University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2022
Program: B.Sc. Engineering (Civil)

Course Title: Professional Practices and Communication | Course Code: CE 403
Time: 2 Hours | Credit Hours: 2.00 | Full Marks: 100

Answer all the questions.

1. (i) Identify the differences between Instructions to Tenderer (ITT) and Tender Data Sheet (TDS) with examples. **[07]**

   (ii) Briefly describe the attributes of a good specification. **[08]**

2. (i) "In addition to provide sufficient information on the quantities of the works to be done, Bill of Quantities (BoQ) can also be used in the periodic valuation of works executed."

   Ascertain the above quoted statement in context to the objectives of BoQ. **[06]**

   (ii) Presume that you are the head of a Tender Evaluation Committee (TEC). In the BoQ, a tenderer has quoted the price of painting a building to be BDT 9,00,000. However, the figure expressed in words reads 'Nine Lac & Eighty Thousand Taka Only'. In the above circumstances, apply your judgement to figure out the correct quoted price. **[04]**

3. (i) Suppose you are the manager of a reputed construction company doing business in Bangladesh. Recently one of your employees, who has been working in your company for 16 years, has been medically certified as mentally incapable to conduct his duties. Your company has decided to terminate his contract with the company. Apply Bangladesh Labour Law (BLL) to figure out the financial benefit that should be given to the employee before his discharge? **[09]**

   (ii) Briefly describe the restrictions or limitations regarding working hours and over time mentioned in the Bangladesh Labour Law (BLL). **[06]**

4. (i) Evaluate Unionism and Collective Bargaining practices from ethical perspective. **[06]**

   (ii) Predict the potential use of Computer as an object of unethical act. **[09]**

5. Assume that you are the Quality Control Engineer of a construction company. During quality control visit in a remote village, you found that a building is being constructed on the bank of a river, and it will be damaged due to flood. Approximately 25% of the

construction has been completed. The survey has been done by your colleague with the consent of the local people. However, the quality of the construction is as per specification. Your job is limited to control the quality of building only.

Discuss the case and recommend your views on whether to continue the construction or not? Validate your recommendation in reference to Code of Ethics. [20]

6. Engineer X who is a fresh engineering graduate obtained his first job at Department of Ground Water Development (DGWD). As his first assignment Engineer X was asked to conduct a district wide study of the inter-links between ground water and surface water at P district and to submit a report as the end product of the study. To facilitate his work, Engineer X's Supervisor provided him a sample report and asked him to just follow the sample report. Engineer X found that the sample report is based on a superficial study, with all the related data taken from western countries. At this point Engineer X requested for permission from his Supervisor to visit the site and collect field-based data. The Supervisor refused, saying that the budget to complete the study is very low, asked Engineer X to prepare the report with data taken from text books or other reports. He also assured that Engineer X would not face any problem since the contract to conduct the study was obtained by a consulting company registered in the name of the DGWD Chairman's spouse, and the DGWD Chairman himself is responsible to check the quality of the report.

Assess the above-mentioned case and answer the following questions with appropriate justification.

(i) Is it moral and ethical for Engineer X to accept the assignment and follow the suggestions of his Supervisor? [08]

(ii) Should Engineer X do his/her best and use data from other report and text books to prepare the report? [06]

(iii) Should Engineer X accept the assignment, collect relevant documents from his Supervisor and then report the case to the Law Enforcement Agency? [06]

(iv) Will Engineer X face any problem if he/she just follows the suggestions of his Supervisor? [05]

.....

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2022
Program: B.Sc. Engineering (Civil)

Course Title: Structural Engineering X | Course Code: CE 425
Time: 2 hours | Credit Hour: 2 | Full Marks: 100

QUESTION 1 [12 MARKS]

"The compressive strength of a concrete cube specimen is larger than that of a cylindrical specimen." Explain the reasons behind it. **[12]**

QUESTION 2 [10 MARKS]

"Incorporation of pozzolanic materials in Ordinary Portland Cement enhances the durability performance of concrete." Justify this statement with chemical reactions and proper comments. **[10]**

QUESTION 3 [20 MARKS]

(a) State the names of different non-destructive tests of concrete. **[7]**

(b) Explain in detail the procedure of pull-out test in concrete. **[7]**

(c) State the precautions that need to be taken while doing Windsor Probe test. **[6]**

QUESTION 4 [10 MARKS]

(a) Using chemical reaction, explain the mechanisms involved in concrete deterioration by the carbonation of concrete. **[6]**

(b) Explain the environmental factors that influence the rate of carbonation of concrete. **[4]**

QUESTION 5 [18 MARKS]

(a) "The absorption capacity of Ultra High-Performance Concrete (UHPC) is much lower than the normal strength concrete, as a result, UHPC has higher resistance of freeze-thaw than normal strength concrete", Do you agree or disagree with this statement? Justify your answer. **[8]**

(b) Explain the fire behavior of lightweight concrete. **[10]**

QUESTION 6 [10 MARKS]

Using a neat sketch, illustrate how does the autogenous healing process work. **[10]**

QUESTION 7 [20 MARKS]

A cylindrical reinforced concrete pier will be constructed for a bridge. The following necessary data are provided for the column and its formwork.

Given data:

Size of the column: Height = 6 m, Diameter = 1 .2 m.

Concrete type: Blended cement containing less than 40% of fly ash without admixture.

Form height = 5.8 m.

Density of concrete = 2450 kg/m^3.

Concrete temperature at placement = 30 °C.

Uniform volume supply rate = One 3 m^3 truck every 25 min.

Table 1: Values of coefficients C1 and C2

Walls: C l = 1 .0	
Columns: C l = 1 .5	
Concrete:	**Value of C2**
Ordinary Portland Cement (OPC) without admixture	0.3
OPC with any admixture, except a retarder	0.3
OPC with a retarder	0.45
Blended cement containing less than 70% slag without admixture	0.45
Blended cement containing less than 70% slag with any admixture, except a retarder	0.45
Blended cement containing less than 70% slag with a retarder	0.6
Blended cement containing less than 70% slag with a retarder Blended cement containing more than 70% slag	0.6

(a) Calculate the concrete lateral pressure and draw the pressure envelope as a function of height for form work design. **[12]**

(b) Explain the effect of concrete temperature on the lateral pressure of formwork. **[8]**

Formula:

$$P_{max} = D\left[C_1\sqrt{R} + C_2 K\sqrt{H - C_1\sqrt{R}}\right] \quad \text{and} \quad D \times h$$

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2022
Program: B.Sc. Engineering (Civil)

Course Title: GIS and Remote Sensing — Course Code: CE531
Time: 2 hours — Credit Hour: 2.0 — Full Marks: 100

[Answer all the questions. Assume reasonable data if any]

1) Describe briefly the basic components of satellite remote sensing process with a neat diagram. [10]

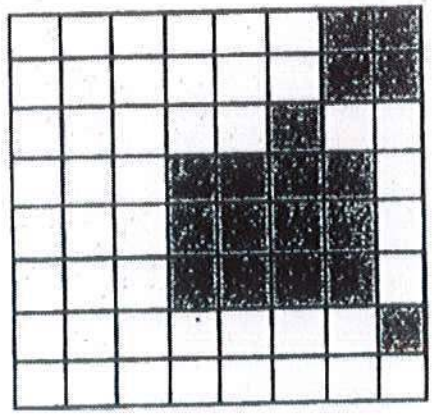
2) Discuss the interaction between Electromagnetic Energy and particles in the atmosphere with a schematic diagram. [10]

3) Summarize the spectral response curve and critical spectral regions. Explain the use of spectral signatures in land-use mapping with s neat sketch. [3+7=10]

4) Illustrate the different generalization techniques available in GIS with necessary diagrams. [20]

5) Illustrate the following types of errors in vector data with schematic diagram: (i) Dangling Nodes, (ii) Sliver Polygon, and (iii) Weird Polygon [3*4=12]

6) Rearrange the below raster using the following raster compression techniques. [10+10=20]
(i) Run length encoding,
(ii) Quad tree compression technique.



7) Explain the difference between edge matching and rubber sheeting in map creation with neat sketches. [10]

8) Explain the advantages and limitations of TIN data model. Explore the uses of Topological Feature Geographic Data. [5+3=8]

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2022
Program: B.Sc. Engineering (Civil)

Course Title: Structural Engineering VI | Course Code: CE 417
Time: 2 hours | Credit Hour: 2 | Full Marks: 100

QUESTION 1

(a) Plastic neutral axis divides the cross section into two equal areas. Explain briefly **[5]**

(b) Distinguish between compact, non-compact and slender steel sections. Which of these sections are not recommended in steel structure design and why? **[3+2]**

(c) What is lateral torsional buckling? How does the lateral torsional buckling affect steel member strength? **[3+2]**

(d) Explain all of the welding symbols (location, size, length, type and any other specification of welding) shown in **Figure 1**. **[10]**

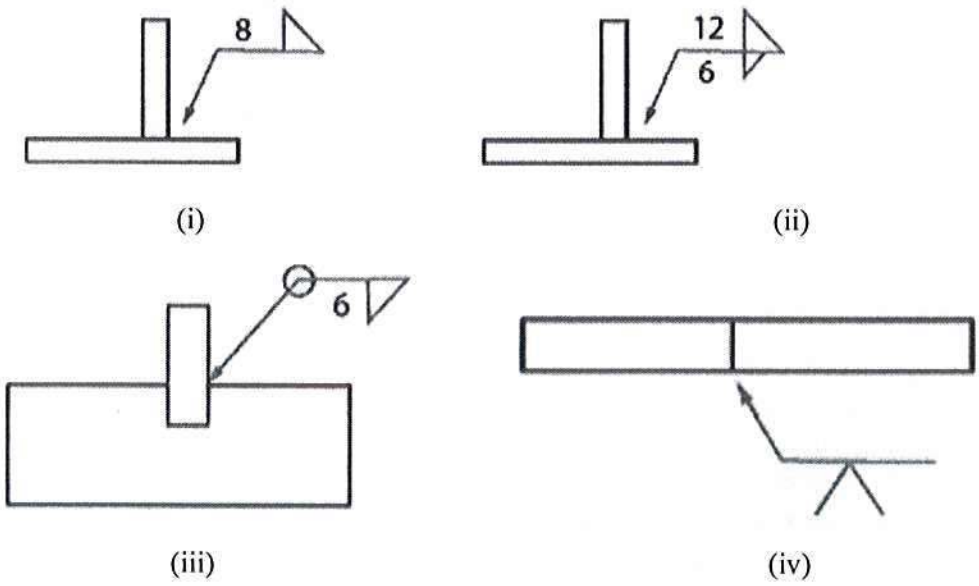


Figure 1

QUESTION 2

Compute moment gradient factor C_b for segments AB, BC and CD of the beam shown in **Figure 2**. The beam has lateral bracing at points B and C; and its cross-section is doubly symmetric. **[20]**

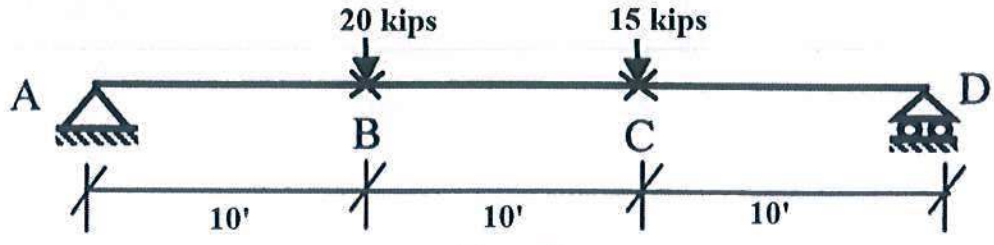


Figure 2

QUESTION 3

From the following table, select the lightest W section of A572 Grade 60 steel to serve as a main member 20 ft long to carry an axial compression service load of 100 kips dead load and 200 kips live load in a braced structure, as shown in **Figure 3**. Assume the member hinged at the top and fixed at the bottom for buckling in either principal direction. Use the **AISC-LRFD** method. **[15]**

Shape	A_g (in^2)	b_f (in)	t_f (in)	r_x (in)	r_y (in)
W10x54	15.8	10	0.61	4.37	2.56
W12x53	15.6	10	0.57	5.23	2.48
W10x49	14.4	10	0.56	4.35	2.54

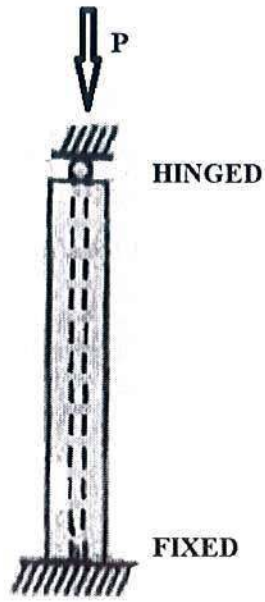


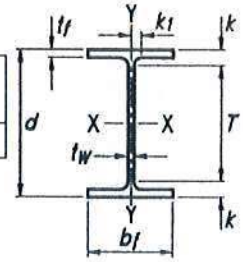
Figure 3

QUESTION 4

Determine the allowable moment capacity of W12x50 section of A572 Grade 60 steel for the beam shown in **Figure 4.** The beam has no lateral bracings in between support points A and B. Use the **AISC-ASD** method. If intermediate lateral supports are provided along the beam to increase its moment capacity, what should be the spacing of the lateral supports that will produce a most economical design? Calculate the allowable moment capacity of the beam for this case also. Assume $C_b = 1$. **[15+5+5]**

Section properties of W12x50:

D (in)	t_w (in)	b_f (in)	t_f (in)	S_x (in^3)	Z_x (in^3)	r_x (in)	r_y (in)	r_{ts} (in)	h_o (in)	T (in)	J (in^4)
12.2	0.37	8.08	0.64	64.2	71.9	5.18	1.96	2.25	11.6	9.25	1.71



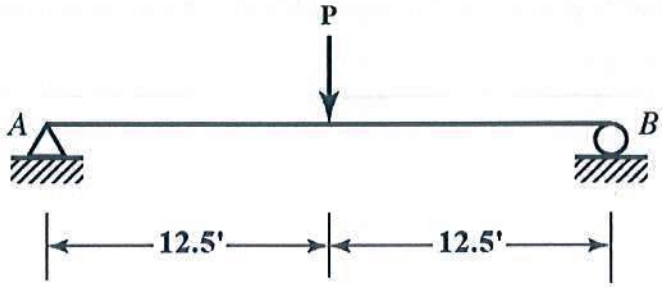


Figure 4

QUESTION 5

Use Fy = 36 ksi and Fu = 58 ksi, E60 electrodes, and the **SMAW** process to design side fillet welds for the full capacity of the 5x3x1/2-in angle tension member shown in **Figure 5**. The member is subjected to repeated stress variations, making any connection eccentricity undesirable. Assume that the **WT** chord member has adequate strength to develop the weld strengths and that the thickness of its web is 3/4 in. Use the **AISC-ASD** method for the calculation, and assume that U = 0.85. **[15]**

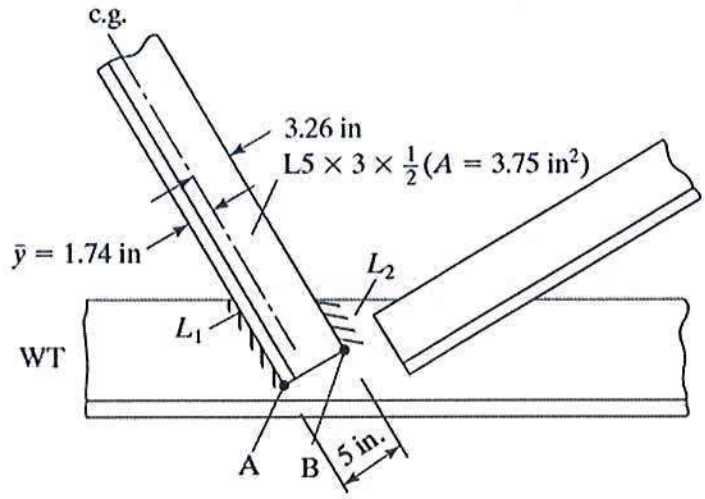


Figure 5

Table: Minimum size of fillet welds

Material Thickness of Thinner Part Joined, in. (mm)	Minimum Size of Fillet Weld, [a] in. (mm)
To 1/4 (6) inclusive	1/8 (3)
Over 1/4 (6) to 1/2 (13)	3/16 (5)
Over 1/2 (13) to 3/4 (19)	1/4 (6)
Over 3/4 (19)	5/16 (8)

Formula

$$F_{cr} = \left[0.658^{\frac{F_y}{F_e}}\right] F_y \quad \text{For } \frac{KL}{r} \le 4.71\sqrt{\frac{E}{F_y}} \qquad F_e = \frac{\pi^2 E}{\left(\frac{KL}{r}\right)^2}$$

$$F_{cr} = 0.877 F_e \qquad \text{For } \frac{KL}{r} > 4.71\sqrt{\frac{E}{F_y}} \qquad P_n = F_{cr} A_g$$

$$C_b = \frac{12.5 M_{max}}{2.5 M_{max} + 3M_A + 4M_B + 3M_C} R_m \le 3.0 \qquad L_p = 1.76 r_y \sqrt{\frac{E}{F_y}}$$

$$L_r = 1.95 r_{ts} \frac{E}{0.7F_y} \sqrt{\frac{Jc}{S_x h_o}} \sqrt{1 + \sqrt{1 + 6.76\left(\frac{0.7F_y S_x h_o}{E \quad Jc}\right)^2}}$$

$$M_n = C_b \left[M_p - (M_p - 0.7F_y S_x)\left(\frac{L_b - L_p}{L_r - L_p}\right)\right] \le M_p$$

$$M_n = M_p - (M_p - 0.7F_y S_x)\left(\frac{\lambda - \lambda_p}{\lambda_r - \lambda_p}\right) \qquad F_{cr} = \frac{C_b \pi^2 E}{\left(\frac{L_b}{r_{ts}}\right)^2} \sqrt{1 + 0.078 \frac{Jc}{S_x h_o}\left(\frac{L_b}{r_{ts}}\right)^2}$$

$$k_c = \frac{4}{\sqrt{h/t_w}}, \text{ where } 0.35 \le k_c \le 0.763 \qquad M_n = F_{cr} S_x \le M_p$$

$$\lambda_r = 0.56\sqrt{\frac{E}{F_y}} \qquad \lambda_r = 1.49\sqrt{\frac{E}{F_y}} \qquad \lambda_{pf} = 0.38\sqrt{\frac{E}{F_y}} \qquad \lambda_{rf} = 1.0\sqrt{\frac{E}{F_y}}$$

$$f'_x = \frac{P_x}{A} \qquad f'_y = \frac{P_y}{A} \qquad M_n = \frac{0.9 E k_c S_x}{\lambda^2}$$

$$f''_x = \frac{Ty}{I_p} \qquad f''_y = \frac{Tx}{I_p}$$

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2022
Program: B.Sc. Engineering (Civil)

Course Title: Structural Engineering V (Prestressed Concrete) Credit Hour: 2 Course Code: CE 415
Time: 2 hours Full Marks: 100

Answer all THREE questions. Assume value for any missing data

1.a) **Fig.1** shows the midspan section of a composite system. The precast girder section is an inverted T section, effectively prestressed to 2400 kN. Moment at midspan due to the weight of the precast section is 300 kN-m. After the girder is erected in place, the top slab (150 mm x 1000 mm) is cast on top of it, which produces a moment of 150 kN-m. After hardening of the floor slab, the composite section must carry a maximum live load moment of 750 kN-m. Compute the extreme fiber stresses of the **girder** at midspan section for the following load conditions:

i) Effective prestress force + weight of the precast section + weight of the slab

ii) All loading combined.

b) In another scenario, the precast girder may be supported on falsework while the cast-in-place slab is being poured and the falsework being removed only after the hardening of the slab concrete. For this case, calculate and draw the stress distribution diagram for the entire section at working stage (all loading combined). **[20+10]**

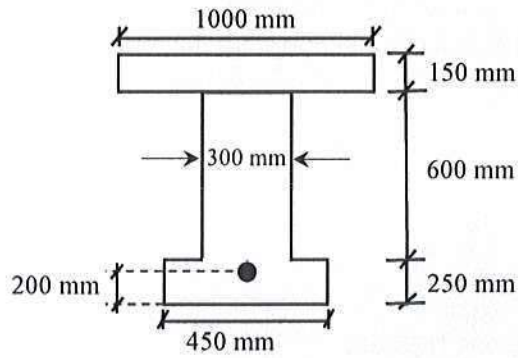


Fig.1

2.a) Construct a preliminary **I-section** for a prestressed-concrete beam, with M_G = 50 kN-m, M_T = 400 kN-m, f_{se} = **850 MPa**, f_c = **-12 MPa**. The depth of the beam 'h' in millimeters can be approximated by an empirical formula $h = 45\sqrt{M_T}$, where M_T is in kN-m.

An I-section is preferred for this solution. Your sketch should clearly show the dimensions of the flange and web, where the width of the flange would be four times the width of the web, and thickness of the flange not exceeding 100 mm.

b) Briefly discuss why an I - section is preferred for this problem. Suggest another shape that will be more cost-effective.

c) Modify the design in **2.a)**, allowing and considering tension in concrete. Sketch the revised section. Given, f_o = **1000 MPa**, f_t' = **2 MPa**, f_b' = **2 MPa**, f_t = **- 12 MPa**, f_b = **- 12 MPa**. **[15+5+15]**

P.T.O.

3.a) Identify the type of shear cracking at section 1-1 of the prestressed girder shown in **Fig.2i** below.
b) **Fig.2ii** shows the simplified longitudinal and cross section of the same girder. Based on the answer to **3.a)**, check the shear strength at section 1-1, which is 1.5 m from the left support. The symmetric I-shaped non-composite section spans 12 m and the c.g.s. of the straight tendon is **135 mm** from the bottom fiber.
Given, $\mathbf{F_{se} = 1971\ kN}$, $\mathbf{f_c' = 48MPa}$. **[5+15]**

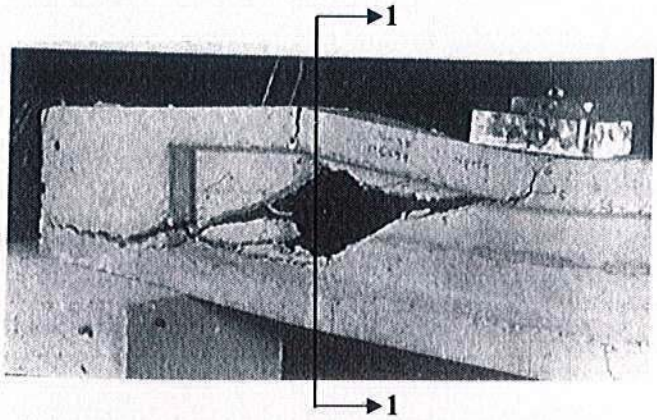


Fig.2i (Sozen, Zwoyer and Siess 1959)

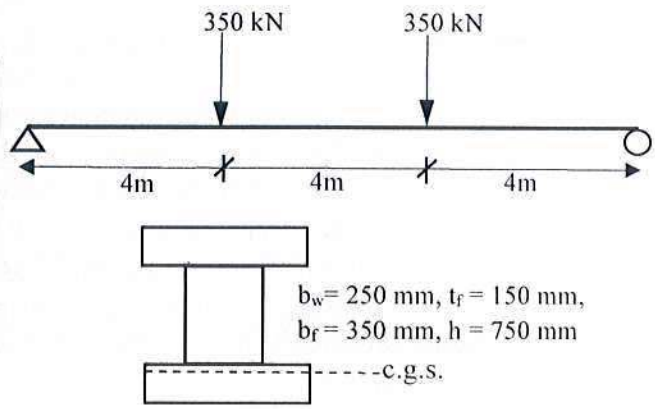


Fig.2ii

4. A rectangular beam with cross-section 450 mm (width) x 1050 mm (depth) is initially posttensioned with a force of 1600 kN. At service load after losses, the prestress in the tendon reduces to 1400 kN. Determine the bearing plate area required to transmit the force to the concrete. Assume, f_{ci}' = 27 MPa, and f_c' = 36 MPa. Take the diameter of the circular hole in the plate (for passing the tendon) to be 125 mm in diameter. **[15]**

Formulae

- $\mathbf{M_G/M_T \leq 30\%}$, $F = \frac{M_L}{0.5h}$
- $\mathbf{M_G/M_T \geq 30\%}$, $F = \frac{M_T}{0.65h}$
- **Elastic design, allowing tension:**

  $e_1 + e_2 = \frac{M_G + f_t' A k_b}{F_O}$, $F = \frac{M_T - f_b' A k_t}{k_t + e}$

  $A_c = \frac{F_O h}{f_b c_t - f_t' c_b}$ **(at transfer)**, $A_c = \frac{Fh}{f_t c_b - f_b' c_t}$ **(under working load)**

  [where f_b & f_t are absolute values]
- $v_{cw} = 0.29\sqrt{f_c'} + 0.3f_{pc} + \frac{V_p}{b_w d}$
- $v_u = \frac{V_u}{\Phi b_w d}$, $\Phi = 0.85$
- $M_{cr} = \frac{I}{y_t}(0.5\sqrt{f_c'} + f_{pe})$
- $V_{ci} = 0.05 b_w d\sqrt{f_c'} + \frac{V_i M_{cr}}{M_{max}}$
- **Average bearing stress on concrete**

  At service load: $f_{cp} = 0.6f_c\sqrt{(\frac{A_b'}{A_b})}$, **not greater than** f_c'

  At transfer load: $f_{cp} = 0.8f_{ci}'\sqrt{\left(\frac{A_b'}{A_b}\right) - 0.2}$, **not greater than** $1.25f_{ci}'$

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2022
Program: B.Sc. Engineering (Civil)

Course Title: Environmental Engineering IV | Credit Hour: 2.0 | Course Code: CE 433
Time: 2 hours | Full Marks: 100

Answer all the questions (30+20+25+25=100). The numbers inside the brackets indicate marks.

1 (a) Define hazardous waste. What are the criteria to identify hazardous waste? (10)

(b) Write down the assumptions of the Fixed Box Model. (10)

(c) What is the sampling technique? What are the criteria of a good sampling program? (10)

2 (a) Discuss the different stages of the life cycle of a lake with figure. (10)

(b) Discuss the pollution control measures to prevent water pollution from industrial sources. (10)

3 (a) A lake is fed by a stream of wastewater. The details are given below: (5)
Lake Area = 130×10^6 m^2, Lake flow rate = 20 m^3/s, Wastewater flow = 0.6 m^3/s, Phosphorus concentration in wastewater = 16 mg/L, Phosphorus concentration in lake = 0, and Settling velocity = 10 m/yr.
Estimate the average phosphorus concentration in the lake. Also, estimate the removal rate at a treatment plant to keep the concentration below 0.015 mg/L.

(b) Compute the efficiency-diameter relation for a gravity settler that has H = 6.7 ft, L = 37 ft, and V_{avg} = 3.7 ft/s, for both the block and mixed flow model, assuming Stokes' law. Here, $\mu = 1.8 \times 10^{-5}$ kg/m.s, $\rho = 2000$ kg/m^3. (10)

(c) Estimate the emissions using Table 4.2 from an 800 MW power plant at full load, burning a typical Pittsburgh seam coal. The thermal efficiency is 40%. The boiler of the power plant is assumed to be PC, tangential fired, dry bottom type. Heating value of coal is 13600 BTU/lb. Ash content = 7.1%, Sulfur content = 2.2%. 1 MW = 3413000 BTU/hr. (10)

4 (a) The area of a city is 4500 miles. The air of the city is heavily polluted with a layer assumed to be 1600 ft thick. One solution to the problem is to pump the air away. Suppose the air should be pumped every day with an average pipe velocity of 55 ft/s. Find the required diameter of the pipe. Is the solution practical? Comment based on your findings. (10)

(b) A plant emits 160 g/s of CO from a stack that has an effective stack height H = 50 m. The wind is blowing at 3.5 m/s, and the stability category is C. Estimate the ground-level concentrations directly below the centerline of the plume at distance 5, 10 and 50 km downwind. Comment on the result. Use Figure 6.9. (10)

(c) A particle is traveling in a gas stream with a velocity of 50 ft/s and a radius of 1 ft. What is the ratio of centrifugal force to gravity force acting on it? Which separator is better, the centrifugal separator or the gravity separator? Explain based on your result. (5)

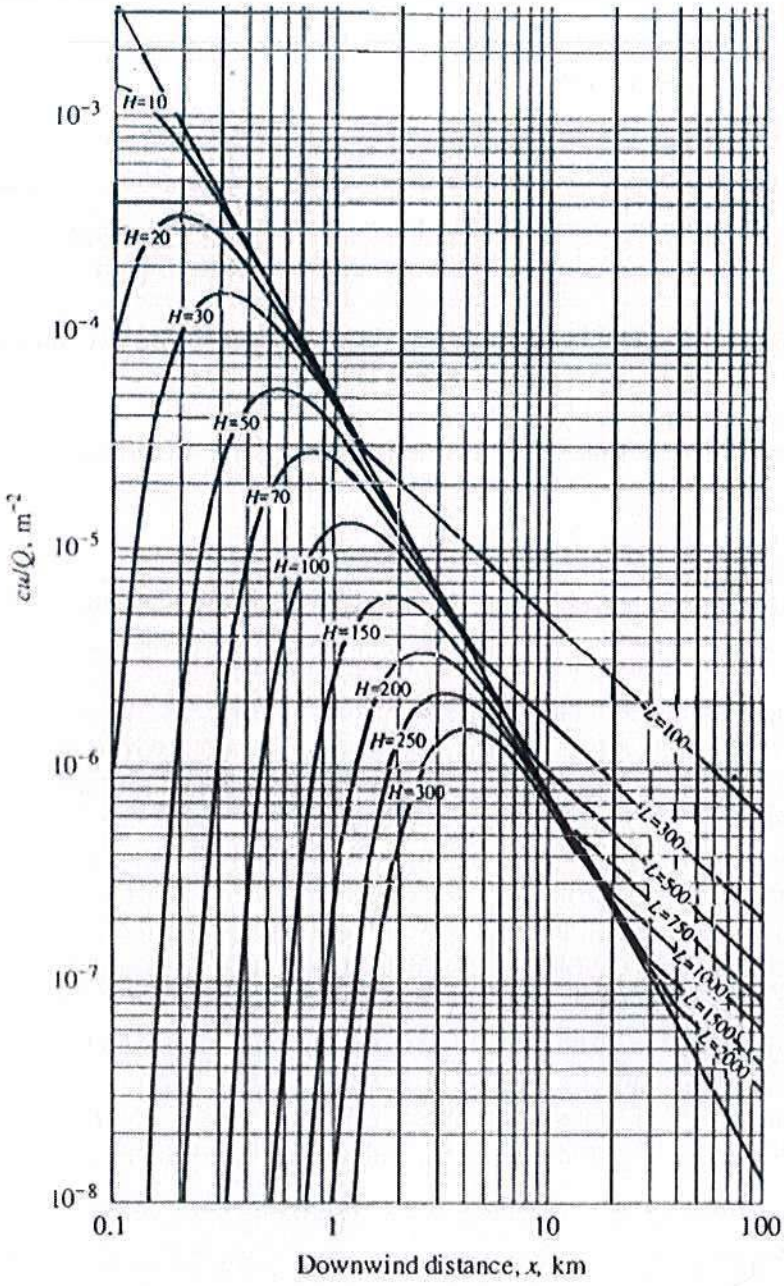


FIGURE 6.9
Ground-level cu/Q, directly under the plume centerline, as a function of downwind distance from the source and effective stack height, H, in meters, *for C stability only.* (From Turner [7].) Here L is the atmospheric mixing height, also in meters.

TABLE 4.2

Emission factors for bituminous and subbituminous coal combustion without control equipment

	Emission factor, lb/ton of coal burned[a]				
Furnace type[b]	All particles[c]	PM_{10}^{c}	$SO_x^{d,e}$	NO_x^{f}	CO
PC, wall-fired, dry bottom	10A	2.3A	38S	21.7	0.5
PC, wall-fired, wet bottom	7A	2.6A	38S	34	0.5
PC, tangential fired, dry bottom	10A	2.3A	38S	14.4	0.5
Cyclone	2A	0.26A	38S	33.8	0.5
Spreader stoker	66	13.2	38S	13.7	5
Hand-fired	15	6.2	31S	9.1	275

Source: Tables 1.1-3 and 1.1-4 of EPA Emission Factors Book [7]. Section 1.1 of that document (Bituminous and Subbituminous Coal Combustion) is 46 pages long and has 19 tables, 6 figures, and 77 literature citations.

[a] To obtain emission factors in kg/MT, divide table values by 2.

[b] The various furnace types are described in [7] and in combustion books. PC means pulverized coal.

[c] The letter A on some particulate and PM_{10} values indicates that the weight percentage of ash in the coal should be multiplied by the value given. Example: If the factor is 10A and the ash content is 8%, the particulate emissions before the control equipment would be 10 · 8 or 80 lb of particulate per ton of coal.

[d] S = the sulfur content, which plays the same role as A in the preceding footnote.

[e] SO_x is expressed as SO_2. It includes SO_2, SO_3, and gaseous sulfates.

[f] NO_x is expressed as NO_2. It includes NO and NO_2.

Department of Civil Engineering
Final Examination Fall 2022
Program: B. Sc. Engineering (Civil)

Course Title: Structural Engineering IX (Earthquake Resistant Design and Retrofitting) | Credit Hours: 2.0 | Course Code: CE 423

Time: 2 hours | Full Marks: 70 (= 7 × 10)

PART A

[Answer **any 2 (Two)** of the following 3 questions]

1. For the structures/elements shown damaged in earthquakes in Figs. 1(a)~(d), write briefly on
   (i) Likely reason for their damage
   (ii) An effective measure that could have prevented/reduced such damage.

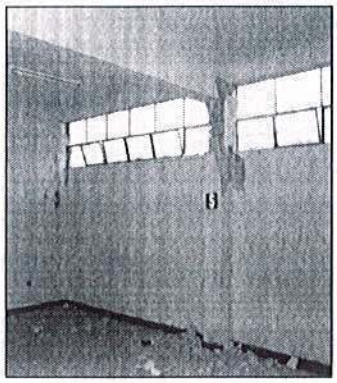


Fig. 1(a)

Fig. 1(b)

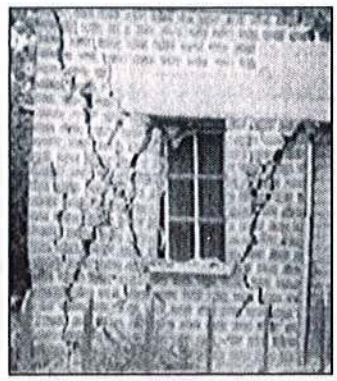


Fig. 1(c)

Fig. 1(d)

2. Briefly describe the seismic retrofit schemes shown in Figs. 2(a)~(d).

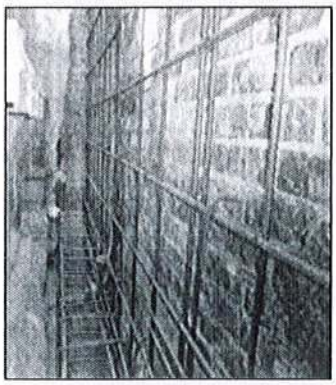


Fig. 2(a)

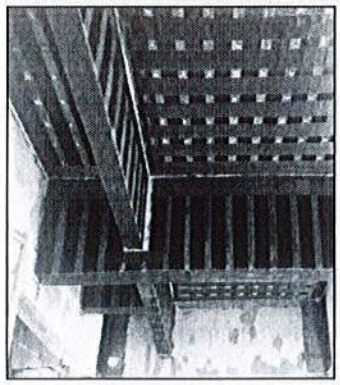


Fig. 2(b)

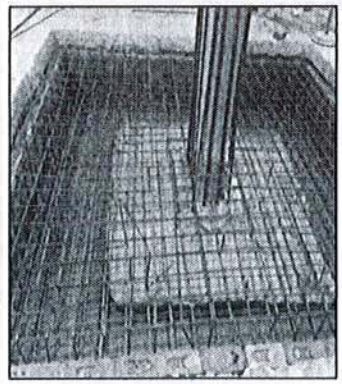


Fig. 2(c)

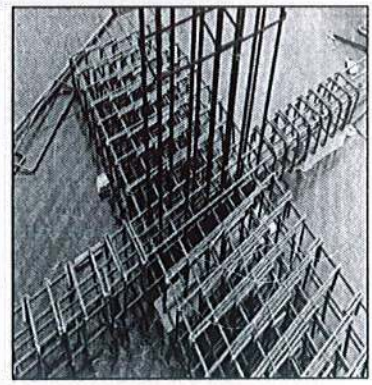


Fig. 2(d)

3. Explain briefly OR draw appropriate sketches (with proper labels) to show
   (i) Details of seismic safety measures for your 'Air-Conditioner' and 'Partition Wall'.
   (ii) Two possible major effects of soil condition on structural response in earthquake.
   (iii) Two seismic retrofit schemes you can apply to a historical brick building, maintaining its external appearance.
   (iv) What you would do if an earthquake hits you right now.

PART B

[Answer **any 5 (Five)** of the following 6 questions]

[Given: R_0 = Last Two Digits of Registration Number, $f_y = (40 + R_0/10)$ ksi, $f_c' = f_y/15$, $E_c = 1000\, f_c'$]

4. Fig. 3 shows the ground floor plan of a 3-storied brick masonry building (with 9′-high solid walls)

   (i) Calculate the
   - Seismic shear force that would cause direct shear stress $\tau_d = (100 + R_0)$ psi in the in-plane walls
   - Maximum torsional shear stress and Maximum horizontal deflection of the building for the shear force calculated

   (ii) Check the adequacy of thickness of the out-of-plane walls

   [Given: $E_{Masonry} = 500 f_c'$, $t_{Wall} = 10''$].

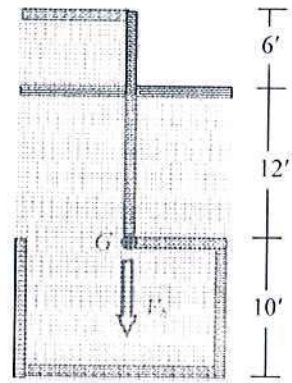


Fig. 3

5. Fig. 4(a) shows the floor plan of a 4-storied steel frame (with 9′ high columns), with member sections as shown in Fig. 4(b), and load on each beam is $w_u = 4.4$ k/ft.

   (i) Calculate shear force capacities V_{beam} and V_{col}

   (ii) Compare the moment capacities M_{pb}* and M_{pc}*.

   $L = (15 + 0.05R_0)$ ft

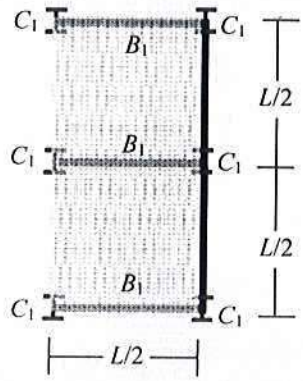


Fig. 4(a)

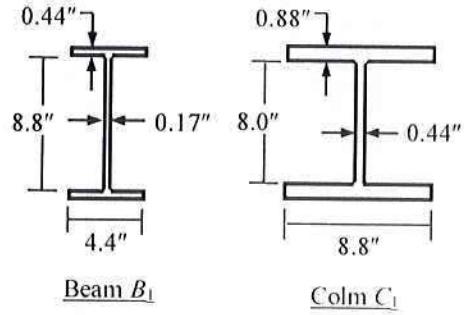


Fig. 4(b)

OR

For the ground floor plan of a 4-storied steel frame (with 9′-high columns) shown in Fig. 4(c), with beam load $w_u = 4.4$ k/ft.

Use the beam and column sections shown in Fig. 4(b) and determine the

(i) Appropriate dimensions (a, c, R) of Reduced Beam Section (RBS)

(ii) Plastic moment capacity of the bream section and RBS

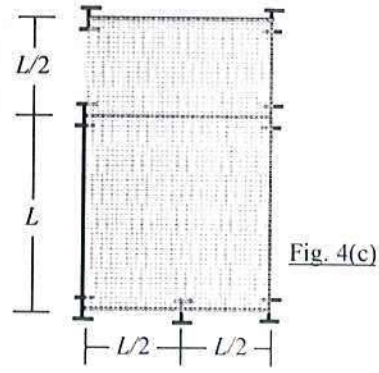


Fig. 4(c)

6. Fig. 5 shows beam (weighing $w = (3 + 0.01R_0)$ k/ft) carrying weight W $(= (10 + 0.05R_0)$ k) and (1′ × 1′) square Column C_0 supported on the 6″-thick flat-slab *abcd*.

Calculate the

(i) Direct Shear force (V_u) and Unbalanced moment (M_{uv}) to be transferred by shear

(ii) Punching shear stress (v_p) around the column, considering the effects of V_u and M_{uv}.

(iii) Allowable punching shear stress (v_{all}) for Drift Ratio (DR) = 0.01.

(iv) Bent-bar shear reinforcements required around the column.

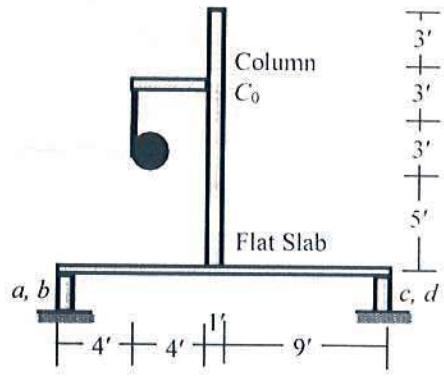


Fig. 5

7. Figs. 6(a), 6(b) show 'weightless' cantilever column a [of height $H = (10 + 0.1R_0)$ ft and Diameter $= (20 + 0.1R_0)$ inch] carrying a weight $W = 44$ kips.

Fig. 6(a) shows it is supported on a Base Isolation system weighing $W_b = 4.4$ kips, Shear Modulus $G = 100$ psi, Bearing Area $A = 100$ in^2, Height $h = 10''$, while Fig. 6(b) shows it supports the same system (i.e same mass and stiffness as the Base Isolation system) as a Tuned Mass Damper (TMD) at top.

Determine the natural frequencies and modal shapes of the system in

Fig. 6(a) OR Fig. 6(b).

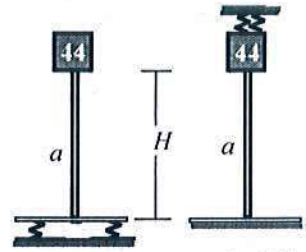


Fig. 6(a) Fig. 6(b)

8. The ground floor plan of a 10-storied RC frame (with 9' high columns) is shown in Fig. 7. All beams are uniformly loaded at $w_u = 4.4$ k/ft.

The column 'C_0' [of dimension $(h \times h)$] is reinforced with longitudinal steel ratio = 0.044, clear cover = 1.5" and 20-mm ties @$S_t = h/2$.

Check whether

(i) Tie reinforcements are adequate for major seismic detailing provisions

(ii) The column would yield in flexure before it fails in shear.

$L = (15 + 0.05R_0)$ ft
$h = (15 + 0.05R_0)$ in

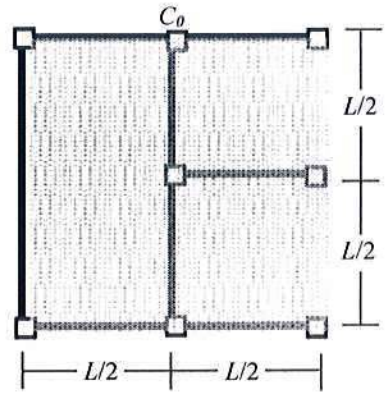


Fig. 7

9. Dohar earthquake (May 5, 2023) (of magnitude $M_w = 4.3$) struck Bangladesh, 11 km west of Dhaka. The hypo-center (focus) of this earthquake had a shallow depth of 10 km. Estimate the

(i) Peak ground acceleration (PGA) of the earthquake [using Esteva-Villaverde (1974)], as well as its intensity [Bolt (1993)]

(ii) Magnitude of the earthquake that would cause the PGA to match the design value in BNBC 2020

(iii) Warning time for an the observer in Dhaka [Given: Shear Wave velocity $V_s = (500 + 5R_0)$ m/sec, $\rho_{Soil} = 2200$ kg/m^3].