4-2

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2021
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) Briefly explain the contents of Bill of Quantities (BoQ). **[6]**

(ii) In a 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'. If you are the head of the Technical Evaluation Committee (TEC), which one would you consider as the quoted price? **[4]**

2. (i) Suppose you are the key person of a Procuring Entity and needed to prepare the specifications for a Generator. Unfortunately, you do not have adequate technical expertise for preparing generalized technical specifications of generator to make the specifications fully understandable to the tenderers. But you know one generator producing company whose product review is good enough. In the above circumstances how will you make the specification? **[4]**

(ii) Describe the tendering process using a flow-chart. **[6]**

3. Are there any restrictions or limitations regarding working hours and over time according to Bangladesh Labour Act? **[10]**

4. (i) Predict the factors those influence moral concern. **[10]**

(ii) What is environmental Ethics? How will you be an effective engineer in ensuring safe and clean environment? **[5+10]**

5. Suppose you are the Managing Director of Metro Rail Corporation (MRC) of a metropolitan city and you have received orders and funding for construction of the metro track and a parking space in a densely forested area of the city. Houses of a few underprivileged families are located in this area.

For the construction, the forest has to be cleared and the families have to be moved to some other place. The locals have started a protest after knowing about the order. They

have become very angry about cutting down thousands of trees and the affected underprivileged families have also joined them because the forest holds emotional value for them.

On the other hand, the Concerned Authority who directly controls the MRC is pressuring you to start cutting down trees as soon as possible. You know that going against Authority's orders will have serious consequences.

What are the ethical issues involved and the options available to you in such a situation? **[25]**

6. You are a Civil Engineer working in an engineering consultancy company. The company had a contract with a reputed foreign NGO to design a new road. You finished the preliminary design (***Figure – 1***) for the new road and showed it to your boss. But your boss didn't like it because the new road is quite far from the NGO's land; so, he told you to modify it and make it close to the NGO's land.

You said no to your boss because in that case two new bridges across the lake would need to be built (***Figure – 1***); hence the cost would be higher. Also, the road would not be practical. The boss was angry and told you if you didn't do what he want, the company will not get future contracts with the NGO and the staff will lose their jobs.

What will you do now? Is it ethical or not ethical to accept your boss order? **[20]**

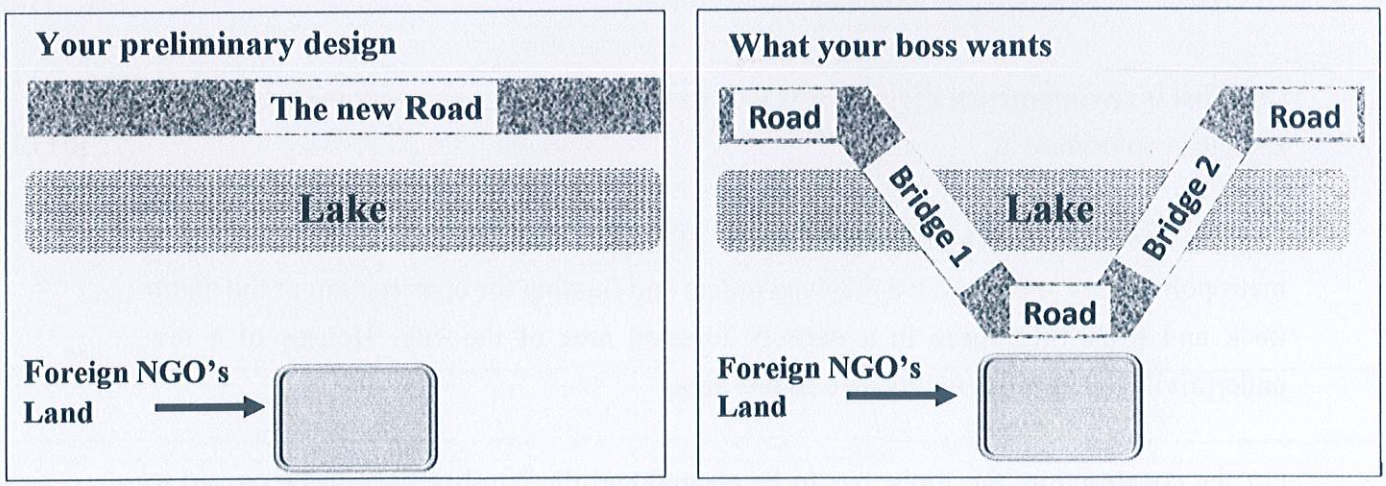

Figure - 1

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University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2021
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 [10 MARKS]

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

QUESTION 2 [20 MARKS]

(a) Outline the main purposes of non-destructive tests. **[7]**

(b) Explain in detail the procedure of rebound hammer test. **[7]**

(c) Identify what are the main factors that affect the rebound number during assessing the concrete strength via rebound hammer test. **[6]**

QUESTION 3 [18 MARKS]

(a) "As the quantity of steel fibers is increased, the workability of steel fiber-reinforced concrete (SFRC) is affected." Justify this statement. **[8]**

(b) List the benefits of using steel fibers in concrete. **[10]**

QUESTION 4 [12 MARKS]

Explain with neat sketches the effect of height to diameter ratio and loading rate on the compressive strength of concrete cylinder specimen. **[12]**

QUESTION 5 [10 MARKS]

Using schematic diagram and chemical reaction, explain the mechanisms involved in concrete deterioration by the corrosion of embedded steel. **[10]**

QUESTION 6 [10 MARKS]

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

QUESTION 7 [20 MARKS]

A circular reinforced concrete column will be constructed inside a bridge. The following necessary data are provided for the circular column.

Given data:

Size of the column: Height = 5 m; Diameter = 1 .3 m

Concrete type: Blended cement containing less than 70% slag with any admixture, except a retarder

Density of concrete = 2500 kg/m^3

Concrete temperature at placement = 20 °C

Uniform volume supply rate = One 4 m^3 truck every 20 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 factors that affect the concrete pressure on 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 2021
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) Graphically explain and identify the different behaviors of a prismatic member under compression. **[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+3]**

(c) What are the types of defects in weld connections? Briefly discuss any three defects of weld. **[3+6]**

(d) For a compression steel member, about which axis (between the major and minor axes) buckling is easier and why? Describe a way of increasing the buckling capacity of a compression steel member without changing the steel section. **[3+2]**

QUESTION 2

Determine the effective length factor, K, for the columns (AB, CD, BE and DF) of the frame shown in **Figure 1**. Given that, $I_{column} = 852$ in^4 and $I_{beam} = 610$ in^4. **[15]**

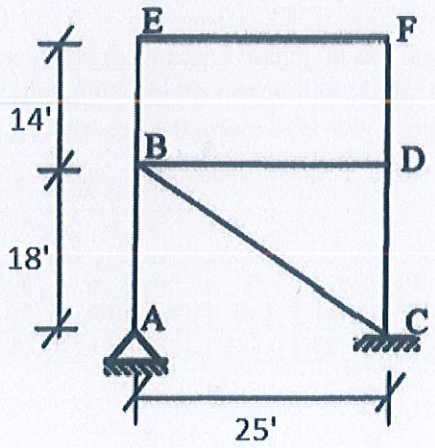


Figure 1

QUESTION 3

Compute moment gradient factor C_b for the beam shown in **Figure 2**. The beam has lateral bracing only at support points A and D; and its cross-section is doubly symmetric. **[15]**

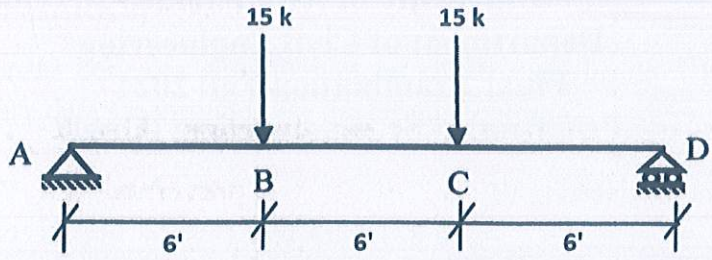


Figure 2

QUESTION 4

Select the lightest W section (from **Table 1**) to carry a service superimposed dead load of 0.8 kip/ft and a service live load of 2 kip/ft on a simply supported span of 22ft. Adequate lateral support is provided. Use A572 Grade 50 steel; and follow the **AISC-ASD** approach. **[20]**

Note: Beam self-weight is not negligible and hence it must be accounted for.

Table 1

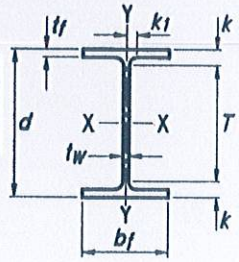
Shape	b_f (in)	t_f (in)	I_x (in^4)	I_y (in^4)	Z_x (in^3)	Z_y (in^3)
W 14x61	10.00	0.645	640	107	102	32.8
W 14x53	8.06	0.660	541	57.7	87.1	22.0
W 14x48	8.03	0.595	484	51.4	78.4	19.6
W 14x43	8.00	0.530	428	45.2	69.6	17.3
W 14x38	6.77	0.515	385	26.7	61.5	12.1

QUESTION 5

Determine the design moment capacity of W8x10 section of A572 Grade 50 steel for the beam shown in **Figure 3.** The beam has no lateral bracings in between support points A and B. Use the **AISC-LRFD** method. What will be the design moment capacity of the beam if a continuous lateral support has been provided along the beam? Compare these two design moment capacities. **[15+10]**

Section properties of W8x10:

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)
7.89	0.17	3.94	0.20	7.81	8.87	3.22	0.841	1.01	7.69	6.5	0.0426



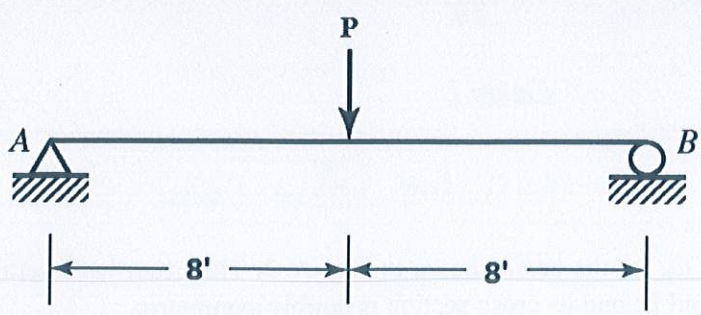


Figure 3

Formula

$$C_b = \frac{12.5M_{max}}{2.5M_{max} + 3M_A + 4M_B + 3M_C} R_m \leq 3.0$$

$$L_p = 1.76 r_y \sqrt{\frac{E}{F_y}}$$

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

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

$$F_{cr} = \frac{C_b \pi^2 E}{\left(\frac{L_b}{r_{ts}}\right)^2} \sqrt{1 + 0.078 \frac{Jc}{S_x h_o}\left(\frac{L_b}{r_{ts}}\right)^2}$$

$$M_n = F_{cr} S_x \leq M_p$$

$$\lambda_{pf} = 0.38 \sqrt{\frac{E}{F_y}}$$

$$\lambda_{rf} = 1.0 \sqrt{\frac{E}{F_y}}$$

$$M_n = M_p - (M_p - 0.7F_y S_x)\left(\frac{\lambda - \lambda_p}{\lambda_r - \lambda_p}\right)$$

$$M_n = \frac{0.9 E k_c S_x}{\lambda^2}$$

$$k_c = \frac{4}{\sqrt{h/t_w}}, \text{ where } 0.35 \leq k_c \leq 0.763$$

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2021
Program: B. Sc. Engineering (Civil)

Course Title: Environmental Engineering IV — Course Code: CE 433
Time- 2 hours — Full marks: 100

Answer all the questions from questions 1-5 (5* 20 =100).
(Assume any missing data)

1. (a) You provide a sample from Hatirjheel to your laboratory attendant to analyze for organic matter. The attendant analyzes for cBOD only and you show the results to your supervisor. Supervisor comments, "Incomplete Analysis. cBOD is not equal to COD." Explain your understanding of this comment. Also consider, if you analyze the sample for COD and obtain cBOD/COD ratio to be 0.3, which type of wastewater treatment you would choose and why? (10)

(b) The following air quality data have been recorded at the Continuous Monitoring Stations/Systems (CAMS) in Dhaka on April 26, 2018. (10)
$PM_{2.5}$ = 80 μg/m^3 (24 hr)
PM_{10} = 170 μg/m^3 (24 hr)
CO = 30 ppm (8 hr)
O_3 = 0.095 ppm (8 hr)
Prepare an AQI report for the day.

2. (a) Discuss the purposes that are accomplished through air quality models. (5)

(b) A stack emitting 65 g/s of NO_2 has an effective stack height of 155 m. The wind speed is 5.7 m/s at 7 m, and atmosphere is adiabatic with Stability class D. Estimate the ground level NO_2 concentration: (15)
   i) Directly downwind at a distance of 3 km
   ii) At a point downwind where NO_2 is maximum
   iii) At a point located 2.4 km downwind and 0.2 km off the downwind axis.

3 (a) Suppose, you receive information regarding two brick kilns which are emitting pollutant gases and the corresponding fume patterns for these two kilns are mentioned as 'looping' and 'fanning' respectively. Justify with neat sketches which one would be more harmful for people living nearby. (10)

(b) Suppose the ambient atmospheric temp profile of an area is given by the following equation: Λ (°C) = 30 – 0.005 z, when z = altitude in m. (10)
If maximum surface temperature is 35°C and average wind speed is 4.7 m/s, estimate the ventilation coefficient and comment on the pollution potential.

4 (a) Suppose, you go on a study tour and find a lake where the water is stagnant, odorous and blurry (containing a lot of suspended solids). Explain the problems that the aquatic beings living in that lake might be facing and develop a water quality management plan for the lake as an environmental engineer. (5+5 =10)

(b) The ultimate CBOD (L_0) in a river due to discharge of wastewater is 30.4 mg/L at 25°C. The deoxygenation and the reaeration constants at 20°C are 0.32/day and 0.6/day. If the time required (t_c) for dissolved oxygen to reach at its minimum is 2.7 days, find the critical DO or DO_{min}. (Equations attached) (10)

5(a) Suppose, you are conducting a study on the leachate from a poorly managed landfill and you come to know that the groundwater being collected through tubewells nearby has been polluted. Develop a hypothesis regarding the probable cause of this groundwater pollution with proper justifications. (10)

(b) Consider a lake with 300×10^6 m^2 of surface area for which the only source of phosphorus is the effluent from a wastewater treatment plant. The effluent flow rate is 0.65 m^3/s and its phosphorus concentration is 15.0 mg/L (= 15.0 g/m^3). The lake is also fed by a stream having 40 m^3/s of flow with no phosphorus. If the phosphorus settling rate is estimated to be 10 m/year, (10)

(a) Estimate the average phosphorus concentration in the lake.

(b) What level of phosphorus removal at the treatment plant would be required to keep the average lake concentration below 0.020 mg/L?

Given Formula:

Ventilation coefficient (m^2/s) = Maximum mixing depth * average wind speed within mixing depth

$$u = u_0\left(\frac{z}{z_0}\right)^p$$

$$\sigma_y = a.x^{0.894} \quad ; \quad \sigma_z = c.x^d + f$$

$$c_{max} = \frac{Q}{u}\left(\frac{C_u}{Q}\right)_{max}$$

$$C(x, 0) = \frac{2Q_L}{\sqrt{(2\Pi)u\sigma_z}}$$

$$C\,(x, 0, 0) = \frac{Q}{\pi u\sigma_y\sigma_z}\exp\left(\frac{-H^2}{2\sigma_z{}^2}\right)$$

$$C\,(x, y, 0) = \frac{Q}{\pi u\sigma_y\sigma_z}\exp\left(\frac{-y^2}{2\sigma_y{}^2}\right)\exp\left(\frac{-H^2}{2\sigma_z{}^2}\right)$$

$$D = \frac{k_d L_0}{k_r - k_d}\left(e^{-k_d t} - e^{-k_r t}\right) + D_0 e^{-k_r t}$$

$$k_r = \frac{3.9u^{1/2}}{H^{3/2}} \qquad t_c = \frac{1}{k_r - k_d}\ln\left[\frac{k_r}{k_d}\left(1 - \frac{D_0[k_r - k_d]}{k_d \cdot L_0}\right)\right]$$

$$D_c = \frac{k_d}{k_r} L_0 e^{-k_r t_c}$$

$DO_{(sat)} = 14.62 – 0.39\ T + 0.007714\ T^2 – 0.0000646\ T^3$

$k_{d\ (at\ T°C)} = k_{20°C} \cdot (1.047)^{T-20}$, $k_{r\ (at\ T°C)} = k_{r20°C} \cdot (1.024)^{T-20}$

$DO_{min} = DO_{sat} – D_c$; $D_0 = DO_{sat} – DO_{mix}$; $DO\ (x) = DO_{sat} – D(x)$

$BOD_m \cdot V_m = BOD_w \cdot V_w + BOD_d \cdot V_d$ $\qquad BOD_t = L_0\ (1 - e^{-kt})$ $\qquad L_t = L_0\ e^{-kt}$

$$P = \frac{S}{Q + \upsilon_s \cdot A}$$

$k_{d\ (at\ T°C)} = k_{20°C} \cdot (1.047)^{T-20}$, $k_{r\ (at\ T°C)} = k_{r20°C} \cdot (1.024)^{T-20}$

Breakpoints							AQI	Category
O_3 (ppm) 8-hr	O_3 (ppm) 1-hr (i)	$PM_{2.5}$ (µg/m³) 24-hr	PM_{10} (µg/m³) 24-hr	CO (ppm) 8-hr	SO_2 (ppm) 24-hr	SO_2 (ppm) Annual		
0.000-0.064	---	0.0-15.4	0-54	0.0-4.4	0.000-0.034	(ii)	0-50	Good
0.065-0.084	---	15.5-40.4	55-54	4.5-9.4	0.035-0.144	(ii)	51-100	Moderate
0.085-0.104	0.125-0.164	40.5-65.4	155-254	9.5-12.4	0.145-0.224	(ii)	101-150	Unhealthy for sensitive group
0.105-0.124	0.165-0.204	65.5-150.4	255-354	12.5-15.4	0.225-0.304	(ii)	151-200	Unhealthy
0.125-0.374	0.205-0.404	150.5-250.4	355-424	15.5-30.4	0.305-0.604	0.65-1.24	201-300	Very unhealthy
(iii)	0.405-0.504	250.5-350.4	425-504	30.5-40.4	0.605-0.804	1.25-1.64	301-400	Hazardous
(iii)	0.505-0.604	350.5-500.4	505-604	40.5-50.4	0.805-1.004	1.65-2.04	401-500	Hazardous

(i) In some cases, in addition to calculating the 8-hr ozone index, the 1-hr ozone index may be calculated and the maximum of the two values is reported

(ii) NO_2 has no short term air quality standard and can generate an AQI only above 200

(iii) 8-hr O_3 values do not define higher AQI values (≥ 301). AQI values of 301or higher are calculated with 1-hr O_3 concentrations.

$$F = gr^2 v_s\left(1 - \frac{T_a}{T_s}\right) \qquad ; \qquad \Delta h = \frac{1.6F^{1/3} x_f^{\,2/3}}{u}$$

$x_f = 120\ F^{0.4}$ if $F \geq 55\ m^4/s^3$: $x_f = 50\ F^{5/8}$ if $F < 55\ m^4/s^3$

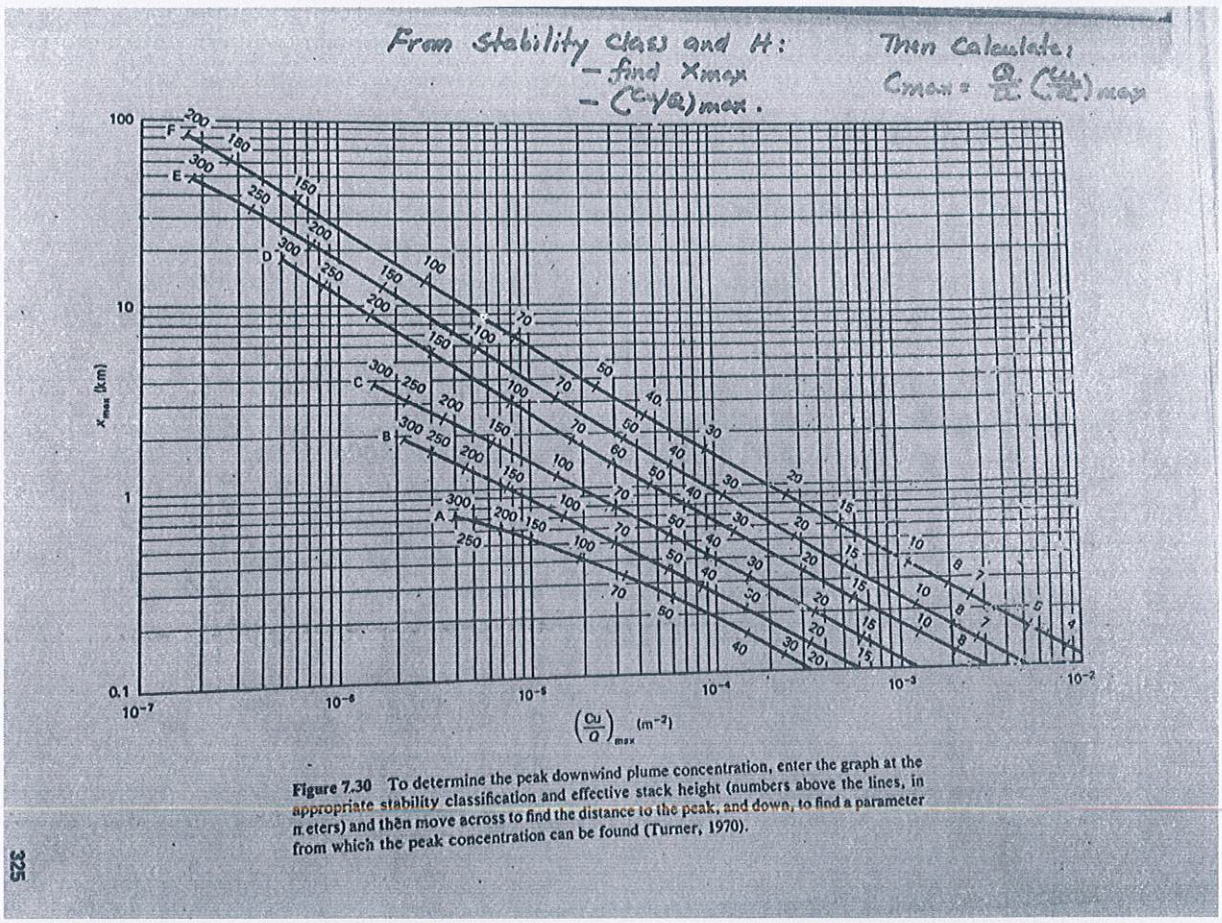


Figure 7.30 To determine the peak downwind plume concentration, enter the graph at the appropriate stability classification and effective stack height (numbers above the lines, in meters) and then move across to find the distance to the peak, and down, to find a parameter from which the peak concentration can be found (Turner, 1970).

Table 4. Constants in empirical relationships for σ_y and σ_z

Stability class	a	$x \leq 1$ km			$x \geq 1$ km		
		c	d	f	c	d	f
A	213	440.8	1.941	9.27	459.7	2.094	-9.6
B	156	106.6	1.149	3.3	108.2	1.098	2.0
C	104	61	0.911	0	61	0.911	0
D	68	33.2	0.725	-1.7	44.5	0.516	-13.0
E	50.5	22.8	0.678	-1.3	55.4	0.305	-34.0
F	34	14.35	0.740	0.35	62.6	0.180	-48.6

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2021
Program: B.Sc. in Civil Engineering

Course Title: Structural Engineering V | Course Code: CE 415 | Credit: 2.0
Time: 2 hours | Full Marks: 100

[Answer all the questions. Assume reasonable value for any missing data]

1. (a) Show the stress distributions in a prestressed concrete beam section for different locations of compressive force (C) according to elastic theory. (8)

   (b) Twenty 7 mm wires in a Freyssinet cable, 30 m long, are tensioned initially to a total stress of 15 kN. What additional elongation of the wires is required to obtain an initial prestress of 1180 MPa.? E_s = 200,000 MPa. Assume no shortening of concrete during the tensioning process and neglect friction. (12)

2. An I-shaped beam is prestressed by prestressing steel with A_{ps} = 4 in.^{2} and an effective stress, f_{se} =180 ksi. The c.g.s. of the strands is 5 in. above the bottom of the beam as shown in Fig. 1 along with the shape of the beam cross section. Find the ultimate resisting moment for the beam section for design following the ACI code. Material properties are: f_{pu}= 270 ksi, f_c' = 7 ksi. (20)

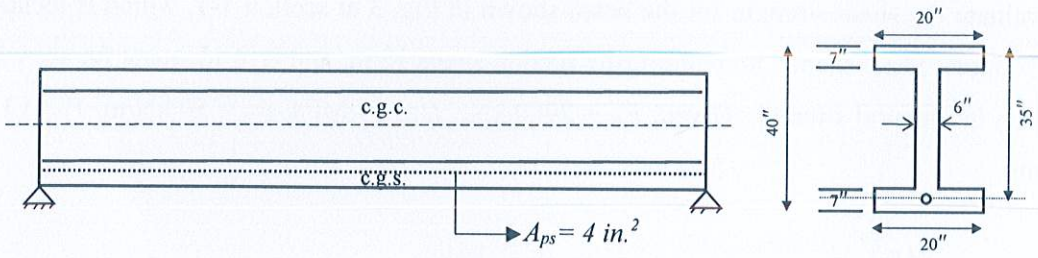


Figure 1

3. Estimate the change of prestress force with time for the pretensioned-prestressed concrete beam shown in Fig. 2. The normal weight concrete beam has only its own weight w_G = 0.45 k/ft acting at transfer of prestress, which occurs approximately 48 hours after initially stressing the tendons to 202.5 ksi in the prestressing bed. For 30 days, the beam carries only w_G on a simply supported 80 ft span. Additional superimposed load, w_s = 1.5 k/ft is added to the beam when erected at 30 days and

is sustained for four years on the beam. Assume, f'_{ci} = 4500 psi, f'_c = 6000 psi, f_{pu} = 270 ksi, relative humidity = 75%, E_s = 27500 ksi, K_{es} = 1, k_{cr} = 2, K_{sh} = 1, $\frac{V}{S}$ = 3, K_{re} = 20, J = 0.15, C = 1.45. (20)

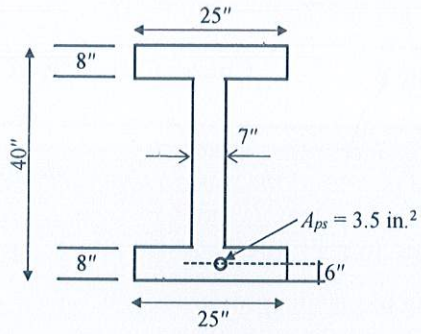


Figure 2

4. (a) Make a preliminary design for a section of a prestressed concrete to resist a total moment of 350 k-ft. The girder moment is 50 k-ft and the overall depth of the section is 40 in. The effective prestress for steel is 130 ksi, and allowable stress for concrete under working load is -1600 psi. (6)

   (b) Make final design for the preliminary section obtained in 4(a) considering no tension in concrete. Assume, f_b = -1.8 ksi, f_o = 150 ksi, f_t = -1.60 ksi. (14)

5. (a) Graphically explain the variation of steel stress with load. (8)

   (b) Evaluate the shear strength for the beam shown in Fig. 3 at section 1-1, which is located at h/2 from support. The I-shaped non-composite section spans 12 m, and it is adequate for w_u = 50 kN/m based on its flexural strength. Given, F_{se} = 2000 kN, f'_c = 49 MPa, w_u = 50 kN/m, V_p = 13 kN, e = 270 mm. (12)

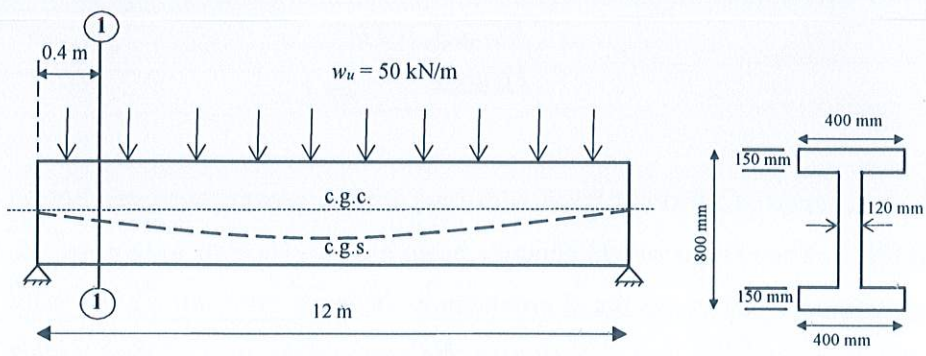


Figure 3

Formula Sheet

$*f_{cir} = 0.9\left(\frac{F_i}{A} + \frac{F_i e^2}{I}\right) - \frac{M_G e}{I}$ $*ES = K_{es}E_s\frac{F_{cir}}{E_{ci}}$ $*E_{ci} = 57000\sqrt{f'_{ci}}$ $*E_c = 57000\sqrt{f'_c}$

$* f_{cds} = \frac{M_{DL}e}{I}$ $*CR = k_{cr}\frac{E_s}{E_c}(f_{cir} - f_{cds})$ $*SH = 8.2 \times 10^{-6}K_{sh}E_s\left(1 - 0.06\frac{V}{S}\right)(100 - RH)$

$*RE = [K_{re} - J(SH + CR + ES)]C$ $* \Delta_s = \frac{f_s \times L}{E_s}$ $* Elastic\ elongation = \frac{f_s}{f_s - f_{s1}}\Delta_s$

$*F = \frac{M_T}{0.65\times h}$, if M_G is greater than 20% of M_T

$*F = \frac{M_L}{0.50\times h}$, if M_G is less than 20% of M_T

$*A_c = \frac{F}{0.50\times f_c}$ $*k = \frac{r^2}{c}$ $*e - k_b = \frac{M_G}{F_0}$ $*F = \frac{M_T}{e+k_T}$ $*A_c = \frac{F_0 \times h}{f_b \times c_t}$ $*A_c = \frac{F\times h}{f_t \times c_b}$ $*F = \frac{M_T}{e+k_T}$

$*\rho_p = \frac{A_{ps}}{b\times d}$ $*f_{ps} = f_{pu}(1 - 0.50\rho_p\frac{f_{pu}}{f'_c})$ $*\omega_p = \frac{\rho_p \times f_{ps}}{f'_c} \leq 0.30$ $*T' = A_s \times f_{ps}$

$*C' = 0.85f'_c\,ab$ $*A_{pf} = 0.85f'_c\,(b - b_w)\frac{h_f}{f_{ps}})$ $*A_{pw} = A_{ps} - A_{pf}$

$* M_u = \phi[A_{pw}f_{ps}\left(d - \frac{a}{2}\right) + 0.85f'_c\,(b - b_w)h_f\left(d - \frac{h_f}{2}\right))]$

$* v_{cw} = 0.29\sqrt{f'_c} + 0.3f_{pc} + \frac{V_p}{b_w \times d}$