University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2019
Program: B. Sc. Engineering (Civil)

7-2

Course Title: Environmental Engineering IV | Course Code: CE 433
Time: 2.00 Hours | Credit Hour: 2.00 | Full Mark: 100

There are four questions. Answer all the questions. (4 X 25 = 100)
(Assume any missing data)

1. A coal burnt power plant emits SO_2 with an emission rate of 127 g/s through a stack that has an effective height of 75m. The wind speed at the stack height is 6.0 m/s and the atmospheric condition is slightly unstable (Stability class C). (25)

   (a) Estimate ground-level concentration of SO_2 directly downwind at distances of 500 m, 700 m, 900 m, 1.2 km, and 2.0 km from the plant stack; and

   (b) Determine the maximum ground-level concentration of SO_2 and the distance from the stack at which the maximum occurs.

   Gaussian Plume Equation used for ground level concentration (z = 0) on centerline (y=0) (with ground reflection), c (x, 0, 0), is as below.

$$c = \frac{Q}{\pi u \sigma_y \sigma_z}\left[\exp -0.5\left(\frac{H}{\sigma_z}\right)^2\right] \quad \text{.....(1)}$$

   The two dispersion coefficients in the above equation, σ_y and σ_z can be reasonably estimated using the charts provided:

2. (a) Identify the specific air pollution control technologies that are available to control particulate emissions at source. State their operating principles and indicate the size range of particulates that each type of technology is capable to remove efficiently. (12)

   OR

   Describe some important health effects of particulate matter (PM), particularly, $PM_{2.5}$; carbon monoxide (CO); and sulfur dioxide (SO_2). Indicate the particular health hazards that are posed by SO_2 in a dusty atmosphere and summarize the mechanism by which H_2SO_4 mist can cause damage to limestone surfaces.

   (b) What are some important advantages of baghouse filters as a particulate emission control technology? Give some examples of its application. (13)

   A fabric filter baghouse must process 15.0 m^3/s of particulate laden air from an industry. Laboratory analysis indicates an air-to-cloth ratio of 9.0 $m^3/min.\ m^2$ cloth will provide adequate filtration. The bags are 0.25 m in diameter and 7.0 m long.

   Determine the number of bags required for a continuously cleaned operation.

3 (a) Please refer to the group project you have worked on for CE 433 Course on "Impact of pollution and solution". Outline some evaluations from your investigations on the impacts of the source of pollution that you studied (industry or system or process). The effect on environment and society could be discussed. (12)

(b) Consider yourself to be working upon a project on rehabilitating Gulshan lake for which you are trying to understand the sustainability of aquatic life forms in different seasons. Make a comparative assessment of seasonal stratification in the lake (Summer and Winter Stratification) and its impact on concentration of Dissolved Oxygen (DO) from your knowledge on thermal stratification. If the lake has a serious problem of eutrophication, evaluate certain strategies to slow down the process or ways you can reverse eutrophication to rehabilitate the river ecosystem. Evaluate the eutrophication potential of Gulshan lake if the water quality analysis shows the concentrations of nutrients P = 0.03 mg/L and N = 0.45 mg/L in the lake. (5+8)

OR

Identify the two processes that are considered in a simple DO model.

Dhanmondi lake has a surface area of 250×10^6 m^2 and only one outlet is responsible for discharging phosphorus into the lake, consider effluent flow rate to be 0.55 m^3/s with concentration of phosphorus at 12 mg/L (= 12 g/m^3). A stream feeds into the lake flowing at a rate of 25 m^3/s with no phosphorus in it. Settling rate of phosphorous can be considered to be 10 m/yr. Calculate the average concentration of phosphorus in the lake. Also analyze the percent removal at the outlet that would be required to keep the average concentration in the lake below 0.05 mg/L. $P = \frac{S}{Q + v_s \cdot A}$

4 (a) Make a comparative evaluation between "Ground water pollution" and "Surface water pollution" based on pollution potential (ways of pollution), process involvement from water cycle (that brings pollutants) and pollution prevention strategies. (13)

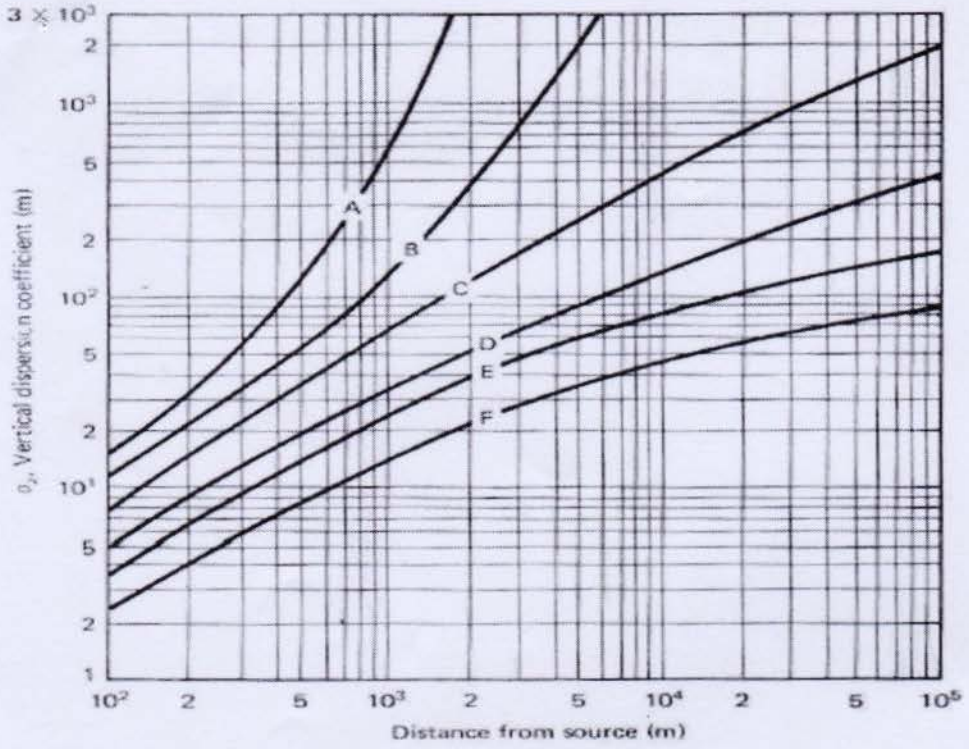
OR

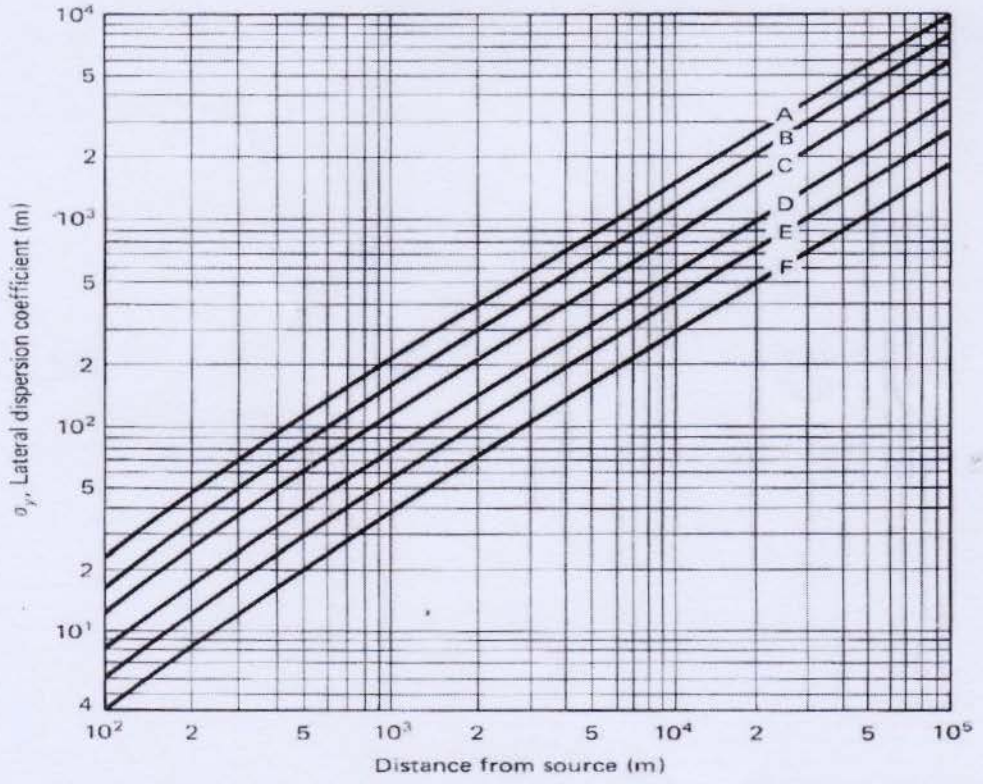
You are an employee of National River Conservation Commission which is working on an urgent requirement to deal with the high concentration of "persistent pollutants" present in Turag and Tongi Canal. You have to provide a solution based on stream purification concept. Please provide your understanding on "waste assimilation capacity" including the physical and chemical forces helping the process. How would you suggest the "persistent pollutants" to get purified from the rivers or which mechanism should influence the role? Also explain how the physical characteristics of the rivers might influence the waste assimilation capacity in general.

(b) Rivers around Dhaka city are facing severe pollution due to both municipal discharge and industrial discharge from outfalls. If you are working on a plan to mitigate the pollution, assume your first suggestion is establishment of cooperative treatment plants. Now, choose the factors first that you need to consider while choosing this control measure. If you have to find a non-invasive and non-expensive solution, explain how you will apply the following measures: (12)

Reducing effluent concentration (C_w), Reducing effluent volume (Q_w).

Given Formulae:





For **Question No. 1**: Charts for determining the dispersion coefficients, σ_z and σ_y

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2019
Program: B. Sc. in Civil Engineering

Course Title: GIS and Remote Sensing | Course Code: CE 531(10:00 am-12:00 pm)

Time: 2.00 Hours | Full Marks: 110

Section A
Marks Distribution [10+10]

1. Answer the following multiple choice questions. **[10*1=10]**

(a) GIS uses the information from which of the following sources?
- (i) Non- spatial information system
- (ii) Spatial information system
- (iii) Global information system
- (iv) Position information system

(b) Which of the following statements is true about the capabilities of GIS
- (i) Data capture and preparation, presentation
- (ii) Data management, including storage and maintenance
- (iii) Data manipulation and analysis
- (iv) All of the above

(c) GIS is the ..... between information processing and the many fields using spatial analysis techniques
- (i) major ground
- (ii) Basic ground
- (iii) common ground
- (iv) estimated ground

(d) Which of the following formats can be used for GIS output?
- (i) DXF
- (ii) PDF
- (iii) GIF
- (iv) HTML

(e) What are the two general data formats used in GIS?
- (i) Vector and raster
- (ii) Points and lines
- (iii) Features and attributes
- (iv) Digital and paper maps

(f) How are neighborhoods represented in GIS?
- (i) Polygons
- (ii) Lines
- (iii) Points

(iv) Locations

(g) A ..... system involving the integration of spatially referenced data in a problem solving environment. (Cowen, 1988)
   (i) Complex support
   (ii) decision support
   (iii) analysis support
   (iv) storage

(h) GIS uses the information from which of the following sources?
   (i) Non- spatial information system
   (ii) Spatial information system
   (iii) Global information system
   (iv) Position information system.

(i) GIS deals with which kind of data
   (i) Numeric data
   (ii) Binary data
   (iii) Spatial data
   (iv) Complex data

(j) Successful spatial analysis needs
   (i) Appropriate software
   (ii) Appropriate hardware
   (iii) Competent user
   (iv) All of the above

2. Answer the following questions. **[2*5=10]**

(a) Discuss "Terrain Analysis" in GIS.
(b) What are the application of GIS for an Environmental Engineer?
(c) Discuss the Disciplines & Technologies connected to GIS.
(d) Sketch the component of Remote sensing System.
(e) What does land cover mean?

Section B

Answer the following questions

Marks Distribution [30+30+30]

3. (a) Find out the bank shifting pattern of "Lower Meghna" for the last two decades. **[10]**

   (b) Geo-reference the image of Rajshahi district and then convert the file as Google earth format. Digitize the geo-referenced image of Rajshahi district boundary along with its water bodies, water ways, roadways, railways track. Calculate the total area of water bodies. Which one is the mostly used transportation system in this area? **[20]**

4. (a) Extract DEM file of Rajshahi district from USGS website earth explorer. **[10]**

   (b) Use the extracted DEM to perform the contour processing. From the contour mapping find out the area having the highest elevation. **[10]**

   (c) Derive the slope gradient from the DEM you have extracted. Improve the display; change the number of classes to 15. What type of raster operation is the calculation of slope gradient? Write down the maximum, minimum and mean of the slope gradient dataset. Perform few other terrain processing to extract the terrain information. **[10]**

5. (a) Find out the changes in land use pattern in terms of Urban area, Barren soil, Vegetation and Water for the last 30 years of Rajshahi District. You have to extract the satellite images from USGS earth explorer. Discuss the significant changes considering the land use pattern practice. **[20]**

   (b) From the point shape file select Rajshahi University. Select the places which are within 1600 m from Rajshahi University. Are there any schools situated in the selected area? What is the total suburb area around this 1500 m from the selected feature. **[10]**

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2019
Program: B.Sc. Engineering (Civil)

Course Title: Environmental Engineering III | Course Code: CE 431
Time: 2.00 Hours | Credit Hour: 2.00 | Full Marks: 100

Answer all the questions. Please note that all questions are NOT of equal value.
Assume data if not available.

1. (a) Explain the term "E-waste". What are the challenges of managing E-waste in Bangladesh? [5+10]

   (b) Draw the hierarchy of priorities in Hazardous Waste Management (HWM). [5]

2. (a) Distinguish the following collection systems of Municipal Solid Waste (MSW) with neat sketches: [15]
   i) hauled-container system: Exchange container mode
   ii) hauled-container system: Conventional mode
   iii) stationary-container systems

   (b) With a free hand graph explain the cost comparison with and without transfer station in a MSW management system. [5]

3. (a) Explain the mechanism of anaerobic solid waste digestion (Figure and chemical reaction required). [15]

   OR

   Explain in details the process flow diagram for MSW composting facilities (Figure required).

   (b) Justify the necessity of recycling and reuse in MSW management system from environmental view point. [5]

4. (a) Compare the following solid waste disposal methods in terms of characteristics and environmental impacts: i) open dump ii) controlled dump and iii) sanitary landfill [15]

   (b) Make comments on "After-use of landfill sites". [5]

5. (a) Solid wastes having the composition showed in Table 1 were generated in the cafeteria of University of Asia Pacific. Determine the energy content of the generated solid wastes from 100 Kg sample. [10]

(b) Estimate the total gas (theoretical) that could be produced from the organic fraction of MSW under anaerobic conditions using the given data below: [10]

- Chemical formula without water= $C_{60}H_{80}O_{40}N$.
- Total weight of organic material is 80 kg including moisture in 100 kg of solid waste. Use the equation given below.

OR

Barrels of 75-gal (US) capacity are to be used for a barrel composting plant for a community of 1000 people in Gazipur. The plant will operate throughout the year. The average temperature measured within the waste is 43° C. The composition of solid waste in a 100kg sample is given in following Table 2. The targeted loss of volume is 50 per cent and the average density of the waste is 450 kg/m^3. The waste generation rate of Gazipur is 0.4 kg/capita/day. Compute the number of barrels required in the barrel composting plant.

Equation:

$$C_aH_bO_cN_d+\left(\frac{4a-b-2c+3d}{4}\right)H_2O\rightarrow\left(\frac{4a+b-2c-3d}{8}\right)CH_4$$
$$+\left(\frac{4a-b+2c+3d}{8}\right)CO_2+dNH_3$$

Table: 1 (Question No. 5 (a))

Component	Weight (%)	Composition (Kg)					
		C	H	O	N	S	Ash
Food wastes	60	13	0.5	2.5	0.5	0.03	1.47
Paper	25	5.5	1.3	6.4	0.71	0.09	1.0
Plastics	15	3.3	0.35	1.1	--	--	0.15

Table: 2 (Question No. 5 (b) OR)

Component	Wet mass, kg	Dry mass, kg	Composition, Kg					
			C	H	O	N	S	ASH
Food Waste	45	18	13	0.5	2.5	0.5	0.03	1.47
Paper	22	15	5.5	1.3	6.4	0.71	0.09	1.0
Cardboard	8	7.5	3.1	0.31	3.2	0.06	0.03	0.8
Plastics	5	4.9	3.3	0.35	1.1	-	-	0.15
Garden trimming	15	5	1.7	0.65	1.85	0.25	0.01	0.54
Wood	5	4	2.1	0.21	1.35	0.2	-	0.14

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2019 (Set A)
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)

---

1. In the earthquake-resistant schemes shown in Figs. 1(a)~(d), comment on arrangement and purpose of

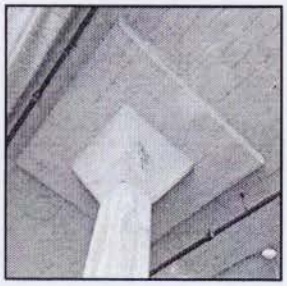


Fig. 1(a)

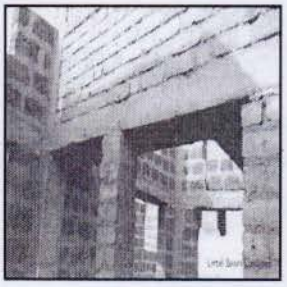


Fig. 1(b)

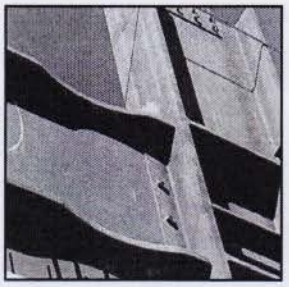


Fig. 1(c)

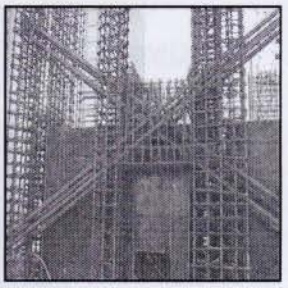


Fig. 1(d)

(i) Drop Panel of Flat Slab [Fig. 1(a)]
(ii) Through/Continuous Lintel of Brick Masonry [Fig. 1(b)]
(iii) Modified Steel Beam Section [Fig. 1(c)]
(iv) Coupled Shear Wall [Fig. 1(d)].

2. Briefly describe the seismic retrofit and rescue measures shown in Figs. 2(a)~(d).

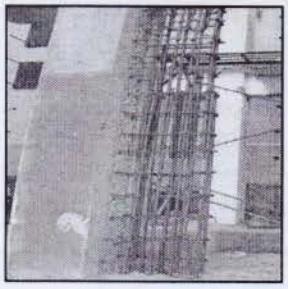


Fig. 2(a): Wing Wall

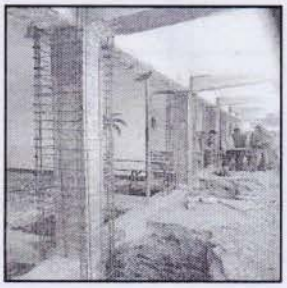


Fig. 2(b): Column Jacket

Fig. 2(c): Self Safety

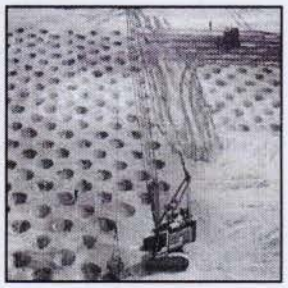


Fig. 2(d): Soil

OR

For structures shown in Figs. 2(e)~2(h) damaged in earthquakes (outside Bangladesh), write briefly on

(A) Likely reason for their structural damage

(B) An effective measure that could have prevented such damage.

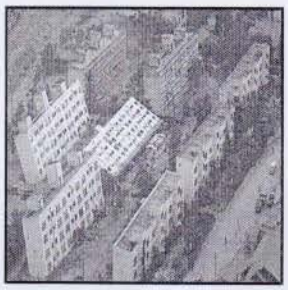


Fig. 2(e): Tilted Buildings
(Nigita 1964)

Fig. 2(f): RC Joint
(Turkey 1999)

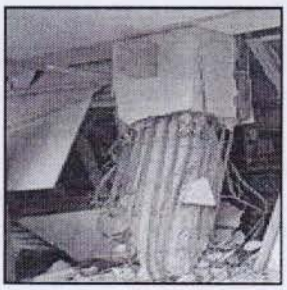


Fig. 2(g): RC Column
(Northridge 1994)

Fig. 2(h): RC Column
(Armenia 2009)

3. Fig. 3 shows a 1-storied frame with 2″-thick flat plate, carrying W_L (= 13 × 125 lb) as live load, supported on three circular columns a_0, b_0 and c_0 (each of diameter d) with Fixed-Base.

   If the central column b_0 carries half the vertical load (i.e. $P_{b0} = W/2 = (W_D + W_L)/2$), while the seismic base shear force V_{base} (= $0.4W$) is resisted equally by the three columns (i.e. $V_{a0} = V_{b0} = V_{c0} = V_{base}/3$)

   (i) Draw the Bending Moment Diagram of the columns and slab

   (ii) Calculate the Maximum Punching shear stress at joint b_0 of the slab, considering both direct shear stress and torsional shear stress

   [Given: $L = 2 +$ (Roll No./100) ft, $d = 1 +$ (Roll No./200) in].

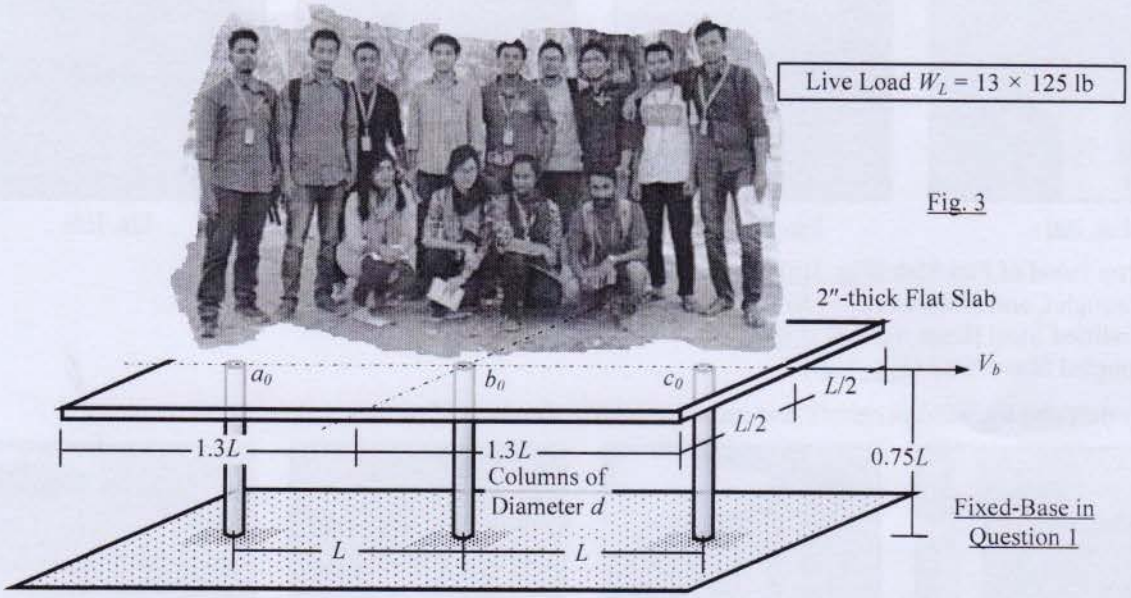


Fig. 3

4. Instead of the massless 'Fixed-Base', the 1-storied frame structure (with three columns) loaded as shown in Fig. 3 (described in Question 3) is supported on three square-shaped base-isolators (i.e. foams) shown in Fig. 4(a), with

   Width $B = L/2$
   Height $h = L$
   Shear Modulus $G = 100$ psi

   [Given: $L = 2 +$ (Roll No./100) ft].

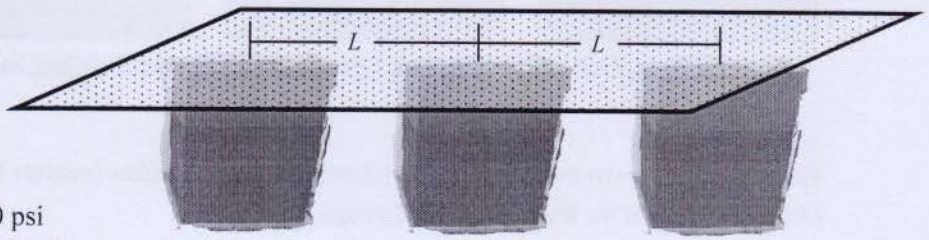


Fig. 4(a)

   (i) Determine the 1st Natural frequency and Modal Shape of the Frame-Foam system

   (ii) Use the BNBC-2015 response spectrum ($Z = 0.20$, $S = 1.2$, $T_B = 0.15$, $T_C = 0.50$, $T_D = 2.0$ sec) to calculate the base shear of the Frame-Foam system, for the 1st mode of vibration.

OR

Fig. 4(b) shows the 6m-high 'Newton's Tree' at his garden in England, while Fig. 4(c) shows the tree with 100 apples (each apple weighing 1-N, hanging from 1-mm branch).

Average diameter of tree's trunk is 0.40-m, while its weight (assumed concentrated at top) is 5000-N.

Determine the

(A) 1st Natural frequency of the tree in Fig. 4(b)

(B) 1st Natural frequency and modal shape of the tree-with-apples in Fig. 4(c) [a 2-DOF system]

[Assume Modulus of elasticity of tree and branch $E_t = 10{,}000$ N/mm^2].

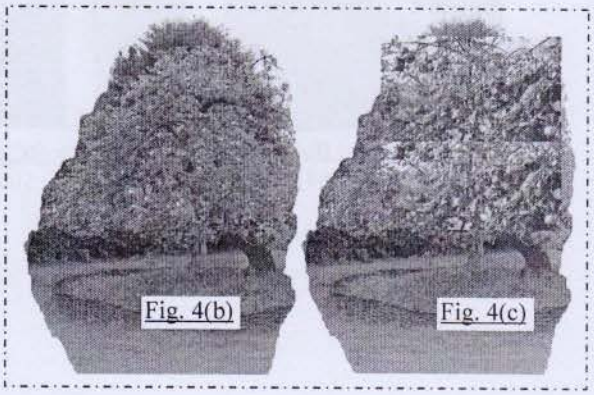


Fig. 4(b) Fig. 4(c)

5. Fig. 5(a) shows the Lalbag Fort Mosque, a 1-storied brick masonry structure whose floor plan and walls are shown in Fig. 5(b).

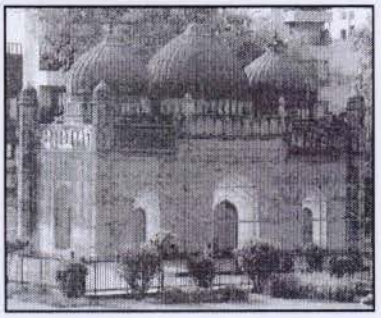


Fig. 5(a): Lalbag Fort Mosque

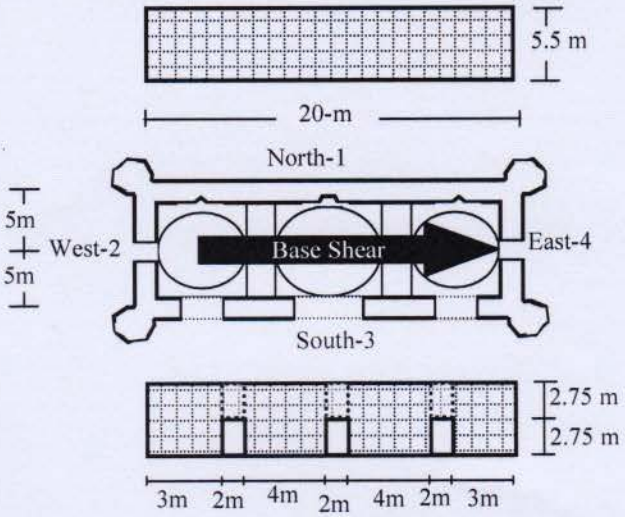


Fig. 5(b): Plan and Walls of Lalbag Fort Mosque

(i) Neglect the openings shown in Fig. 5(b) and Fig. 5(c) to calculate the stiffness and shear stress at North-1 and South-3, when subjected to base shear V_b = 1000 kN

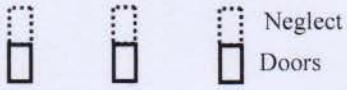


Fig. 5(c)

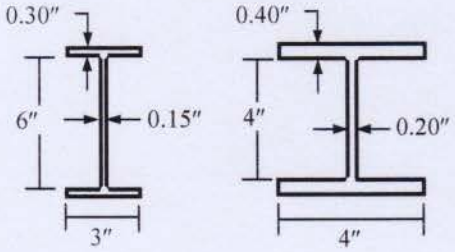
[Given: E_c = 15 GPa, t_{Wall} = (1 + Roll No./100) m].

(ii) Check South-3 shown in Fig. 5(b) for total opening size and wall thickness.

6. Given the beam and column sections shown in Fig. 6(a) for the steel frame loaded as in Fig. 6(b), with f_y = (50 + Roll No./10) ksi, check if the

(i) (h/t_w) of Beam section is large enough

(ii) 'Weak-Beam-Strong-Column' condition is satisfied.



Beam Column

Fig. 6(a)

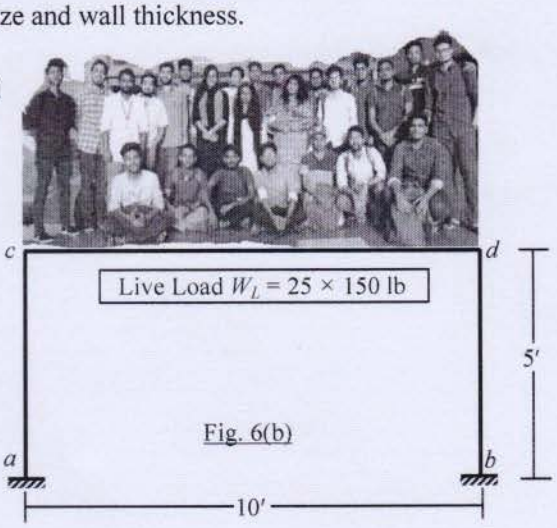
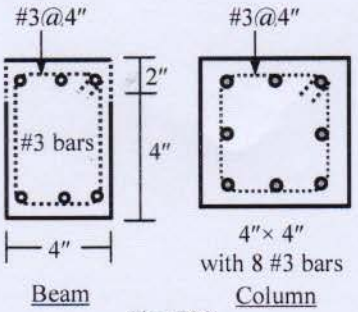


Fig. 6(b)

7. Given the beam and column sections shown in Fig. 7(a) for the RC frame in Fig. 6(b), with f_y = (50 + Roll No./10) ksi, f_c' = f_y/15, check if the

(i) Beam section will fail in shear or in flexure

(ii) 'Weak-Beam-Strong-Column' condition is satisfied.



Beam Column

Fig. 7(a)

OR

If the El Centro earthquake (1940) with (M_w = 6.9) originated from rock with shear modulus 100 GPa, Poisson's Ratio 0.10 and density 2000 kg/m^3, calculate the

(A) Average displacement of the fault plane over a rupture area of 5000 km^2

(B) Epicentral distance [using Milne-Davenport (1969)] for a ground motion with Z = 0.313

(C) Warning time for an observer at the Epicentral distance calculated in (B).

List of Useful Formulae for CE 423

* $Z = 0.0069\, e^{(1.64\,M)}/\{1.1\, e^{(1.1\,M)} + R_e^{\,2}\}$ [Milne and Davenport (1969)]

* Governing equation of motion of SDOF system for ground motion $\Rightarrow m\, d^2u_r/dt^2 + c\, du_r/dt + k\, u_r = -m\, d^2u_g/dt^2$

* For lumped 2-DOF system

$$\begin{pmatrix} m_1 & 0 \\ 0 & m_2 \end{pmatrix} \begin{Bmatrix} d^2u_1/dt^2 \\ d^2u_2/dt^2 \end{Bmatrix} + \begin{pmatrix} c_1 + c_2 & -c_2 \\ -c_2 & c_2 \end{pmatrix} \begin{Bmatrix} du_1/dt \\ du_2/dt \end{Bmatrix} + \begin{pmatrix} k_1+k_2 & -k_2 \\ -k_2 & k_2 \end{pmatrix} \begin{Bmatrix} u_1 \\ u_2 \end{Bmatrix} = \begin{Bmatrix} f_1(t) \\ f_2(t) \end{Bmatrix}$$

* Eigenvalue problem (to calculate natural frequencies and modal vector)

$$|\mathbf{K} - \omega_{nr}^{\,2}\, \mathbf{M}| = 0 \qquad \text{and} \qquad [\mathbf{K} - \omega_{nr}^{\,2}\, \mathbf{M}]\, \boldsymbol{\phi}_r = \mathbf{0}$$

* <u>BNBC 93</u>

$V_b = ZICW/R$, where $C = 1.25S/T_n^{2/3} \le 2.75$

* $T_n = C_t\,(h_n)^{3/4}$

$C_t = 0.083$ for steel, 0.073 for RC frame, 0.049 for others

* <u>Proposed new BNBC-2015</u>

$V_b = (2/3)\, ZICW/R$, where

$C = S\,[1 + (T_n/T_B)\,(2.5\eta - 1)]$ for $0 \le T_n \le T_B$

$= S\,(2.5\eta)$ for $T_B \le T_n \le T_C$

$= S\,[(2.5\eta)\,(T_C/T_n)]$ for $T_C \le T_n \le T_D$

$= S\,[(2.5\eta)\,(T_C T_D/T^2)]$ for $T_D \le T_n$

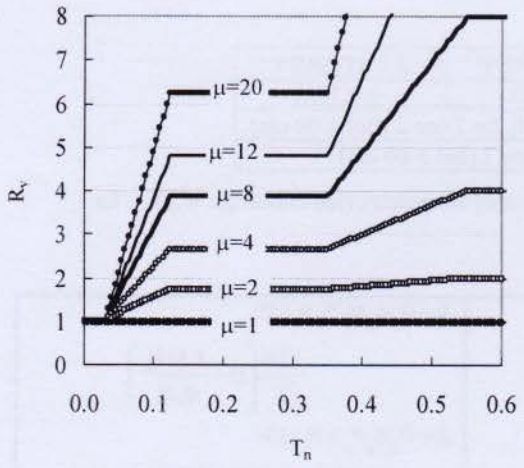
Soil Type	S	T_B	T_C	T_D
SA ($V_s \ge 800$m/s)	1.00	0.15	0.40	2.00
SB	1.20	0.15	0.50	2.00
SC	1.15	0.20	0.60	2.00

* $T_n = 0.0466(h_n)^{0.90}$ for RC frames

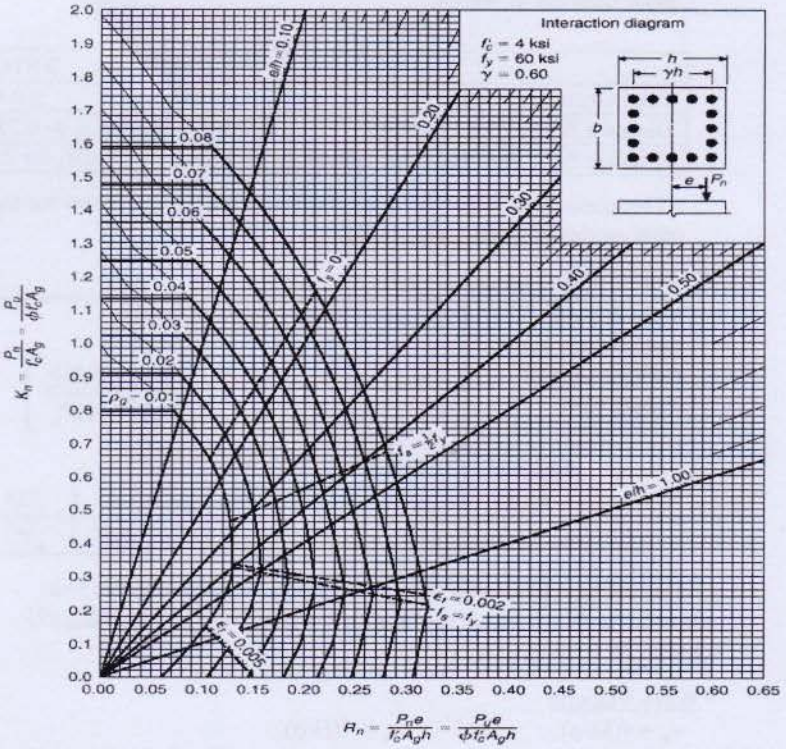
$= 0.0724(h_n)^{0.80}$ for Steel frames

$\eta = \sqrt{\{10/(5+\xi)\}} \ge 0.55$

* $R_y = f_0/f_y$ $\quad \mu = u_m/u_y$



Variation of R_y with T_n



* <u>Reinforced Concrete</u>

* $V_{Des} \ge 1.4\,(M_{ul} + M_{u2})/L_n + V_{Ext}$

* For Beam, $a = A_s f_y/0.85 f_c' b$

$M_{ult} = A_s f_y\,(d - a/2)$

* $V_c = 2\sqrt{f_c'}\,bd$, $\quad S_{max} = A_s f_y d/(V_n - V_c)$

* $\sum M_{c,ult} \ge 1.2 \sum M_{b,ult}$

* Flat slab

$M_{ub} = [1/\{1+ 2/3\sqrt{(c_1 + d)/(c_2 + d)}\}] M_u$ and $M_{uv} = M_u - M_{ub}$

$v_l = V_u/A_c - M_{uv}\, c_l/J_c$ and $v_r = V_u/A_c + M_{uv}\, c_r/J_c$

where A_c = Area of the critical section

c_l, c_r = Distances from centroid of critical section to the left and right face of section respectively

J_c = Property of critical section analogous to polar moment of inertia

For an interior rectangular column, $A_c = d\,[2(c_1 + d) + 2(c_2 + d)]$

$J_c = 2d(c_1+d)^3/12 + 2(c_1+d)d^3/12 + d(c_2+d)(c_1+d)^2/2$

For an interior circular column, $A_c = \pi d(c + d)$, $J_c = \pi d(c + d)^3/8$

Lateral Drift and Punching Shear

DR = 3.5 – 5.0 VR, if VR ≤ 0.6 and DR = 0.5, if VR > 0.6

where VR is the shear ratio, given by the relation, $VR = V_u/(\phi V_c)$

where V_u is the factored axial force of the column and V_c is the nominal capacity in the absence of unbalanced moment, calculated from

$V_c = (2 + 4/\beta_c)\sqrt{f'_c}\, b_o\, d \le 4\sqrt{f'_c}\, b_o\, d$

* Brick Masonry

Stiffness of Cantilever and Fixed Wall or Pier (Wall height h, width d, thickness t, E_m = Modulus of elasticity)

$k_c = E_m t/[4(h/d)^3 + 3(h/d)]$ $k_f = E_m t/[(h/d)^3 + 3(h/d)]$

$X_m = \sum(W_i X_i)/\sum W_i$ and $Y_m = \sum(W_i Y_i)/\sum W_i$

$X_r = \sum R_{yi} x_i$ and $\bar{Y}_r = \sum R_{xi} y_i$

Torsional eccentricities are given by $e_x = \bar{X}_m - \bar{X}_r$ and $e_y = \bar{Y}_m - \bar{Y}_r$

$P_{xi} = P_x (R_{xi}) \pm P_x e_y (R_{xi}\, \bar{y}_i/J_r)$ $P_{yi} = P_y (R_{yi}) \pm P_y e_x (R_{yi}\, \bar{x}_i/J_r)$

where $\bar{x}$ or $\bar{y}$ are perpendicular distances from center of rigidity to the wall axis and $J_r = \sum(R_y\, \bar{x}^2 + R_x\, \bar{y}^2)$ is the polar moment of inertia.

	1 STOREY	2 STOREY	≥ 3 STOREY
Total Opening $B_1 + B_2 + B_3$	$\le 0.5L_1$	$\le 0.42L_1$	$\le 0.33L_1$
Distance B_4 between Openings	$\ge 0.5H_2$ for Zone 3, or $0.25H_2$ for Zone 2 (but ≥ 60 cm)		
Distance B_5 of Opening from Corner	$\ge 0.25H_1$, or $0.125H_1$ for Zone 2 (but ≥ 60 cm)		

- Thickness (t) of wall ≥ h/14 for single-storied buildings, h/9 for top story of multistoried buildings, h/20 for other stories of multistoried buildings

* Steel Structure

Webs of I-shaped beams in combined flexure and axial compression	h/t_w	for $P_u/\phi_b P_y \le 0.125$: $\frac{640}{\sqrt{F_y}}\left(1 - \frac{2.75 P_u}{\phi_b P_y}\right)$ for $P_u/\phi_b P_y > 0.125$: $\frac{191}{\sqrt{F_y}}\left(2.33 - \frac{P_u}{\phi_b P_y}\right) \ge \frac{253}{\sqrt{F_y}}$	for $P_u/\phi_b P_y \le 0.125$: $\frac{520}{\sqrt{F_y}}\left(1 - \frac{1.54 P_u}{\phi_b P_y}\right)$ for $P_u/\phi_b P_y > 0.125$: $\frac{191}{\sqrt{F_y}}\left(2.33 - \frac{P_u}{\phi_b P_y}\right) \ge \frac{253}{\sqrt{F_y}}$

The following relationship must be satjsfied for beam-column joint $\Sigma M_{pc}^* > \Sigma M_{pb}^*$

Also $M_{pb}^* = M_{pr} + V_{beam}(s_h + d_{col}/2)$, and $M_{pc}^* = M_{pc} + V_{col}(d_{beam}/2)$

with $M_{pr} = 1.1\, R_y\, M_p$

* Wave Velocity

$v_p = \sqrt{(M/\rho)}$ and $v_s = \sqrt{(G/\rho)}$,

where M = p-wave Modulus = $E(1-\nu)/[(1+\nu)(1-2\nu)]$, and G = Shear Modulus = $E/[2(1+\nu)]$

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2019
Program: B.Sc. Engineering (Civil)

Course No: CE 415 **Course Title: Structural Engineering V**
Time: 2.0 hours **Full Marks: 100**

***Answer all** questions. **Assume reasonable value** for any missing data.*

1. (a) A symmetric I-shaped beam as shown in **Figure 1** is prestresssed with A_{ps}= 2350 mm^2 as prestressing steel with an effective stress f_{se} of 1100 MPa. The c.g.s. of the strands is 115 mm above from the bottom of the beam. Determine the ultimate moment of the section using strain compatibility method (moment curvature analysis). (20)
Given that, f'_c = 48 MPa, $E_s = 190\times10^3$ MPa, β_1=0.7 and E_c= 27800 MPa.

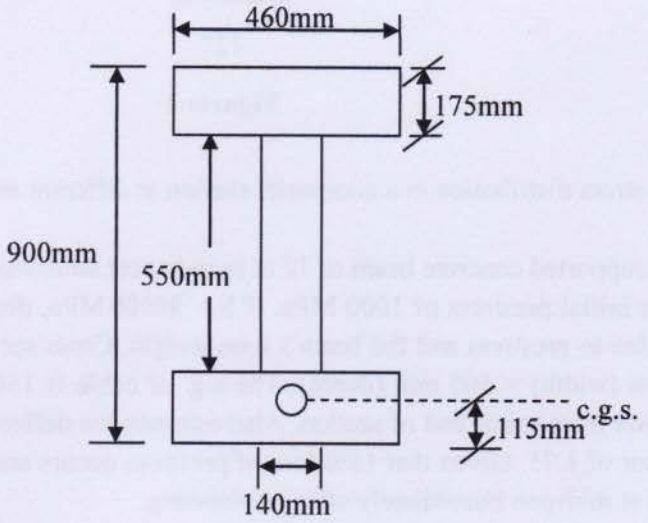


Figure: 1

(b) Briefly explain about the sources of losses of prestress in prestressed concrete member. (5)

2. (a) A section of simply supported composite beam is shown in **Figure 2.** The precast stem is prestressed with an effective force of 400 kips assuming a total loss as 15%. Compute the stresses in the section at different stages of loading and also draw the stress distribution at these stages if the bending moment at the section are as follows: (20)

- Due to precast stem = 150 k-ft
- Due to top slab = 80 k-ft
- Due to live load = 400 k-ft

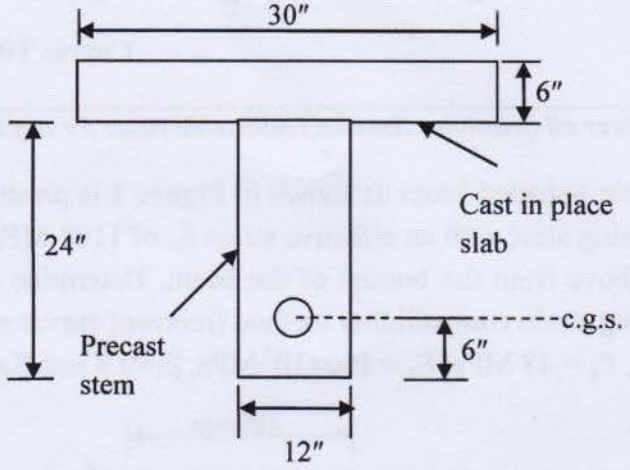


Figure: 2

(b) Show the stress distribution in a composite section at different stages of loading with sketches. (5)

3. A simply supported concrete beam of 12 m span is post tensioned with 860 mm^2 of high-tensile steel to an initial prestress of 1000 MPa. If E_c= 36000 MPa, determine the initial deflection at midspan due to prestress and the beam's own weight. Cross section of the rectangular beam is of 300 mm (width) × 500 mm (depth). The c.g. of cable is 150 mm from bottom at midspan and 300 mm from top at end of section. Also estimate the deflection after 2.5 months assuming creep factor of 1.75. Given that 15% loss of prestress occurs and a concentrated load of 45 kN is applied at midspan immediately after prestressing. (15)

4. Evaluate the shear strength for section a-a for the beam shown in **Figure 3**. The symmetric I-shaped non-composite section spans 20 m and it is adequate for w_u = 85 kN/m. Given, F = 1860 kN, f'_c= 50 MPa, w_d = 6.5 kN/m (beam weight), and e = 340 mm at section a-a. (20)

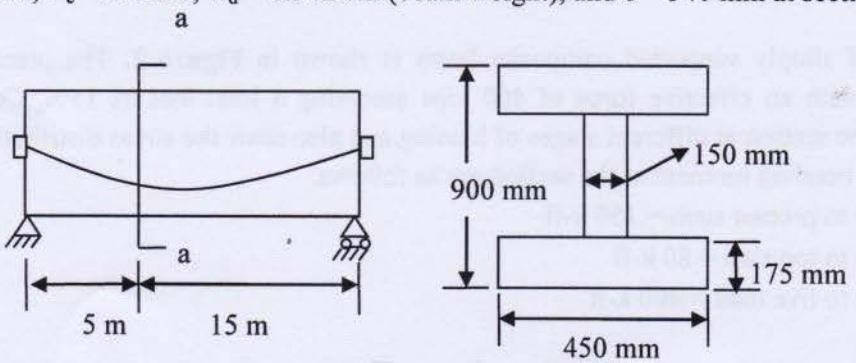


Figure: 3

5. Make final design for the preliminary section shown in **Figure 4** (obtained based on elastic theory) allowing no tension in the concrete both at transfer and under working load. Also make comment on the adequacy of the section considering the given moment. (15)

Given that f_t=-11 MPa, f_b = -12MPa, f_0 = 1035 MPa, f_{se} = 860 MPa, F = 826 kN, M_T= 435kN-m, M_G= 55kN-m, and I= 17.64×10^9 mm^4.

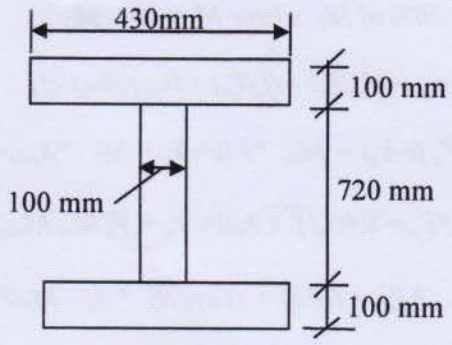


Figure: 4

CE 415 - Formulae Sheet

*$F = M_T/(0.65h)$, if M_G is greater than 20% of M_T

*$F = M_L/(0.5h)$, if M_G is less than 20% of M_T, where $M_L = M_T - M_G$

*$A_c = A_{ps}f_{se}/0.5f_c$ *$\varepsilon_{pu} = \varepsilon_{pu} + \varepsilon_{ce} + \varepsilon_{ct} = (f_{se}/E_s) + (f_c/E_c) + [\varepsilon_{pu}\{(d-c)/c\}]$

*$K = r^2/c$ * $M_1 = f'_b A_c k_t$ * $F_o(e-k_b) = M_G$ *$F(e+k_t) = M_T$ *$A_{c(b)} = (F_o h)/(f_b C_t)$ *$A_{c(t)} = (Fh)/(f_t C_b)$

*$f = -(F/A) \pm (Fey/I) \pm (My/I)$ *$V_{ci} = 0.05\sqrt{f'c}\, b_w d + V_d + V_i M_{cr}/M_{max}$ *$f_r = 0.62\sqrt{f'c}$

* $M_{cr} = (I/y_b)(0.5\sqrt{f'c} + f_{pe} - f_d)$ * $f_{pe} = (F/A) + (Fey_b/I)$ * $a_1 = M_T/F$ * $a_2 = M_G/F_o$

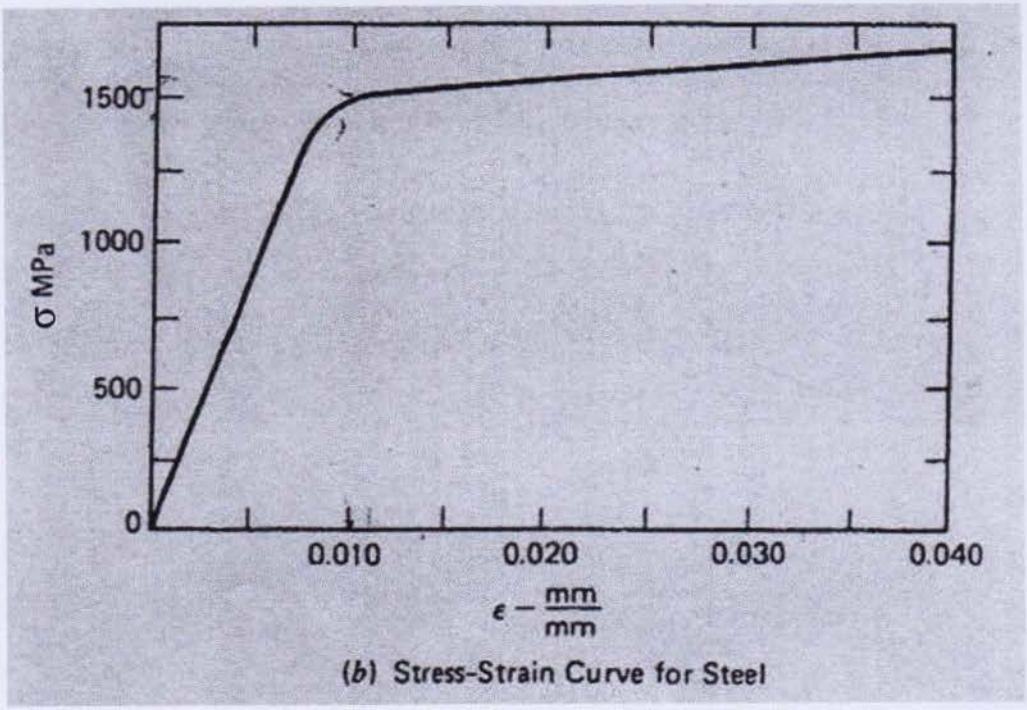
*$e_t = f'_b I/Fc_b$ * $e_b = f'_t I/F_o c_t$

*$\Delta_{prestress}$ in a simply supported beam = $(5wl^4/384EI)$

* $\Delta_{self\text{-}weight}$ in a simply supported beam $= (5wl^4/384EI)$

* Δ_{moment} in a simply supported beam $= (Ml^2/8EI)$

* $\Delta_{point\text{-}load}$ in a simply supported beam $= (Pl^3/48EI)$



(b) Stress-Strain Curve for Steel

University of Asia Pacific
Department of Civil Engineering
Midterm Examination Fall 2019
Program: B.Sc. Engineering (Civil)

Course Title: Structural Engineering VI (Design of Steel Structures) Course Code: CE 417
Time: 2 hour Full Marks: 100

ANSWER ALL QUESTIONS. Any missing data can be assumed reasonably.

1. a. Graphically explain and identify the different behaviors of a prismatic member under compression. **[5]**
   b. Select the lightest section of A 36 steel for a 20 feet column to carry an axial load of 170 kips. Use AISC-ASD method. Assume Fixed-Pinned ends of the column in both axes. Probable Column sizes with sectional properties are given in **Annexure-1.** **[15]**

2. a. Define stiffened and unstiffened element of column section. **[4]**
   b. Select the lightest **W** section to carry a uniform dead load of 1 kip/ft and live load of 1.5 kip/ft on a simply supported beam span of 30 ft. Adequate lateral support is provided. The live load deflection is limited to L/360.Use A572 Grade 50 and ASD method. Probable Beam sizes with sectional properties are given in **Annexure-1**. **[16]**

3. a. Define classification of Connections according to AISC. **[7]**
   b. Determine effective length for column (**BC, EF** and **GH**) of the frame shown in ***Fig.1*** **[13]**
   [Given: $I_{column} = 716\ in^4$ *and* $I_{beam} = 833\ in^4$].

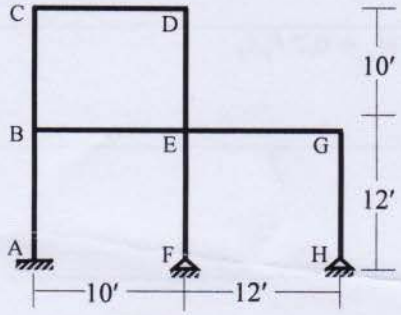


Fig.1

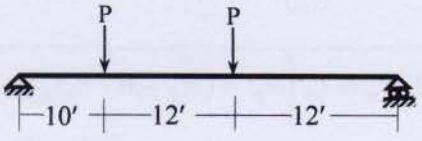


Fig.2

4. a. Define different types of beam. **[5]**
   b. Determine the design moment capacity of **W18×106** section used as a flexure member of a grade 50 steel and calculate the load **P** for the beam shown in ***Fig:2***.The beam has no lateral bracing. Use **AISC-LRFD** approach.
   [Given: $S_x = 204\ in^3$, $r_y = 2.66\ in$, $r_{ts} = 3.10\ in$, $J = 7.48\ in^4$, $h_o = 17.8\ in$, $b_f = 11.2\ in$, $t_f = 0.94\ in$, $t_w = 0.59\ in$ *and* $C = 1$] **[15]**

5. a. Define compact, non-compact and slender section. **[5]**
   b. A **W18×143** (b_f=11.2 in and d=19.5 in) column transmit an axial compressive live load of 625 kip and dead load of 250 kip on a concentrated base having a top surface area of 35 in by 50 in. Determine the size and thickness of base plate using A36 material. The concrete base has f'c=4 ksi. Follow **ASD** method. **[15]**

Annexure-1

List of Useful Formulae for CE 417

1. $Fcr = \left[0.658^{\frac{F_y}{F_e}}\right] F_y \; for \frac{KL}{r} \le 4.71\sqrt{\frac{E}{F_y}} \; or \; F_e \ge 0.44\, F_y$	
2. $Fcr = 0.877 F_y \; for \frac{KL}{r} > 4.71\sqrt{\frac{E}{F_y}} \; or \; F_e < 0.44\, F_y$	
3. $F_e = Fcr = \frac{\pi^2 E}{\left(\frac{KL}{r}\right)^2}$	4. $V_n = 0.6 F_y d t_w \; when \frac{h}{t_w} \le 2.24\sqrt{\frac{E}{F_y}}$
5. $\lambda_f = \frac{b_f}{2t_f} \; and \; \lambda_w = \frac{h}{t_w}$	6. $\lambda_{pf} = 0.38\sqrt{\frac{E}{F_y}} \; and \; \lambda_{pw} = 3.76\sqrt{\frac{E}{F_y}}$
7. $\lambda_{rf} = 1.0\sqrt{\frac{E}{F_y}}$	8. $\frac{L_p}{r_y} = 1.76\sqrt{\frac{E}{F_y}}$
9. $Lr = 1.95\frac{E}{0.7F_y}\sqrt{\frac{J_c}{S_x h_o}}\sqrt{1+\sqrt{1+6.76\left(\frac{0.7F_y}{E}\;\frac{S_x h_o}{J_c}\right)^2}}$	
10. $F_{cr} = \frac{C_b \pi^2 E}{\left(\frac{L_b}{r_{ts}}\right)^2}\sqrt{1+0.078\frac{J_c}{S_x h_o}\left(\frac{L_b}{r_{ts}}\right)^2}$	11. $M_r = 0.7\, F_y S_x$
12. $M_n = C_b\left[M_p - (M_p - 0.7\, F_y S_x)\;\left(\frac{L_b - L_p}{L_r - L_p}\right)\right]$	
13. $M_n = \left[M_p - (M_p - 0.7\, F_y S_x)\;\left(\frac{\lambda - \lambda_{pf}}{\lambda_{rf} - \lambda_{pf}}\right)\right]$	
14. $P_p = (0.85 f'c A_1)\sqrt{\frac{A_2}{A_1}} \le 1.7\, f'_c A_1$ and $f_{p(max)} = (0.85 f'_c)\sqrt{\frac{A_2}{A_1}} \le 1.7\, f'_c$	
15. $L'_p = L_p + (L_r - L_p)\left(\frac{M_p - M'_p}{M_p - M_r}\right)$	16. $t \ge l\sqrt{\frac{2P_u}{\phi F_y BN}} \;\; or \;\; t \ge l\sqrt{\frac{2\Omega P_u}{F_y BN}}$
17. $P_u \le \phi\, f_{p(max)} B \times N$	18. $P_a \le \frac{f_{p(max)} B \times N}{\Omega}$

Beam Size:

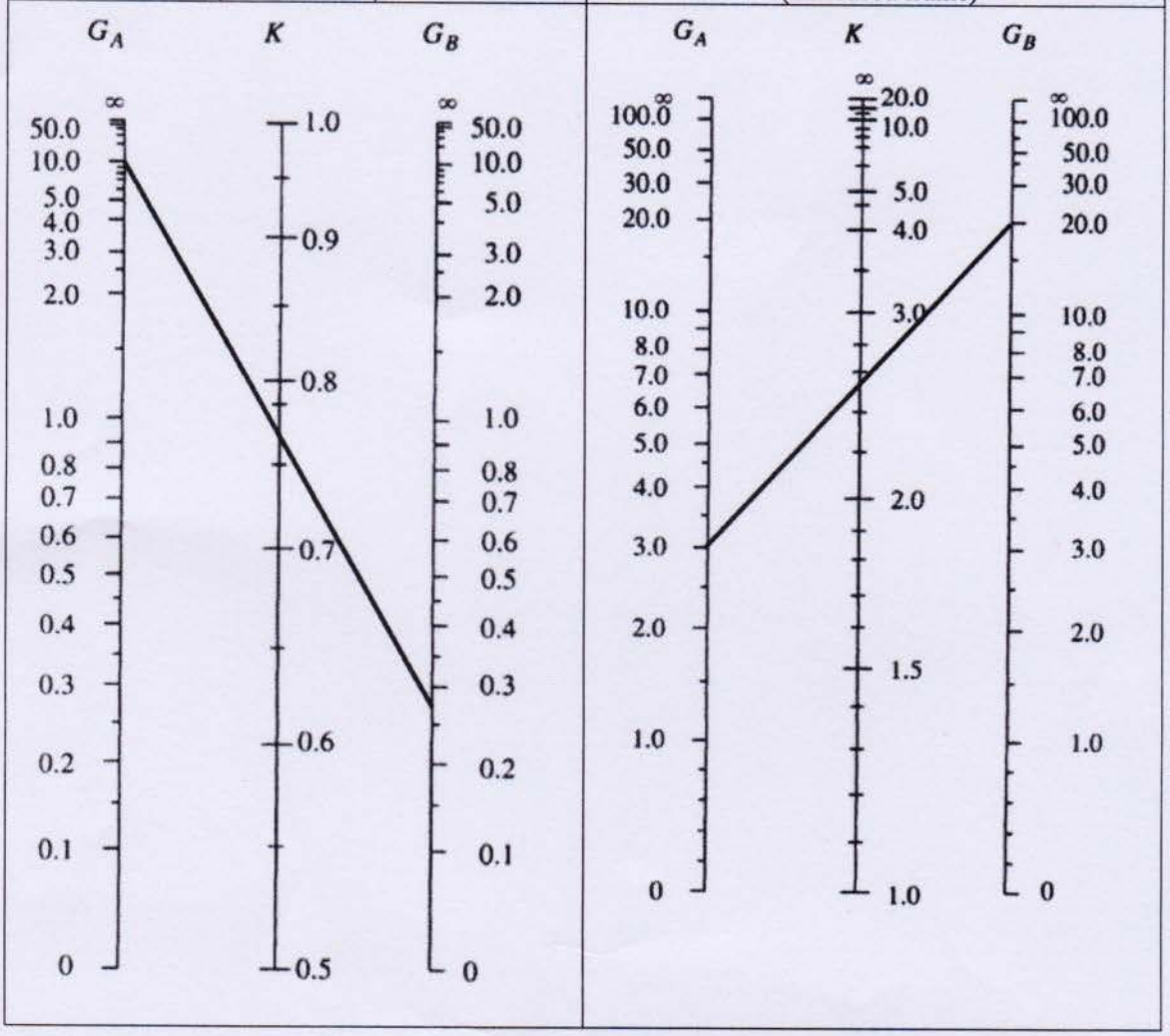
Size	I(in^4)	Z(in^3)	d (in)	t_w(in)
W 21×48	959	107	20.6	0.35
W 18×97	1750	211	18.6	0.535
W 21×93	2070	221	21.6	0.58

Column Size:

Size	Ag(in^2)	rx(in)	ry(in)
W 10×39	11.5	4.27	1.98
W 10×45	13.3	4.32	2.01
W 12×40	11.7	5.13	1.94

Annexure-2

Alignment chart or Nomograph	
Sidesway prevented (Braced frame)	Sidesway not prevented (Unbraced frame)



University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2019
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

PART A

Answer the following questions.

1. Point out the outcome/aspect addressed by the following statements from the CODE OF ETHICS OF ENGINEERS. **[20]**
(Hints: To ensure what; to avoid what; to encourage whom; to enhance/ uphold honour; to build professional reputation; etc., or mention 'When'.)

(a) Engineers shall not knowingly associate with nor permit the use of their names nor firm names in business ventures by any person or firm which they know, or have reason to believe, are engaging in business or professional practices of a fraudulent or dishonest nature.

(b) Engineers shall not solicit nor accept an engineering contract from a governmental body on which a principal, officer of employee of their organization serves as a member.

(c) Engineers shall undertake to perform engineering assignments only when qualified by education or experience in the specific technical field of engineering involved.

(d) Engineers should be committed to improving the environment to enhance the quality of life.

(e) Engineers shall issue no statements, criticisms, nor arguments on engineering matters which are inspired or paid for by an interested party, or parties, unless they have prefaced their comments by explicitly identifying themselves.

(f) Engineers shall not reveal confidential information or findings of any commission or board of which they are members.

(g) Engineers shall give proper credit for engineering work to those to whom credit is due.

(h) Engineers shall not accept compensation, financial or otherwise, from more than one party for services on the same project, nor for services pertaining to the same project, unless the circumstances are fully disclosed to, and agreed to, by all interested parties.

(i) Engineers shall be dignified and modest in explaining their work and merit.

(j) Engineers shall admit and accept their own errors and refrain from distorting or altering the fact(s) to justify their decisions.

2. (i) Give three suggestions to the engineers under your supervision to continue their professional development throughout their career. **[6]**
(ii) Prepare a list of issues about work condition to be described to a newly appointed engineer for a construction project near a busy road. **[6]**

3. Prepare a list of items to be checked in reviewing a design. Consider all the relevant aspects of CODE OF ETHICS OF ENGINEERS. **[6]**

4. Select one of the three organizations to carry out a Mega Project in Chittagong. Justify your selection according to the CODE OF ETHICS OF ENGINEERS. [12]

	Points Earned based on the Assessments of Bidding Documents and On-Site Findings		
	Organization A	Organization B	Organization C
Physical Resources: 25 Points			
(a) Equipment for Field Work (20 pt.)	12	12	18
(b) Laboratory Test Facilities (5pt.)	5	5	5
Human Resource: 20 Points			
(a) Engineers (10 pt.)	8	12	14
(b) Technicians (10 pt.)	10	12	16
Previous Experience: 35 Points			
(a) Small Projects (15 pt.)	15	15	11
(b) Mega Projects (20 pt.)	11	6	16
Adequacy of Resources to Meet Deadlines: 20 Points			
Basis of Evaluation: Scheduling & On-Site Findings	10	12	15
Checking Competency for the Project			
% of the Project Work outside the Area of Competence	10	25	10

PART B

Answer the following questions.

5. (i) List the essential elements of a tender document. [4]
   (ii) Explain why specification is necessary. Describe the attributes of good specification. [6]

6. (i) Describe the tender process using a flow-chart. [5]
   (ii) Write down the roles of Tender Evaluation Committee (TEC). [5]

7. (i) What are the purposes of Project Evaluation? Differentiate between Formative and Summative Evaluation. [6]
   (ii) Describe the Project Evaluation process using a flow-chart. [4]

8. (i) Classify Workers with a brief description of each category. [5]
   (ii) Explain various women and children's issues covered in Bangladesh Labour Law. [5]

9. (i) What measures should be taken to response an emergency in a workplace. [5]
   (ii) Mention the worker's duties to ensure occupational safety. [5]

.....