4-2

University of Asia Pacific
Department of Civil Engineering
Final Examination Spring 2023
Program: B.Sc. Engineering (Civil)

Course Title: Project Planning and Management | Course Code: CE 401
Time: 3 Hours | Credit Hours: 3.00 | Full Marks: 150

Answer all the questions.

1. (i) "The ultimate goal of e-Government Procurement is *Public Spending Optimization.*". Explore the goals of e-Government Procurement system in context to the above quoted statement. **[08]**

   (ii) Suppose that you are assigned to prepare the feasibility study report for the project titled "Construction of Marine Drive in Coastal region". Prepare a list of studies those you will include in your report. **[07]**

2. The network of a bridge construction project is shown in **Figure 1**, along with the duration of each activity. Apply network analysis technique to determine the Earliest and Latest Event Time of each activity. **[20]**

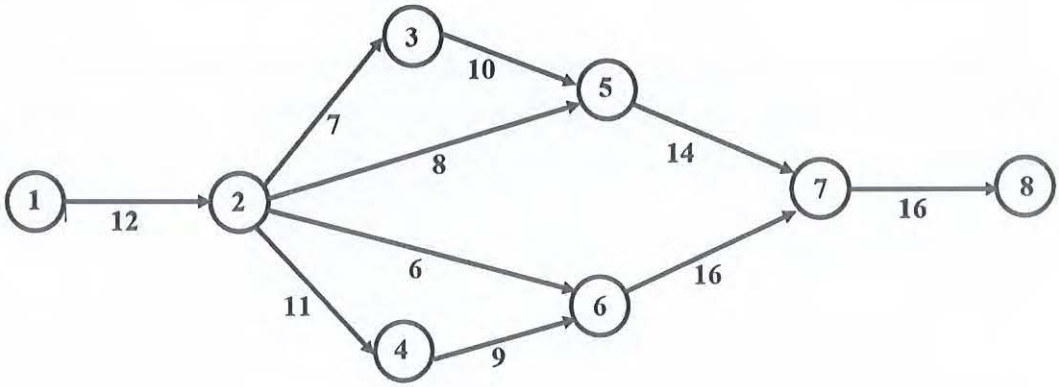


Figure 1

3. Apply CPM technique to the network shown in **Figure 1** to determine the followings:

   (a) Activity Time (EST, EFT, LST, LFT) of each activity. **[15]**
   (b) Total Float of each activity. **[05]**
   (c) The Critical Path. **Show the Critical Path on the Network.** **[05]**

4. A municipality has two incinerators for burning trash. Incinerator A costs \$3.80 per ton of trash to operate, and has a capacity of 28 tons per day. Incinerator B costs \$4.25 per ton to operate, and has a capacity of 30 tons per day. The municipality produces over 100 tons of trash per day, and all trash not burned in the incinerators must be buried in a land fill at a cost of \$5.00 per ton. The city mayor wants to minimize costs by burning as much trash as possible. However, the city must conform to environmental regulations limiting production of pollutants from burning

in the incinerators to 180 pounds of hydrocarbons and 640 pounds on particulates a day. Incinerator A produces 3 pounds of hydrocarbons and 20 pounds of particulates for every ton of trash burned, and incinerator B produces 5 pounds of hydrocarbons and 10 pounds of particulates for every ton of trash.

(a) Figure out the objective function and constraint equations as a linear programming problem for the above-mentioned case. **[10]**

(b) Investigate using **Graphical method** to determine the optimum amount of trash to burn in each incinerator. **[20]**

5. Your rich uncle has promised to give you $3,000 a year at the end of each of the next six years to help you pay for university tuition fee. Using a discount rate of 4%, what is an equivalent gift that he could give you today? Apply appropriate capital budgeting technique to answer the question. **[30]**

6. (i) Demonstrate the relation of Holding, Ordering and Total Cost with Order Quantity using graph and hence derive the equation to calculate the Economical Order Quantity (EOQ). **[10+10]**

(ii) A manufacturing company places a semi-annual order of 24,000 units at a price of $20 per unit. Its holding cost is 15% of its acquisition cost and the order cost is $12 per order.

Calculate the followings:

(a) Economical Order Quantity (EOQ). **[05]**

(b) Number of orders per year. **[05]**

.....

University of Asia Pacific
Department of Civil Engineering
Final Examination Spring 2023
Program: B.Sc. in Engineering (Civil)

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

QUESTION 1

(a) With a neat sketch, explain a method of welding that can be readily followed to minimize the distortion of welding connection. [5]

(b) Explain the reason of imposing minimum weld size in a metal connection. [5]

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

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

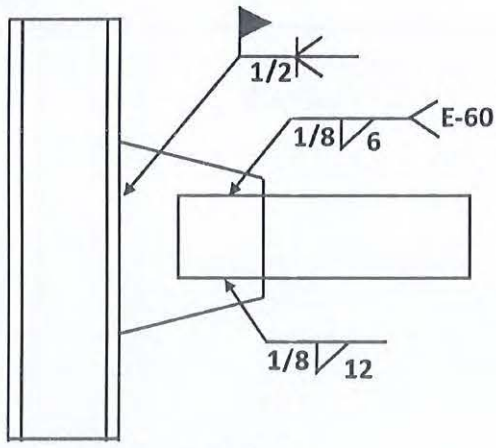


Figure 1

QUESTION 2

Select the lightest W section (from **Table 1**) to carry a service superimposed concentrated service dead load of 8 kips and a service live load of 10 kips working at the middle point of a simply supported beam. The length of the beam is 14 ft, and adequate lateral support is provided. Use A572 Grade 50 steel, and follow the **AISC-ASD** approach. Note: Beam self-weight is not negligible and hence it must be accounted for. [20]

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 14×26	5.03	0.420	245	8.91	40.2	5.54
W 14×38	6.77	0.515	385	26.7	61.5	12.1
W 14×30	6.73	0.385	291	19.6	47.3	8.99
W 14×34	6.75	0.455	340	23.3	54.6	10.6
W 14×22	5.0	0.335	199	7.0	33.2	4.39

QUESTION 3

A column is made up by a W steel section having $F_y = 50$ ksi (**Figure 2**). The top and bottom supports of the column are pinned and fixed, respectively. Along the strong axis direction, lateral pinned support is also provided as shown in the figure. Calculate the design compressive load carrying capacity (P) of the column. [15]

Geometrical Properties of the W Section:

D (in)	t_w (in)	b_f (in)	t_f (in)	A (in^2)	Z_x (in^3)	Z_y (in^3)	r_x (in)	r_y (in)	r_{ts} (in)
38.8	0.645	14.7	1.03	38.8	234	113	4.8	3.76	4.23

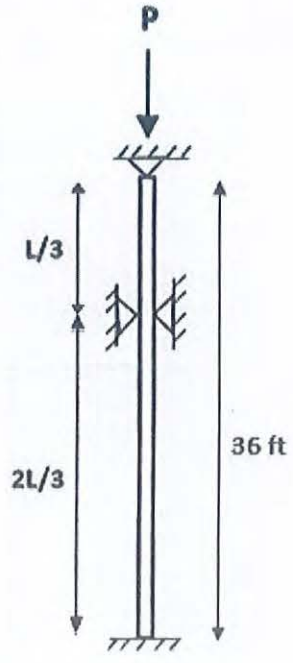


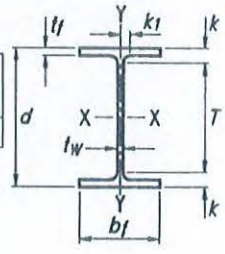
Figure 2

QUESTION 4

Determine the design moment capacity of W14×90 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 D. Use the **AISC-LRFD** method. What will be the design moment capacity of the beam if lateral bracings are provided at the center of the beam? Compare these two design moment capacities. Assume $C_b = 1.2$. [15+10]

Section properties of W14x90:

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)
14.0	0.44	14.5	0.71	143	157	6.14	3.7	4.1	13.3	10.0	4.06



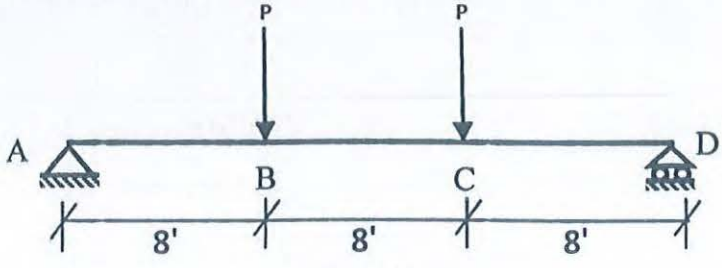


Figure 3

QUESTION 5

By following the elastic vector method, compute the required size of **E60XX** fillet weld for the weld configuration and loading condition shown in **Figure 4**. Assume the plate thickness does not affect the result. Use the **AISC-ASD** method for the calculation. **[15]**

Given: Service load, P = 25 kips

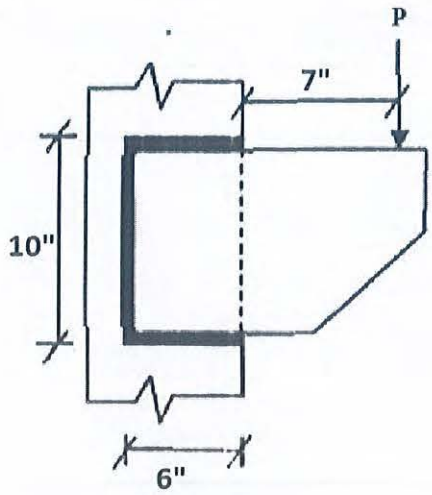


Figure 4

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

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

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

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

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

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

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

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

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

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

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

University of Asia Pacific
Department of Civil Engineering
Final Examination Spring 2023
Program: B.Sc. in Engineering (Civil)

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

QUESTION 1 [12 MARKS]

"Incorporation of fly ash increases the setting time and workability of concrete." Justify this statement. **[12]**

QUESTION 2 [10 MARKS]

Explain the three basic approaches for improving durability as well as mechanical performances of concrete. **[10]**

QUESTION 3 [20 MARKS]

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

(b) Outline the application of pull-out test for concrete structures. **[7]**

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

QUESTION 4 [10 MARKS]

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

QUESTION 5 [18 MARKS]

(a) "Change of water-to-cement ratio may not significantly affect the permeability of no-fines concrete" Do you agree or disagree with this statement? Justify your answer. **[10]**

(b) List the benefits of using steel fibers in concrete. **[8]**

QUESTION 6 [10 MARKS]

Explain the role of superabsorbent polymers (SAPs) on the autogenous healing process of concrete. **[10]**

QUESTION 7 [20 MARKS]

A reinforced concrete wall needs to be constructed at a construction site. The following necessary data are provided for the wall and its formwork.

Cross sectional size of the wall: Thickness = 350 mm, Length = 10 m.

Height = 3 m

Concrete type: Blended cement containing 20% of fly ash with an accelerating admixture.

Form height = 3.5 m.

Density of concrete = 2400 kg/m^3.

Concrete temperature at placement = 30 °C.

Uniform volume supply rate = One 7 m^3 truck every 30 mins.

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 or 40% fly ash without admixture	0.45
Blended cement containing less than 70% slag or 40% fly ash with any admixture, except a retarder	0.45
Blended cement containing less than 70% slag or 40% fly ash with a retarder	0.6
Blended cement containing more than 70% slag or 40% fly ash	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 workability of concrete 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 Spring 2023
Program: B.Sc. in Civil Engineering

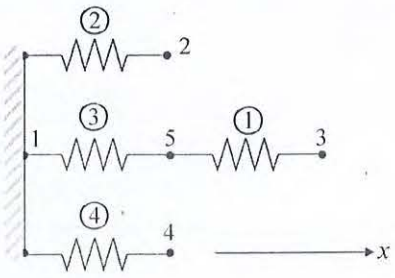
Course Title: Structural Engineering VII | Course Code: CE 419

Time: 2.0 hours | Credit Hour: 2.0 | Full Marks: 80

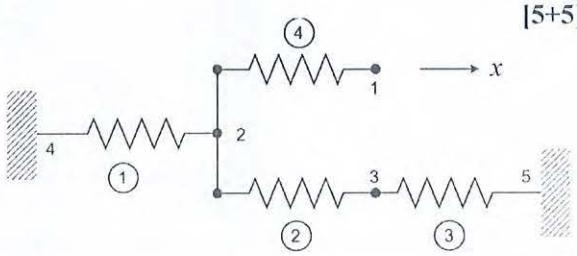
Answer the following questions

1. For the spring system with arbitrarily numbered nodes and elements (as shown below), formulate the global stiffness matrix: **[5+5]**

i)



ii)

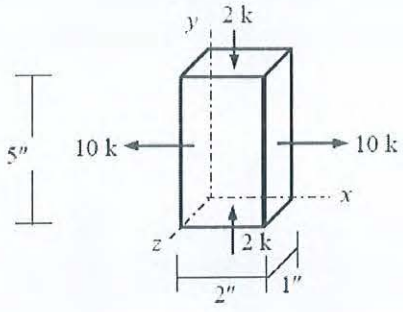


2. (i) Explain the concept of *isoparametric element*. Why are they used in FEM? **[5]**

(ii) Demonstrate the use of nodes at discontinuities. What is the effect of element aspect ratio on the accuracy of FEM results? **[5]**

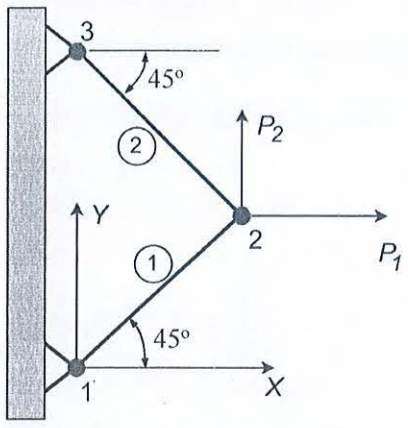
3. (i) Explain Plain Strain and Plain Stress conditions in terms of stress-strain/constitutive relations.

(ii) The rectangular prism shown below is subjected to uniformly distributed normal forces in the x and y directions and is restrained in the z direction (i.e., $\varepsilon_{zz} = 0$). Calculate the normal stresses $(\sigma_{xx}, \sigma_{yy}, \sigma_{zz})$ and strains $(\varepsilon_{xx}, \varepsilon_{yy}, \varepsilon_{zz})$ that develop in the prism [Given: E = 2000 ksi, Poisson's ratio $\nu = 0.20$]. **[5 + 10]**

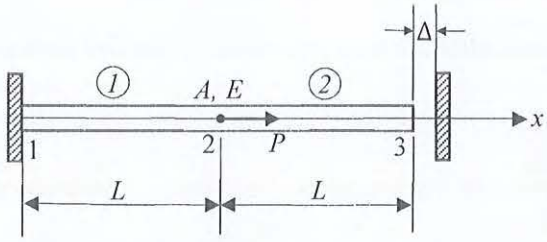


4. Answer any three out of the four questions: **[15+15+15]**

(a) A simple plane truss is made of two identical bars (with E, A, and L), and loaded as shown in the following figure. Determine the: *i*) Displacement of node 2; *ii*) Stress in each bar.



(b) Determine the support reaction forces at the two ends of the bar shown below:



$P = 6.0 * 10^4\ N$

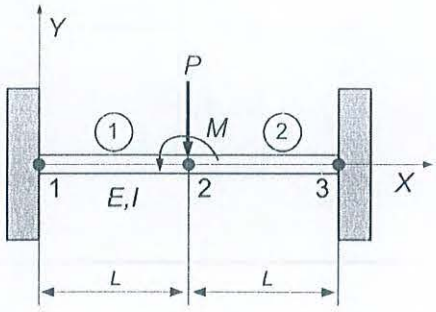
$E = 2.0 * 10^4 \frac{N}{mm^2}$

$A = 250\ mm^2$

$L = 150\ mm$

$\Delta = 0.8\ mm$

(c) The beam shown below is clamped at the two ends and acted upon by the force P and moment M in the midspan. Determine the deflection and rotation at the center node and the reaction forces and moments at the two ends.



(d) Determine the shape function of a three noded bar element with natural co-ordinate system.

University of Asia Pacific
Department of Civil Engineering
Final Examination Spring 2023
Program: B. Sc. Engineering (Civil)

Course Title: Environmental Engineering IV Credit Hours: 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 eutrophication. Briefly describe the principal controlling factors of eutrophication. **(10)**

(b) Define the following **(10)**
(i) Aerosol (ii) Smog (iii) Smoke (iv) Dust

(c) Which factors should be considered in selecting sample stations? **(10)**

2 (a) Which particle size are most damaging to lungs? Explain the reasons. **(10)**

(b) Discuss the pollution control measures to prevent marine pollution. **(10)**

3 (a) Analyze the efficiency-diameter relation for a gravity settler that has H= 7 ft, L = 35 ft, and V_{avg} = 3.6 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. **(15)**
Comment on block flow and mixed flow model based on your result.

(b) Estimate the emissions using Table 4.2 from a 900 MW power plant at full load, burning a typical Pittsburgh seam coal. The thermal efficiency is 35%. The boiler of the power plant is assumed to be PC, wall fired, wet bottom type. Heating value of the coal is 13600 BTU/lb. Ash content = 6.7%, Sulfur content = 1.9%. 1 MW = 3413000 BTU/hr. **(10)**

4 (a) Estimate the effective stack height H for a 2 m diameter stack whose exit gas has a velocity of 15 m/s when the wind velocity is 2.5 m/s, the pressure is 1 atm and the stack and surrounding temperatures are 100 °C and 115 °C, respectively. The height of the stack, h = 50 m. **(5)**

(b) The stack in problem (a) emits 170 g/s of CO. The stability category is C. Estimate the ground level concentrations directly below the centerline of the plume at distance 5, 10, 50, and 100 km downwind. **(15)**
If the height of the stack, h changes to 100 m, what will be the ground level concentrations directly below the centerline of the plume at distance 5, 10, 50, and 100 km downwind? Analyzing your result suggest an air pollution control strategy to prevent air pollution from stack emission. Use Figure 6.9.

(c) An industry discharges 250 kg BOD_5/day to a lake. Calculate the population equivalency for this load. Water usage per person = 225 L/person-day, domestic wastewater BOD_5 = 275 mg/L. **(5)**

TABLE 4.2

Emission factors for bituminous and subbituminous coal combustion without control equipment

Furnace type[b]	Emission factor, lb/ton of coal burned[a]				
	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 $10 \cdot 8$ 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.

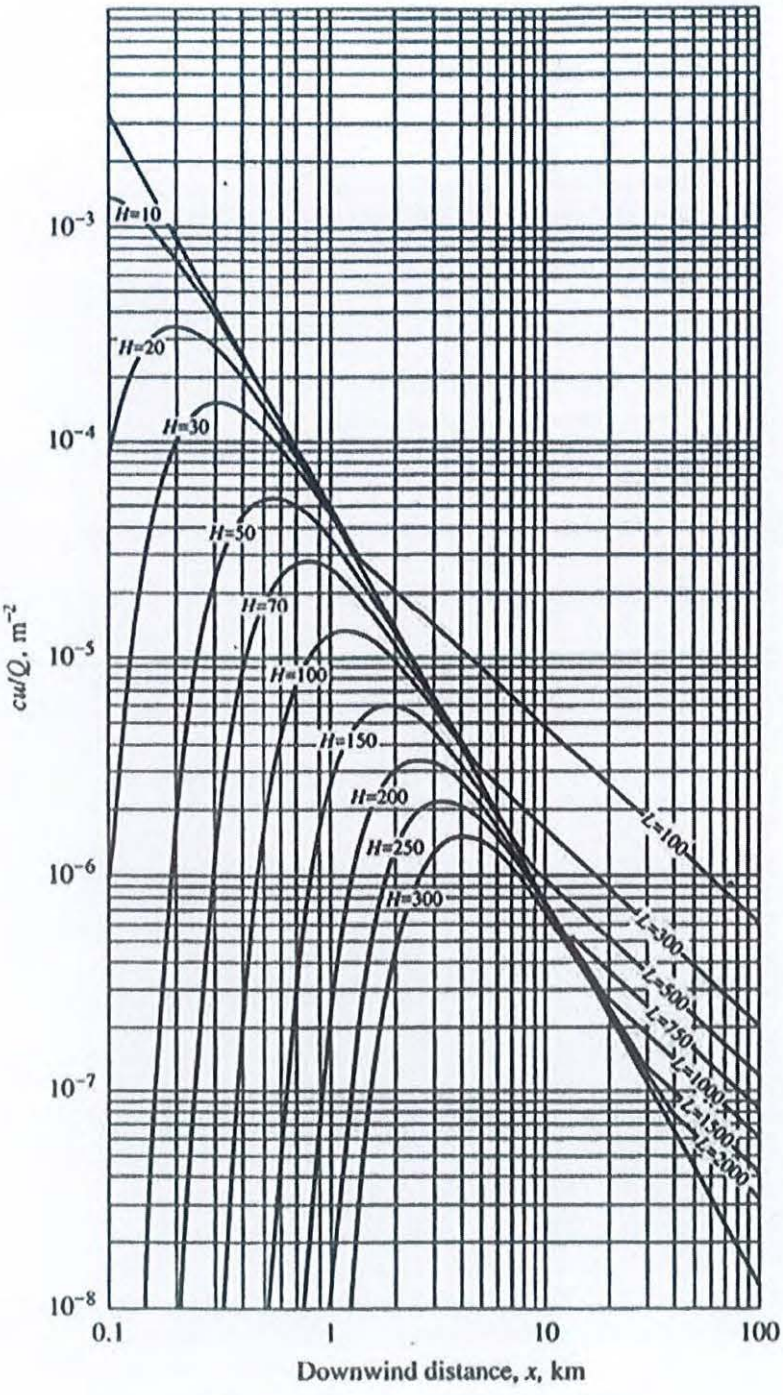


FIGURE 6.9
Ground-level cu/Q, directly under the plume centerline, as a function of downwind distance from the source and effective stack height, H, in meters, *for C stability only.* (From Turner [7].) Here L is the atmospheric mixing height, also in meters.