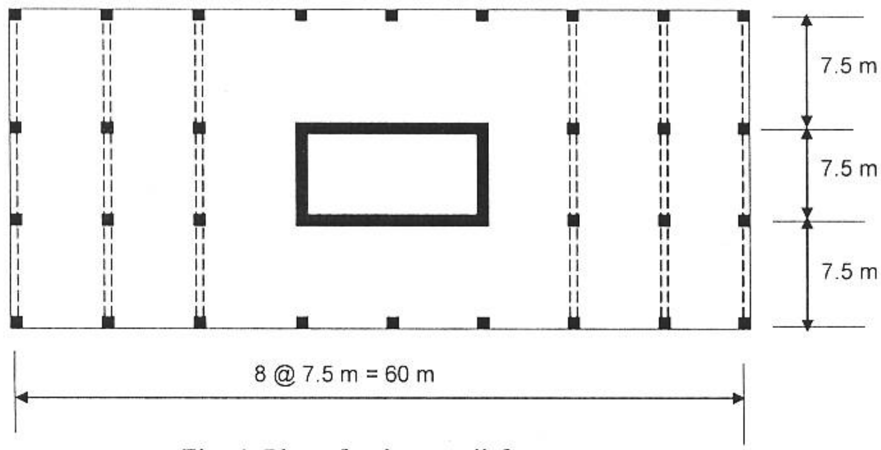


Fig. 4: Plan of a shear wall-frame structure

Section B

Answer the following questions. **(26x2 = 52 marks)**

6. a) Discuss on different modes of shear failure of strip footings on sand. 4

b) How can bearing capacity values be obtained by direct approaches instead of using rigorous theoretical approaches. 4

c) In a mass-housing complex scheme over a vast area, two types of soils were encountered. One of which is partially saturated silty clay with c_u =5.8 kN/m^2, φ_u = 25° and γ = 18.5 kN/m^3 and extends over most of the area. The other, predominantly clay having c_{cu} =55 kN/m^2, spreads to a lesser extent. The water-table is at a greater depth. As per the design, strip footings of the building have to be placed at 1 m depth. Compute the width of the footing required in each type of soil if the load intensity is 150 kN/m run. Adopt a factor of safety of 2.5 in the both soils, and only shear failure needs to be considered. For , φ_u = 25°, N_c = 20.7, N_q = 10.7, N_γ = 10.8.

If there is a possibility of watertable rising to the ground surface, what should be the change in the widthof the footing in both areas. The submerged unit weight of the silty clay is 11.2 kN/m^3. 18

7. a) State the bearing capacity criteria for soil based on the stability requirements of a foundation. 4

b) Discuss on the different factors affecting bearing capacity of a soil. 4

c) Write on different correction factor used in the bearing capacity equation. 4

d) In a waterhouse building, two unequally loaded columns are combined be a rectangular combined footing. It is proposed to place the footings at a depth of 1.5 m on a saturated clay with the following soil properties:

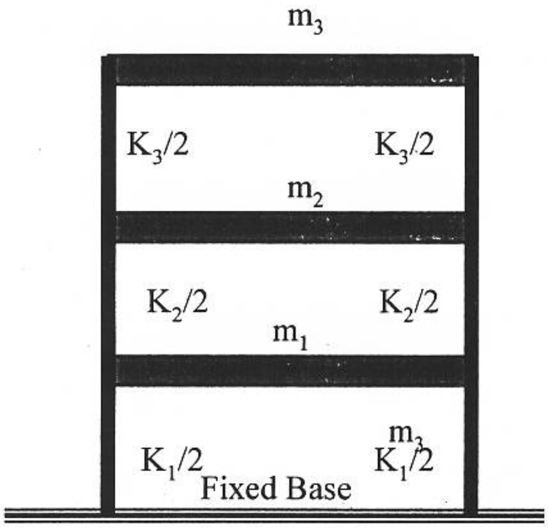
$$c_u = 72 \text{ kN/m}^2,\ \varphi_u = 0 \text{ and } = 17.8 \text{ kN/m}^3.$$

The loads on the columns are 720 and 1170 kN with a spacing of 5 m and the centre of the 720 kN column is placed at a distance of 0.8 m from the property line.

Sketch the combined footing as described. Estimate the dimension of the footing, neglecting the weight of the footing. Adopt a factor of safety of 3.
For, φ_u = 0°, adopt Terzaghi's values N_c = 5.7, N_q = 1, N_γ = 0. 14

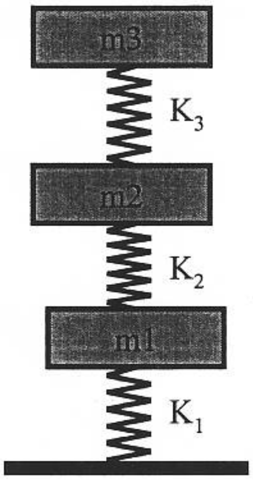
Section B (Open Book Part) – Two Hours

4. Refer to the following 3-DOF system. 70



Three Storey Building

Very stiff floor slabs relative to the supporting columns.



Model – 3DOF

Given:
$m_3 = m = 40$ ton; $m_2 = 2$ m; $m_1 = 2.5$ m
$K_3 = K = 10{,}000$ kN/m; $K_2 = 2K$, $K_1 = 3K$

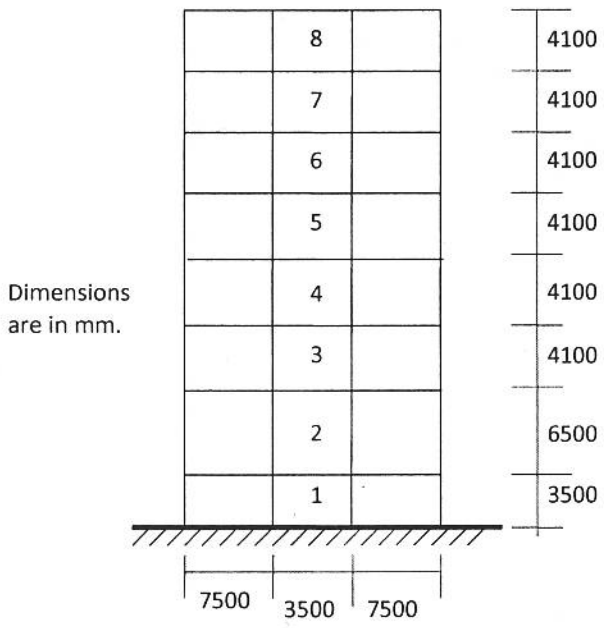
Soil type = S2; Seismic coefficient = 0.2; Occupancy type = Standard
Code = 1990 SEAOC; 1 kN = 1 ton.m/sec2

By modal analysis, determine the modal frequencies, mode shapes, equivalent modal forces, and base shear.

5. Refer to the following special moment-resisting building frame system. 70

Calculate lateral EQ forces using equivalent lateral force procedure. Also, by using Rayleigh method and top deflection method, calculate the fundamental period of the structure.

The following data are provided:
Occupancy – standard, Seismic zone – 3, Soil condition – S2, Code - SEAOC. The weight of the roof is 900 kN and that of the other floor is 1500 kN each.



Elevation of 8 -storey RC Frame

Horizontal storey stiffness of each floor

Storey No.	8	7	6	5	4	3	2	1
K x 10^3 (kN/m)	25	40	40	45	50	70	25	150