University of Asia Pacific
Department of Civil Engineering
Final Examination, Fall 2016
Program: B.Sc in Civil Engineering

Course Title: Principles of Management | Course Code: IMG301

Time: 2 Hours | Full Marks: 50

Answer any 3 Questions from 2-5. Answering Question no.1 is compulsory.

1. The numbers of Engineering Metals sold by Quantum Builders and Engineering Ltd. over 7 day period were as follows: 20

Day	1	2	3	4	5	6	7
Units Sold	25	31	29	33	34	37	35

Given the above data: prepare a forecast using each of these approaches:

a) Simple Average

b) A 3-period moving average (N=3)

c) A 3 period weighted average using weights of C1=0.5, C2= 0.3 and C2=0.2

d) Exponential smoothing with a smoothing constant α=0.4

2. Describe Maslow's Hierarchy of Needs, Theory X and Theory Y with examples. 10

3. Define Team, Group and draw comparison between the two. 10

4. Write down the steps involved in Strategic Management. Conduct a SWOT (Strength, Weakness, Opportunities and Threats) analysis on Department of Civil Engineering, University of Asia Pacific. 10

5. Conduct Porter's five forces analysis on the telecommunication industry of Bangladesh. 10

----------Good Luck----------

Forecasting Formulae

- **Simple Average (Mean)**

$$F_{t+1} = \frac{A_t + A_{t-1} + A_{t-2} + \ldots\ldots\ldots\ldots}{n}$$

- **Moving Average**

$$F_{t+1} = \frac{A_t + A_{t-1} + \ldots\ldots\ldots + A_{t-N+1}}{N}$$

- **Weighted Moving Average**

$$F_{t+1} = C_1 A_t + C_2 A_{t-1} + \ldots\ldots\ldots + C_N A_{t-N+1}$$

where

$$C_1 + C_2 + \ldots\ldots\ldots C_N = 1$$

- **Exponential Smoothing**

$$F_{t+1} = \alpha A_t + (1 - \alpha) F_t$$

where

$$0 \leq \alpha \leq 1$$

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2016
Program: B.Sc. Engineering (Civil)

Course Code: CE 313 **Time: 180 Minutes**
Course Title: Structural Engineering II **Credit Hour: 3.0** **Full Marks: 20x10 = 200**

Answer any 10 of the following 14 Questions. *The figures are not drawn to scale.* Any missing data can be assumed reasonably.

[1] In Figure 1, determine the corresponding uniformly distributed loads and missing moments value by using approximate vertical load analysis. Also draw the axial force diagram of columns LIFB and MJGC. **(20)**

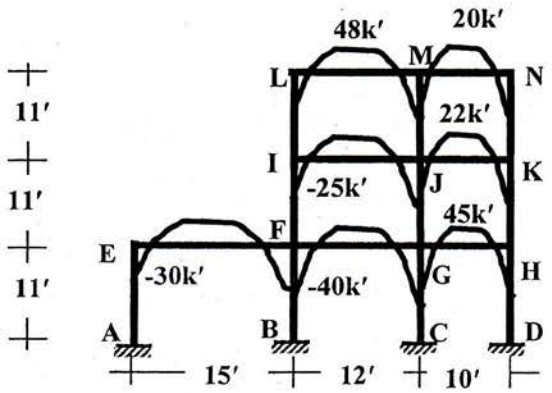


Figure 1

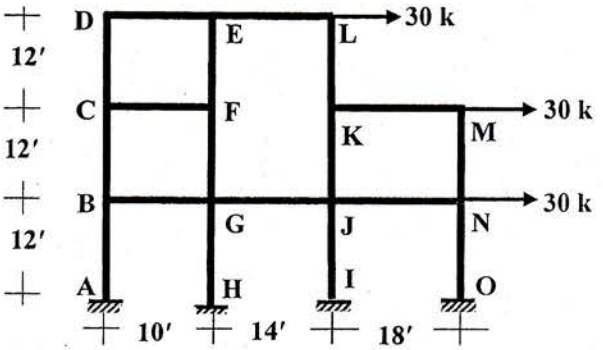


Figure 2

[2] Use the Cantilever Method to determine all the unknown forces and moments at joint J of the frame shown in Figure 2. Assume all the columns have same cross-sectional area. **(20)**

[3] Use the Virtual Work Method to determine the deflection $\Delta_{H(\rightarrow)}$ and $\Delta_{C(\downarrow)}$ of the truss shown in Figure 3. Given, EA = 75 x 10^3 k. **(20)**

[4] Determine the member forces HG, HF, ED and CD of the statically indeterminate truss shown in Figure 4. The diagonals can carry half the panel shear. **(20)**

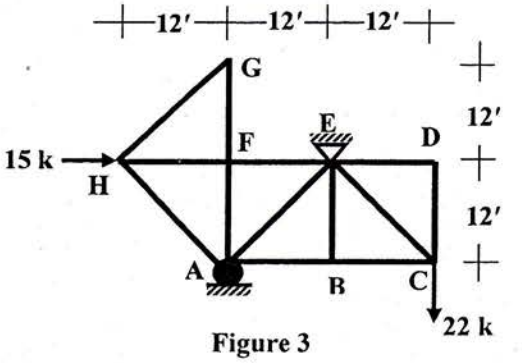


Figure 3

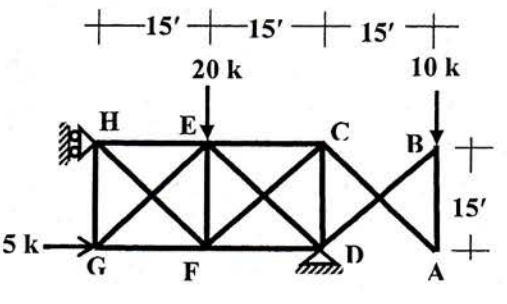


Figure 4

[5] Use the Virtual Work Method to determine the value of P to cause $\Delta_{C(\downarrow)} = 2''$ in the beam shown in Figure 5. Given, E = 3600 ksi, I = 4200 in^4. **(20)**

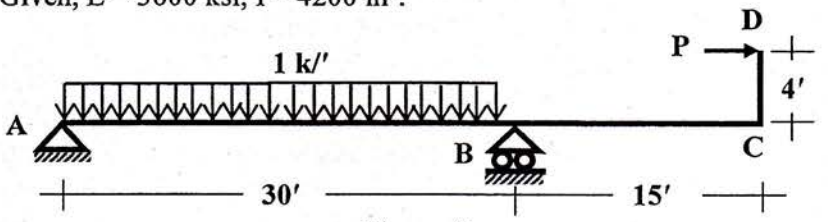


Figure 5

[6] Horizontal deflection at point B is given $\Delta_{B(\rightarrow)} = 4''$ for the frame shown in Figure 6. Determine the value of the load *P* by using the Virtual Work Method. Given, EI = 30x10^6 k-in^2. **(20)**

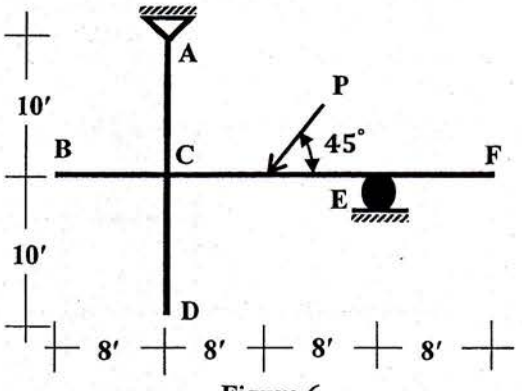


Figure 6

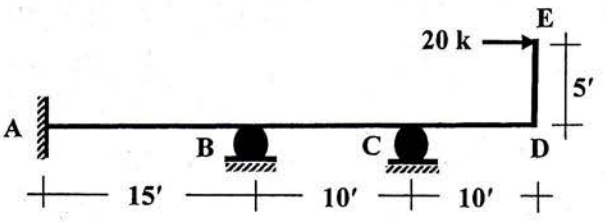


Figure 7

[7] Use the Flexibility Method to determine the support reactions and draw the BMD of the beam shown in Figure 7. Assume the support C has settled 2 inches. Given, EI = 30x10^6 k-in^2. **(20)**

[8] Draw BMD of the frame shown in Figure 8 by using the Moment-Distribution Method. Assume the support E has settled 2.5 inches. Given, EI = 16x10^7 k-in^2. **(20)**

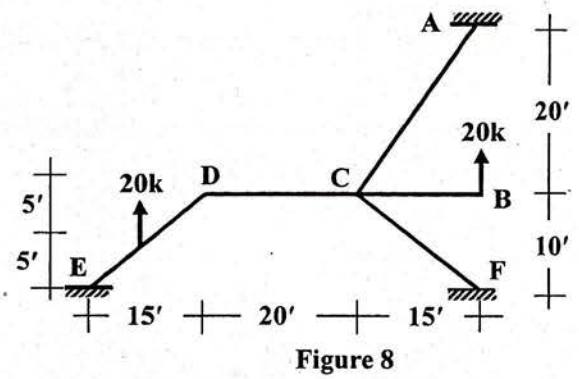


Figure 8

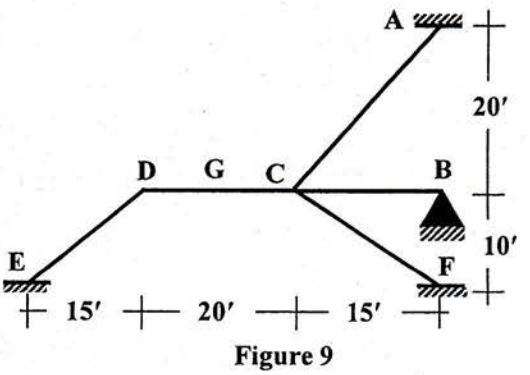
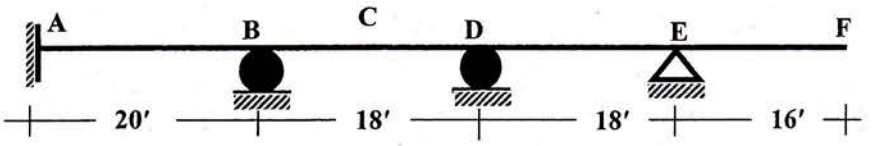


Figure 9

[9] Draw the influence line for moment at G of the frame shown in Figure 9 and place a uniformly distributed dead load 2 k/′, and a moving load of 10 kips for maximum positive moment. Use Moment-Distribution Method to draw the BMD of the frame. Given, E = 3000 ksi, I = 3200 in^4.**(20)**

[10] Draw the influence line for positive moment at C of the beam shown in Figure 10 and place a uniformly distributed dead load 3.5 k/′, live load 2.5 k/′ and a point moving load of 5 kips for maximum positive moment. Given, E = 3600 ksi, I = 1728 in^4. **(20)**

Figure 10



[11] In Figure 10 support D has settlement of 3.5 inches. Use the Moment-Distribution Method to draw BMD of the beam. Given, E = 30x10^3 ksi, I = 4000 in^4. **(20)**

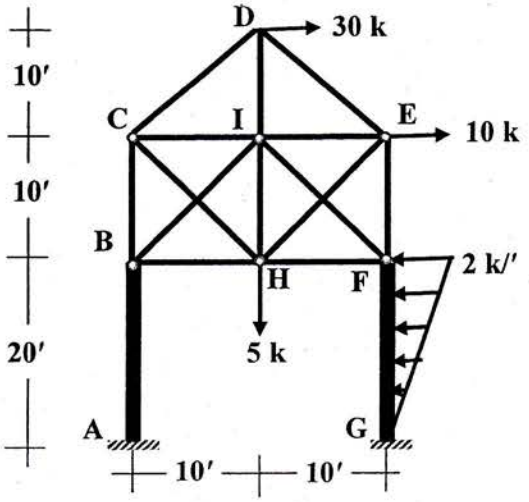


Figure 11

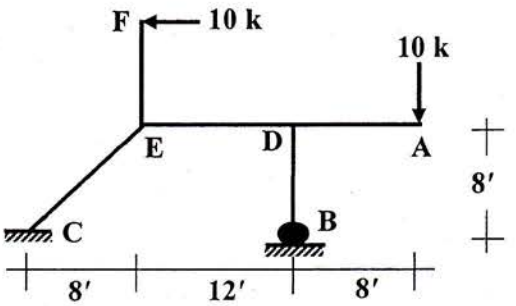


Figure 12

[12] A portal frame is connected with statically indeterminate truss as shown in Figure 11.

(a) Use Portal Method to calculate the support reactions A, G and draw the BMD of GF. **(8)**

(b) Calculate member forces in BC, IF, CH by assuming diagonal members can take tension only. **(12)**

[13] Use Flexibility Method to draw BMD of the frame shown in Figure 12. Given, E = 3600 ksi, I = 1728 in^4. **(20)**

[14] (a) What are the differences between Moment-Distribution Method and Flexibility Method? Which method you would chose for BMD of indeterminate structures and why? **(2.5+2.5)**

(b) What is moment carryover? Show that the moment carryover factor is $\frac{1}{2}$ for prismatic members (fixed end). **(1+4)**

(c) What are the differences between portal and cantilever method? Use appropriate sketches if necessary. **(4)**

(d) What is influence line (IL)? What is the purpose of IL? Distinguish between determinate and indeterminate ILs? Use appropriate sketch if necessary. **(6)**

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2016
Program: B.Sc. in Civil Engineering

Course Title: Design of Reinforced Concretes II | Course Code: CE 317
Time: 3 (Three) hours | Full Marks: 140

There are 10 (Ten) questions in this section. Answer any 7 (Seven).
Assume reasonable values for any missing data. Symbols used have their usual meanings.

1. (a) The slab system shown in **Figure 1** carries service live load of 60psf and dead load of 40 psf in addition to its own weight. It is supported on all sides by beams. **17**

(i) Determine the slab thickness
(ii) Calculate the moments in short direction
(ii) Calculate the slab reinforcements in short direction and show them in a plan and cross-sectional view.
Given: $f_c' = 3$ ksi and $f_y = 60$ ksi.

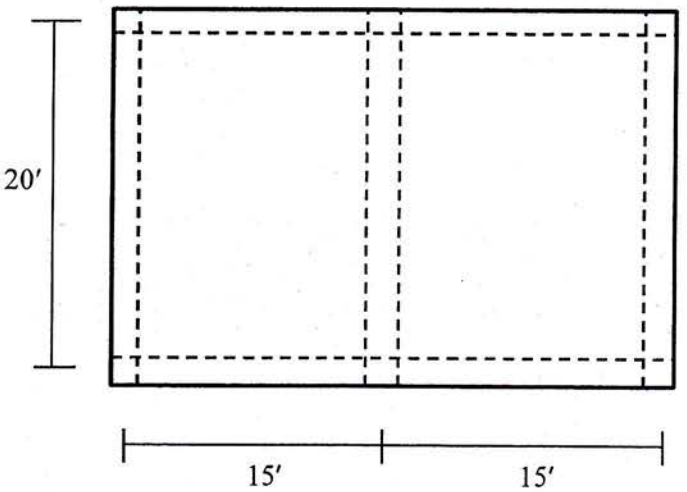


Figure 1

(b) Explain why transverse reinforcements are used in RC columns. Also compare between the effect of ties and spirals on the strength and ductility of columns. **3**

2. (a) Design a short column for $P_u = 600$ k, $M_u = 125$ k-ft. Place the bars uniformly around the all four faces of the column. Also design the ties as per ACI guidelines and show the details in neat sketch.
Given: $f_c' = 4$ ksi and $f_y = 60$ ksi.

(b) Explain why the factors ϕ and α are used for column design. Also explain why a smaller value of ϕ is used for columns compared to beams.

3. (a) Why are special reinforcements needed at the corners of a two way slab system? Discuss the possible special arrangements. **3**

(b) Using Direct Design Method, determine the minimum thickness required, corresponding moments and slab reinforcement in any one direction for panel 3 of the flat plate floor shown in **Figure 2.** Edge beams are not used along the exterior floor edges. Assume that the floor system is to support service live load of 80 psf and dead load of 60 psf in addition to its own weight. **17**
Given: $f_c' = 3$ ksi and $f_y = 60$ ksi.

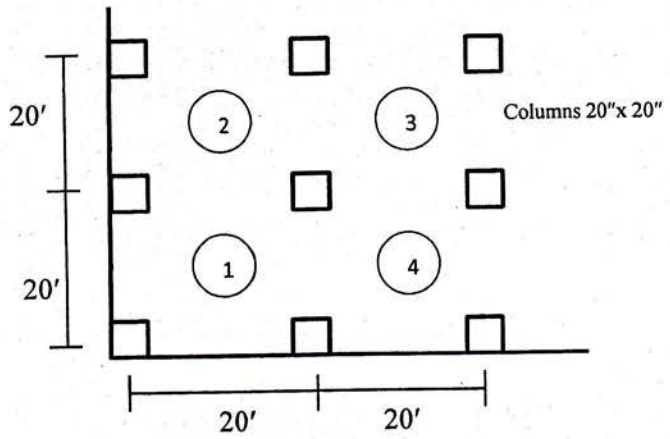


Figure 2

4. (a) A 12×20 inch column is reinforced with four #9 bars as shown in the **Figure 3** Given that $f_c' = 4$ ksi, $f_y = 60$ ksi. Determine **18**
(i) The load P_b, moment M_b and corresponding eccentricity e_b for balanced failure;
(ii) The load and moment for a point in the tension failure region of the interaction diagram.
(iii) The load and moment for a point in the compression failure region of the interaction diagram.
(iv) The axial load P for zero eccentricity.

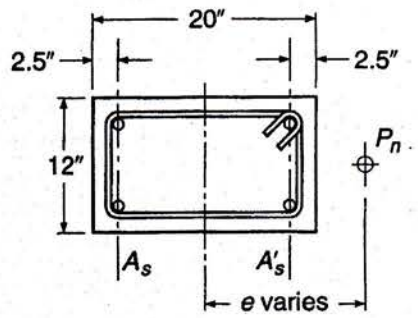


Figure 3

(b) Why does ACI code specify higher value for shear stresses in punching than in beam shear stresses? **2**

5. (a) What is the basic difference between the internal couple of a prestressed section and that of a reinforced beam section? **3**

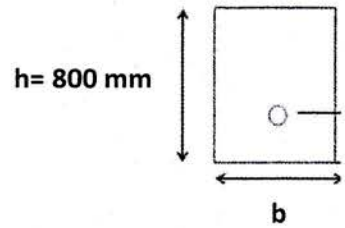
(b) What is the difference (analysis and design) between bonded and un-bonded prestressed concrete beams? **4**

(c) Calculate the cracking moment of a prestressed concrete beam of size 12" x 30" prestressed with 24 Nos. 7 mm wires (Area = 0.0598 in^2) to a stress of 160 ksi at an eccentricity of 6" at center span. Given: $f_c' = 8$ ksi and n= 6. **13**

6. (a) Design a rectangular section with h = 800 mm for a simply supported 15.0 m span prestressed concrete beam shown in Figure 4. The service loads are weight of the beam itself, W_G; additional dead load, W_D = 10 kN/m; live load, W_L = 14 kN/m. Assume, W_G = 6 kN/m which needs to be checked. Material properties are given as: **18**
E_s= 2 x 10^5 MPa; E_c = 2.5 x 10^4 MPa; f_{se} = 850 MPa; f_{ci}' = 28 MPa; f_c' = 35 MPa; f_0 = 1025 MPa

(i) Make a preliminary design of the beam i.e. determine b, A_{ps}

(ii) Make the final design. Change only b, A_{ps} if required. Draw the final sketch with location of steel.



Mid-span section

Figure 4

(b) What are the different sources of prestress loss in a prestressed concrete member? **2**

7. (a) Use USD to design a square footing for a 30" x 30" column with a working dead load (*DL*) = 800 kip and live load (*LL*) = 500 kip. Allowable bearing capacity of soil = 3.5 ksf. Show reinforcements in plan and sections with neat sketches. **10**
Given: f_c' = 3 ksi and f_y = 60 ksi.

(b) If a rectangular footing, 18 ft x 22 ft is provided for the same column as in 7(a), design the reinforcements for the footing. **10**

8. (a) 20 inch dia cast-in-situ piles will be provided for a RC column 48" x 48" in section. The column will carry a *DL*= 2000 kip and *LL*= 850 kip. The allowable load carrying capacity of the 20 inch diameter pile= 200 kip. Design the pile cap using USD method. Make neat sketches (plan and section) showing all the reinforcements and necessary details. **14**
Given: f_c' = 4 ksi and f_y = 60 ksi. Assume self-weight of pile cap about 10% of total load.

(b) The part plan of a structure as shown in Figure 5 consists of columns C_1, C_2, C_3 and C_4 carrying axial loads of 500 kip, 600 kip, 700 kip and 800 kip respectively. All the columns are 24" x 24" in size. If the allowable soil bearing capacity is 4 ksf, calculate the area of a combined footing for the columns and make a layout plan of the footing showing all the columns and all dimensions. **6**

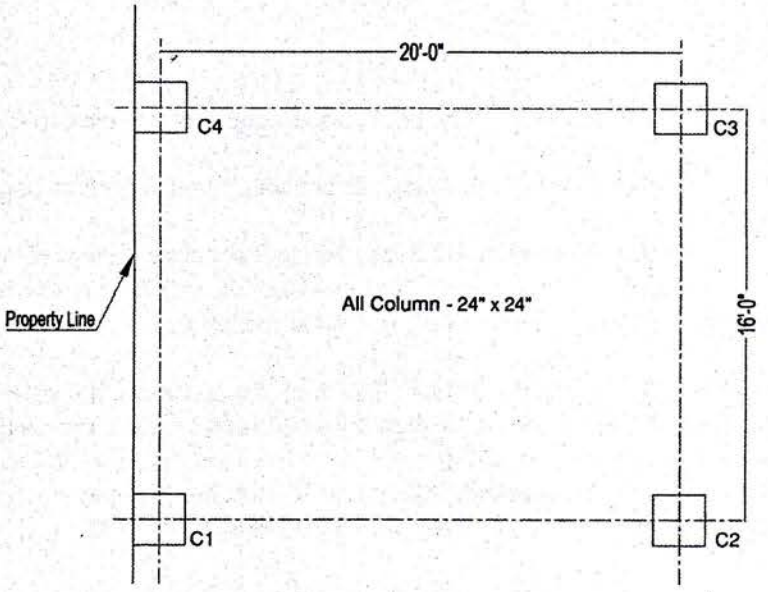


Figure 5

9. (a) Determine the factor of safety against overturning and sliding for the plain concrete gravity retaining wall shown in Figure 6. Concrete unit weight = 145 pcf and earth unit weight = 110 pcf. Given, $\phi = 25°$, $f = 0.45$. **10**

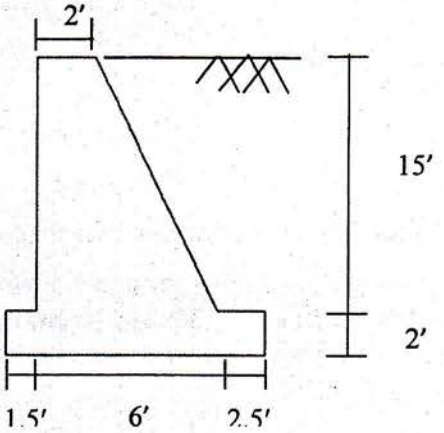


Figure 6

(b) An exterior 24 x 18 inch column with DL = 170 kips, LL = 130 kips, and an interior 24 x 24 inch column with DL = 250 kips, LL = 200 kips are to be supported on a combined rectangular footing whose outer end cannot protrude beyond the outer face of the exterior column. The center to center distance of column is 18 ft and the allowable bearing pressure of the soil is 6 ksf. The bottom of the footing is 6 ft below grade and a surcharge of 100 psf is specified on the surface. Determine the thickness of the footing using the shear and bending moment given in Figure 7 for $f_c' = 3$ ksi, $f_y = 40$ ksi. **10**

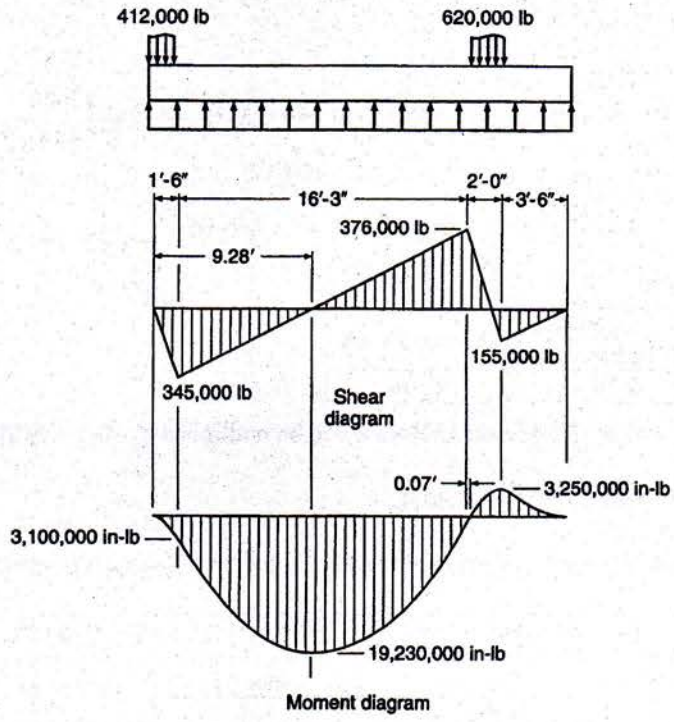


Figure 7

10. (a) Briefly outline the design provisions for two types of shear reinforcement in flat slabs. **4**

(b) Why ACI has specified minimum and maximum reinforcement ratio for RC column design? **3**

(c) Use USD to design a spirally reinforced column with a working dead load (DL) = 500 kip and live load (LL) = 300 kip. Also design the spirals for that circular column. Given: f_c' = 4 ksi and f_y = 72.5 ksi. **13**

Co-efficient Method:

$Ma = C_a\, w_u\, la^2$
$Mb = C_b\, w_u\, lb^2$
Thickness h =P/180 ≥ 3.5, P = panel perimeter
Shear strength of the slab, $\varphi V_c = 2\sqrt{f_c'}bd$

$$d = \sqrt{\frac{M_u}{\phi\rho f_y(1-0.59\rho\frac{f_y}{f_c'})}} \qquad \text{Here } \rho = \rho_{max} = 0.75\rho_b = 0.75 * 0.85*\beta_1 \frac{f_c'}{f_y} * \frac{87000}{87000+f_y}$$

Direct Design Method:

Minimum thickness of Flat Slab

Exterior Panels without Edge Beams	Exterior Panels with Edge Beams	Interior Panels
$L_n/33$	$L_n/36$	$L_n/36$

For reinforcements with fy ≠ 40 ksi, the tabulated values are to be multiplied by (0.8 + fy/200).

$$M_o = w_n L_2 L_n^2/8;\ M_u^{(-)} = 0.65M_o;\ M_u^{(+)} = 0.35M_o$$

Distribution Factors applied to Static Moment M_0 for Positive and Negative Moments

Position of Moment	Ext Edge unrestrained (a)	Slab with beams between all supports (b)	No beam between interior supports		Exterior Edge fully restrained (e)
			Without edge beam (c)	With edge beam (d)	
Exterior $M^{(-)}$	0.00	0.16	0.26	0.30	0.65
Interior $M^{(-)}$	0.75	0.70	0.70	0.70	0.65
$M^{(+)}$	0.63	0.57	0.52	0.50	0.35

$\alpha = E_{cb}I_b/E_{cs}I_s \quad \beta_t = E_{cb}C/2E_{cs}I_s \quad C = \sum(1-0.63\, x/y)\, x^3y/3$

% of Exterior $M^{(-)}$ supported by Column Strip = $100 - 10\beta_t + 12\,\beta_t\,(\alpha_1 L_2/L_1)\,(1-L_2/L_1)$

% of $M^{(+)}$ supported by Column Strip = $60 + 30\,(\alpha_1 L_2/L_1)\,(1.5-L_2/L_1)$

% of Interior $M^{(-)}$ supported by Column Strip = $75 + 30\,(\alpha_1 L_2/L_1)\,(1-L_2/L_1)$

For slabs without beams between supports ($\alpha_1 = 0$) and without edge beams ($\beta t = 0$), the portion of negative moments in column strip is simply 100% and 75% for exterior and interior supports, respectively, and portion of positive moment in column strip is simply 60%.

Punching shear capacity $V_c = 4\sqrt{f'_c}\, b_o\, d$

Short Column:
Axial Capacity $P_u = \alpha\,\phi\,A_g[0.85f_c' + \rho_s(f_y - 0.85f_c')]$

$$c = c_b = d\frac{\epsilon_u}{\epsilon_u + \epsilon_y} \qquad f_s = \epsilon_u E_s \frac{d-c}{c} \le f_y \qquad f_s' = \epsilon_u E_s \frac{c-d'}{c} \le f_y \qquad C = 0.85f_c'ab$$

$$P_n = 0.85f_c'ab + A_s'f_s' - A_sf_s$$

$$M_n = P_n e = 0.85f_c'ab\left(\frac{h}{2} - \frac{a}{2}\right) + A_s'f_s'\left(\frac{h}{2} - d'\right) + A_sf_s\left(d - \frac{h}{2}\right)$$

$$K_n = \frac{P_u}{\phi f_c' A_g} \qquad R_n = \frac{M_u}{\phi f_c' A_g h}$$

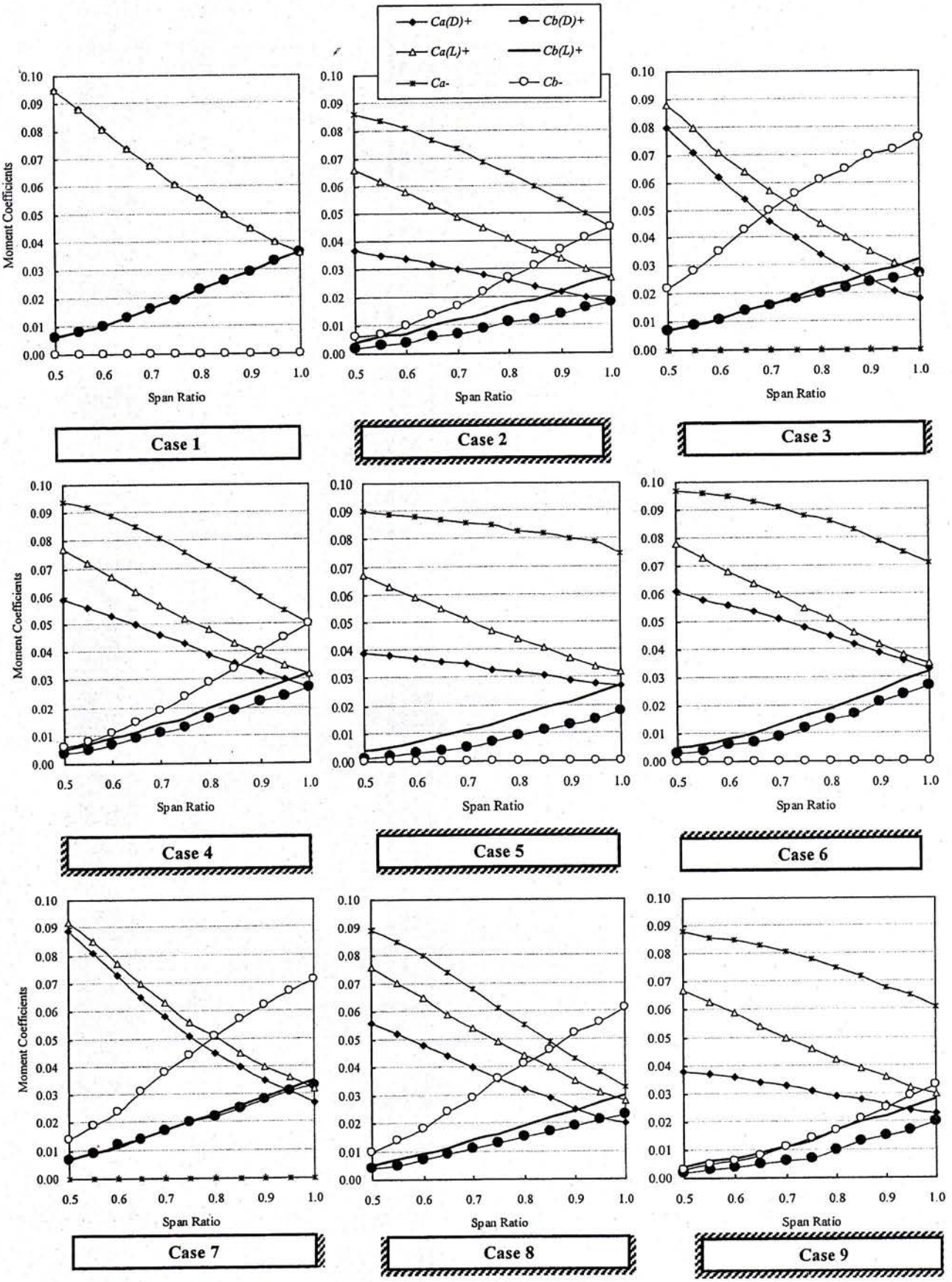
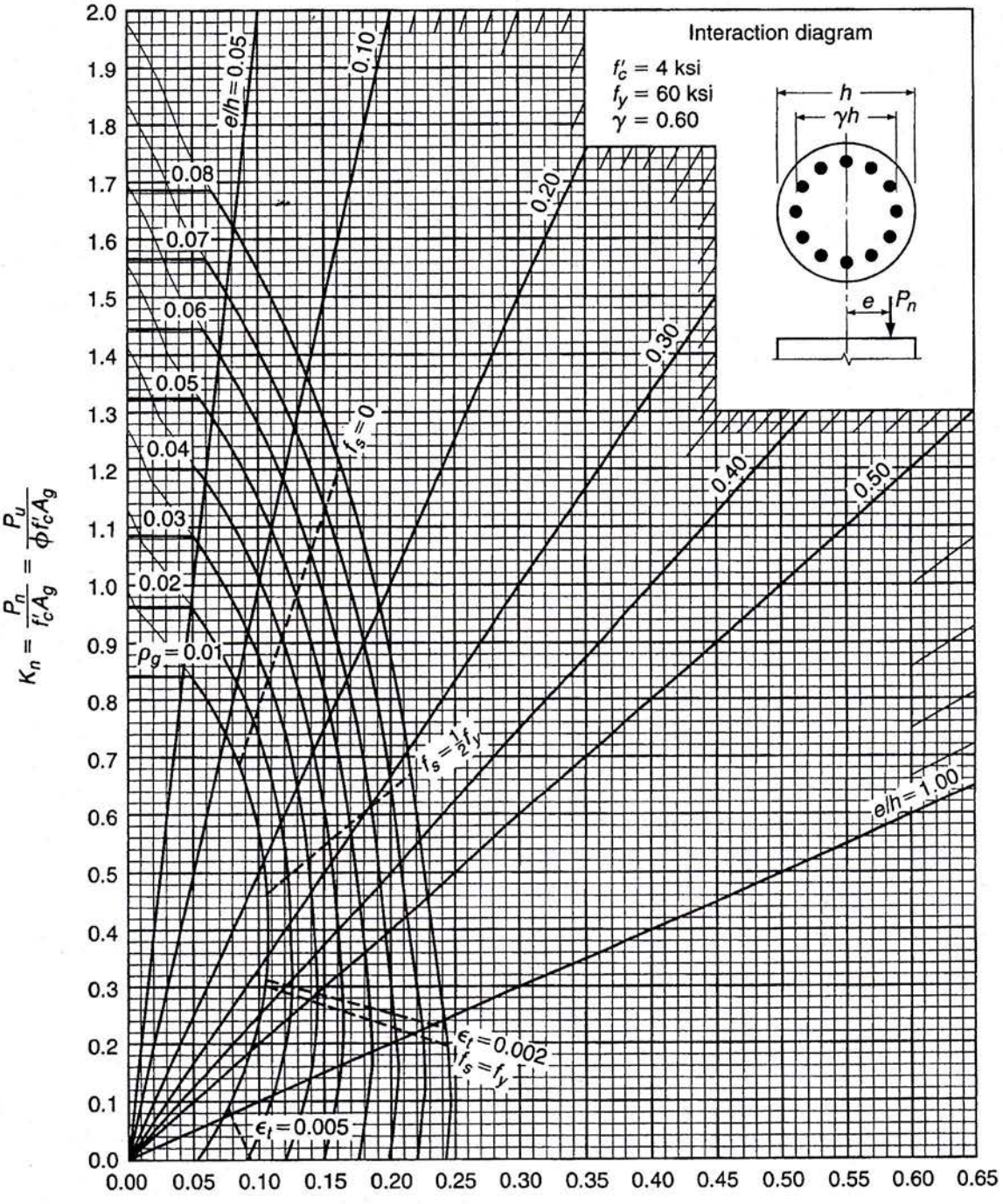
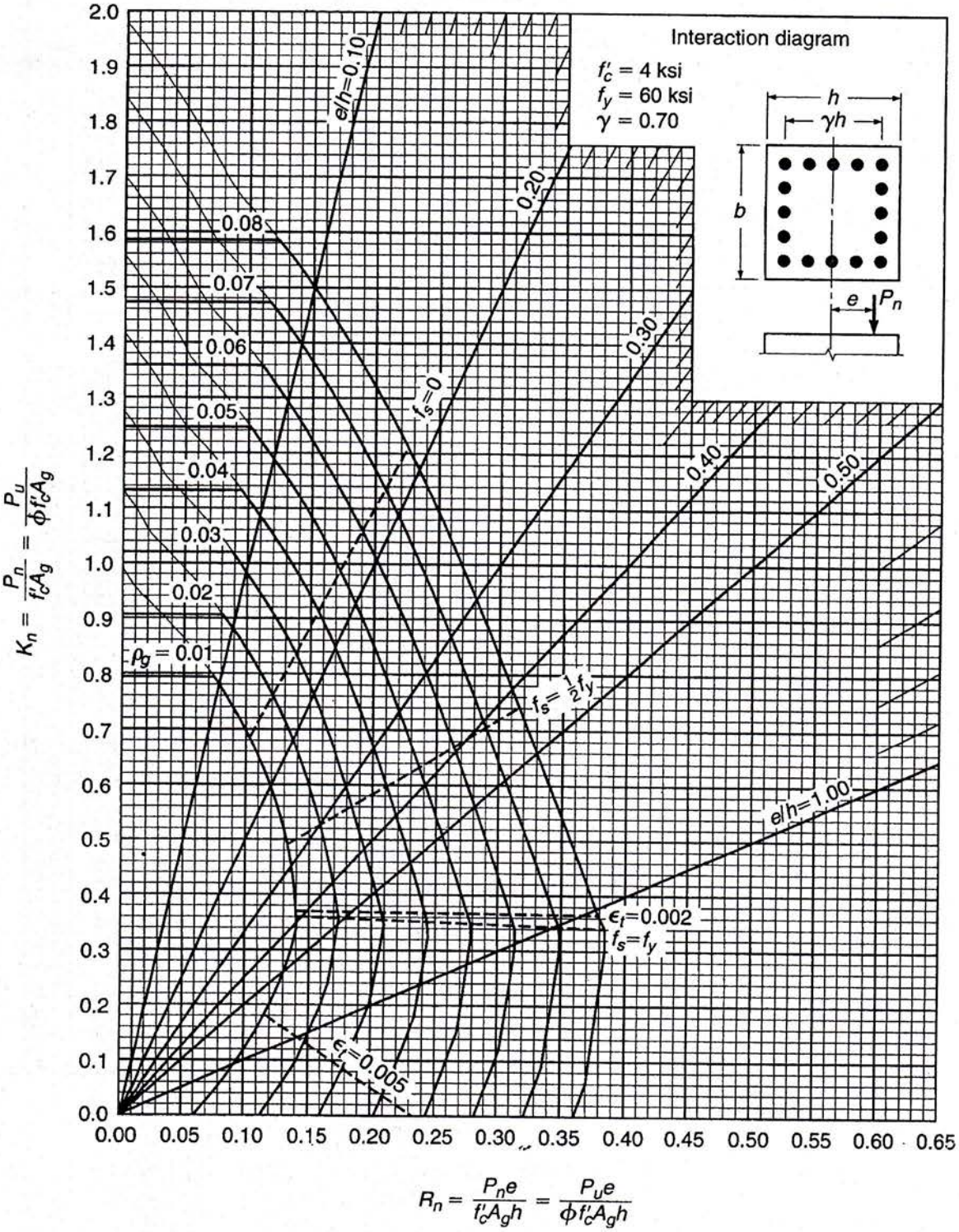
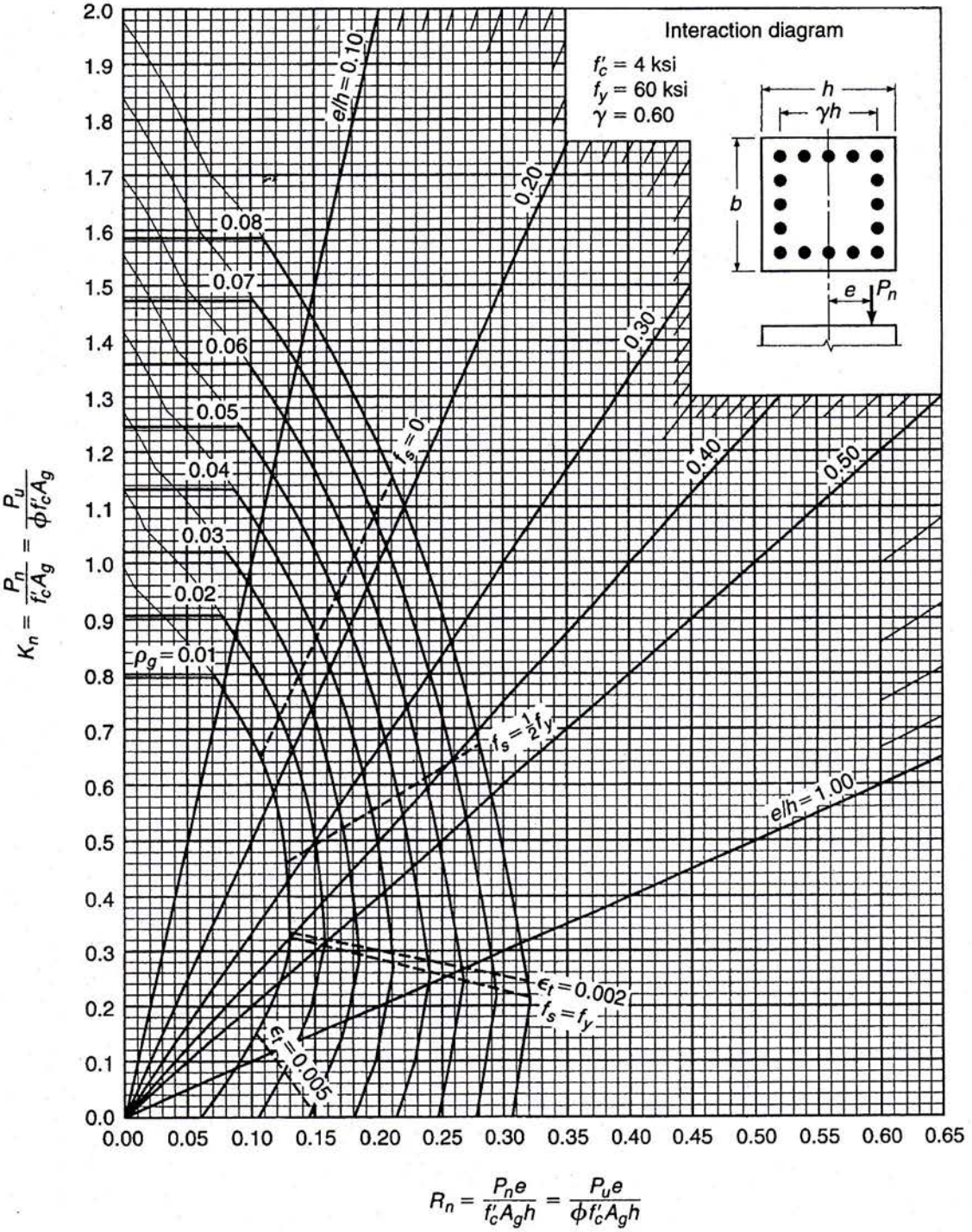


Fig. 1.5: Moment coefficients for different support conditions


Interaction diagram
f'_c = 4 ksi
f_y = 60 ksi
γ = 0.60
h
γh
e
P_n
e/h = 0.05
0.10
0.20
0.30
0.40
0.50
e/h = 1.00
0.08
0.07
0.06
0.05
0.04
0.03
0.02
ρ_g = 0.01
f_s = 0
$f_s = \frac{1}{2} f_y$
$f_s = f_y$
ϵ_t = 0.002
ϵ_t = 0.005
$K_n = \frac{P_n}{f'_c A_g} = \frac{P_u}{\phi f'_c A_g}$
$R_n = \frac{P_n e}{f'_c A_g h} = \frac{P_u e}{\phi f'_c A_g h}$


Interaction diagram
f'_c = 4 ksi
f_y = 60 ksi
γ = 0.70
h
γh
b
e
P_n
e/h=0.10
0.20
0.30
0.40
0.50
e/h=1.00
0.08
0.07
0.06
0.05
0.04
0.03
0.02
ρ_g = 0.01
f_s=0
$f_s=\frac{1}{2}f_y$
ϵ_t=0.002
$f_s=f_y$
ϵ_t=0.005
$K_n = \frac{P_n}{f'_c A_g} = \frac{P_u}{\phi f'_c A_g}$
$R_n = \frac{P_n e}{f'_c A_g h} = \frac{P_u e}{\phi f'_c A_g h}$


Interaction diagram
f'_c = 4 ksi
f_y = 60 ksi
γ = 0.60
h
γh
b
e
P_n
e/h = 0.10
0.20
0.30
0.40
0.50
e/h = 1.00
0.08
0.07
0.06
0.05
0.04
0.03
0.02
ρ_g = 0.01
$f_s = 0$
$f_s = \frac{1}{2} f_y$
ϵ_t = 0.002
$f_s = f_y$
ϵ_t = 0.005
$K_n = \frac{P_n}{f'_c A_g} = \frac{P_u}{\phi f'_c A_g}$
$R_n = \frac{P_n e}{f'_c A_g h} = \frac{P_u e}{\phi f'_c A_g h}$

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2016
Program: B.Sc. Engineering (Civil)

Course Title: Environmental Engineering II | Course No: CE 333
Time: 3.0 hours | Full Marks: 150

*Answer any **three** out of **four** questions from each part (25*6=150)*
Assume reasonable value of missing data (if any)

Part A

1. (a) What is Hygienic education? Briefly discuss the interrelationship between water, sanitation and health education with figure. [4+6]
   (b) Define sanitation. Show in a figure how sanitation can cut the transmission route of pollution and diseases. [5+10]

2. (a) What are blackwater and greywater? Why the reclamation and reuse of greywater are simpler and easier than blackwater? [6+4]
   (b) What is vent stack? Discuss the governing principles of plumbing system in a building. [3+12]

3. (a) Draw the flow chart of mechanisms that occur in anaerobic digestion of sludge treatment. Discuss the drying bed method for sludge dewatering process. [5+5]
   (b) Design and sketch a two-compartment septic tank to serve a house of 8 persons. The production of wastewater is 120 lpcd. The tank is to be de-sludged every 6 years. [15]

4. (a) "*The understanding of microbiology is crucial for wastewater treatment*"—justify the statement. What microorganism is vital for biological treatment of industrial wastewater? [6+4]
   (b) Write down the composition of wastewater. What are the factors on which the composition of wastewater depends on? What are the objectives of wastewater treatment? [5+5+5]

Part B

5. (a) Explain how wastewater is considered as a resource. [10]
   (b) What are the differences between raw sludge and digested sludge? What are the basic options for the ultimate disposal of treated sludge? [7+8]

6. (a) Draw a sketch of a ventilated improved pit (VIP) latrine showing all the elements. Why is VIP latrine considered most hygienic among all forms of pit latrines? [5+5]
   (b) Describe the following processes of wastewater treatment in detail:
   i) Preliminary treatment process ii) Secondary treatment process. [7+8]

7. (a) Draw a typical bacterial growth pattern in wastewater indicating different stages. Mention the factors that affect bacterial growth in a biological reactor. [5+5]

(b) Define *trap* and *strength of a trap* with sketch. Mention the qualities of a good trap. [10+5]

8. (a) What are the common coagulants used in wastewater treatment processes? What are the roles of coagulant in wastewater treatment? [5+5]

(b) Mention the categories and applications of water reuse. Draw a conceptual graph for water quality changes during municipal uses of water in a time sequence with water reclamation. [7+8]

University of Asia pacific
Department of Civil Engineering
Final Examination Fall 2016
Program: B.Sc. Engineering (Civil)

Course Title: Transportation Engineering I (Transport and Traffic Design) Course Code: CE 351
Time: 3 Hours Full Marks: 150

There are **six** questions. Answer **five** of them

1. a) Briefly explain the elements of Passing Sight Distance for a two-lane highway. 12
   b) Categorize traffic signs along with examples. 10
   c) Two straight sections of a highway meet at an angle of 140^0. If the radius of simple circular curve is 600 m, find 8
      i) Tangent distance and
      ii) Apex distance

2. a) What are the different types of traffic signal controller? 5
   b) Describe different types of vertical deflection measures for traffic calming? 15
   c) An urban primary road with 70 ft pavement width having a reflectance of 11% carries a maximum of 1850 vph at night-time. Design the lighting system considering Sodium source with mounting height of 50 ft and a maintenance factor of 0.88. Draw the lighting layout. 10

3. a) A transition curve is to be used to join the ends of a 4.72^0 circular curve with the straight. The length of transition curve is 140 m. Find out offsets at some interval and draw the transition curve? 10
   b) The following spot speeds (km/hr) were observed for 45 vehicles traversing a segment of an arterial road. 20

      57, 36, 33, 65, 76, 26, 58, 57, 70, 69, 88, 58, 37, 53, 65, 39, 36, 48, 42, 45, 63, 46 42, 76, 45, 37, 65, 58, 39, 36, 53, 45, 73, 56, 43, 37, 47, 44, 68, 53, 67, 64, 65, 36, 49.

      Calculate the modal speed, design speed, average speed, safe speed, median speed and upper limit of speed. (Consider pace as **11-20, 21-30** and so on)

4. a) Write short notes on any **four**: 16
      i) Depth perception
      ii) Origin Destination survey
      iii) Glare resistance
      v) Cone of vision
      iv) Park and Ride system

   b) An accident assessor guesses that a bus strike a bridge pier at a speed of 230mi/hr. determined by her evaluation of damage. After examination to the accident location she detected skid marks of 70 ft on the asphalt pavement (f=0.425) and 30 ft on the earth shoulder (f=0.25). There is +4% grade. Estimate the speed of the vehicle at the commencement of skid signs. 14

5. a) A positive 4% grade vertical curve is followed by a negative 5% grade at a section of a two-lane highway. Determine the required length of vertical curve needed to satisfy design stopping sight distance? Assume the stopping sight distance to be 600 ft. 12

b) The corner of a shopping mall is near to the horizontal curve having a radius of 150 ft on a national highway. The inside lane in 15 ft wide and the inside edge of the road is 7 ft from the corner of a shopping mall. What should be the speed limit of that section of the roadway? Assume reaction time as 2.5 second and friction factor as 0.34. 12

c) Derive the relationship of mobility and accessibility in terms of highway classification. 6

6. a) Briefly describe how Economic factor and Military factor effect the development of transportation system in Bangladesh. 12

b) Briefly explain the constraints of road and water transportation sector in Bangladesh. 12

c) What are the factors that affect the choice of particular type of mode? 6

Necessary equations:

$$S<L: \quad L=\frac{AS^2}{100(\sqrt{2h_1}+\sqrt{2h_2})^2}$$

$$S>L: \quad L=2S-\frac{200(\sqrt{h_1}+\sqrt{h_2})^2}{A}$$

$$S<L: \quad L=\frac{AS^2}{200[2.0+S(\tan 1^\circ)]}$$

$$S>L: \quad L=2S-\frac{200[2.0+S(\tan 1^\circ)]}{A}$$

$$d_s = 1.47 S_i t + \frac{S_i^2}{30(0.348 \pm 0.01G)}$$

where:

d_s	=	safe stopping distance, ft
S_i	=	initial speed of vehicle, mi/h
G	=	grade, %
t	=	reaction time, s
0.348	=	standard friction factor for stopping maneuvers

TABLES & FIGURES for Question 2 c)

TABLE 1 RECOMMENDED AVERAGE ILLUMINATION (LUMENS/FT^2)

Pedestrian traffic[1]	Vehicular traffic[2] (vph)			
	Very light (<150 vph)	Light (150 – 500 vph)	Medium (500 – 1,200 vph)	Heavy (>1,200 vph)
Heavy	-	0.8	1.0	1.2
Medium	-	0.6	0.8	1.0
Light	0.2	0.4	0.6	0.8

Notes: (1) Heavy: As on main business street
Medium: As on secondary business streets
Light: As on local streets
(2) Night hour flow in both directions

TABLE 2 ADJUSTMENT FACTORS FOR RECOMMENDED AVERAGE ILLUMINATION VALUES

Surface Reflectance	Adjustment Factors
3 % or less	1.5
10%	1.0
20% or more	0.75

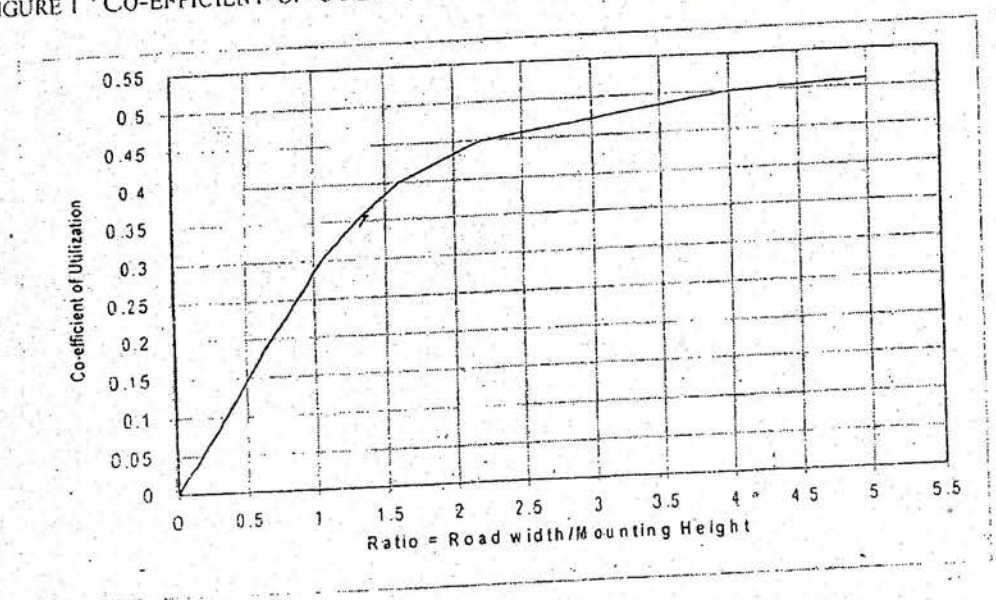
TABLE 3 LIGHTING SOURCE CHARACTERISTICS

Source Types	Expected Life (hrs)	Lighting Efficiency (Lumens/Watt)	Wattage (Watt)
Tungsten	1000	8 – 14	Up to 1000
Fluorescent	6000	50 – 75	Up to 250
Sodium	6000	100 – 120	Up to 160
Mercury	7500	20 – 60	Up to 400

TABLE 4 RECOMMENDED ARRANGEMENT OF STREET LIGHTING

Type of Arrangement	Pavement Width
One side	Width <= 30ft
Both sides – Staggered	30ft > Width <= 60ft
Both sides – Opposite	Width > 60ft

FIGURE 1 CO-EFFICIENT OF UTILIZATION CURVES (FOR LIGHT DISTRIBUTION TYPE III)



Note: Due to poor maintenance, the actual co-efficient of utilization is reduced by a factor usually 0.8 (i.e. taken as 80%).

University of Asia Pacific
Department of Civil Engineering
Semester Final Examination Fall 2016

Course: CE 363 Course Title: Engineering Hydrology
Full Marks: 150 Time: 3 hours

Assume any reasonable value, if not given

Part A
There are FOUR questions Answer any THREE

1(a). Write short notes on any four: (2.5x4=10)

i) Meteorology of Bangladesh
ii) Factors affecting rate of evaporation
iii) Synthetic unit hydrograph
iv) Current meter
v) Return period
vi) Attenuation

1(b). Assuming that all the water in the atmosphere is involved in the hydrological cycle, estimate the average residence time of atmospheric moisture using the following data: (5)

Volume of atmospheric moisture =	0.01290	M km^3
Precipitation rate on land =	118000	km^3 / yr
Precipitation rate on ocean =	459000	km^3 / yr
Evaporation from land =	75000	km^3 / yr
Evaporation from ocean =	508000	km^3 / yr

1(c). Calculate in one step the perceptible water in a 1000 m high saturated air column above 1 m^2 of ground surface, if the surface conditions are pressure = 101.3 kPa, air temperature = 20°C and the lapse rate is 6.5°C/km. (10)

2(a) Describe Dalton's law of evaporation. (5)

2(b) Figure 1 (see page 4) shows a catchment with 12 raingauge stations in and around the catchment. The rainfalls recorded by each of these stations are shown in figure 1. Find average annual rainfall in the area using Isohyetal method. Assume, 1 small grid = 10 km^2. (15)

2(c). State required data for reservoir routing, and how to choose Δt? (3+2=5)

3(a). Explain Horton's equation. How to calculate other losses while calculating runoff? (5+5=10)

3(b). If K = 4.0 hr and x = 0.2, route the following inflow hydrograph for a channel reach. Outflow at the beginning of the flood, Q = 0 cusec. (15)

Time (hr)	0	6	12	18	24	30	36	42
Inflow (cusec)	0	10	37	76	111	136	150	153

4(a). Define unit hydrograph and state the assumptions involved in the unit hydrograph theory? (5)

4(b). A reservoir with a surface area of 300 ha had the following climatic data in a month: mean relative humidity = 50%, mean wind velocity at 2.0 m above ground = 26 km/h, mean temperature = 20 °C.
If at surface temperature, saturated vapour pressure is 17.54 mm of mercury. Compute the average monthly evaporation from the reservoir and the volume of water evaporated in a year using Meyer's formula. (10)

4(c). A storm over a catchment of 10 km^2 produced a direct runoff of 5.8 cm. The time distribution of the storm is as follows. Estimate Φ index and the volume of runoff at the outlet. (10)

Time from start (hr)	1	2	3	4	5	6	7	8
Incremental rainfall (cm)	0.4	0.5	1.5	2.3	1.8	1.6	1	0.5

Part B
There are FOUR questions Answer any THREE

5(a). Sketch and identify different components of flood hydrograph? (5)

5(b). Describe different methods of base flow separation. Explain the *S-curve* method to develop a 6-h UH by using 12-h UH of the catchment. (5+5=10)

5(c). The ordinates of a 3-hr unit hydrograph are as given below:

Time	0	3	6	9	12	15	18	21	24	27
UH ordinate (cumec)	0	60	120	90	50	30	20	10	5	0

If two storms, each of 3-hr duration and having rainfall excess values of 2.0 cm and 4.0 cm respectively, then compute the Direct Runoff Hydrograph. (10)

6(a). Explain the role of drainage density and shape of basin on hydrograph. (10)

6(b). Given below are the observed flows from a 6-h storm on a stream with a catchment area of 500 km^2.

Time	0	4	8	12	16	20	24	28	32	36	40	44	48
Discharge (cumec)	10	100	250	200	150	100	70	50	35	25	12	11.5	9.5

Derive the ordinates of the 6-hr unit hydrograph. (15)

7(a). A flood-frequency computation for Padma River by using Gumbel's method yields the following data:

Return period, T (yrs)	Peak flood (cumec)
300	84960
50	71570

What would be the flood discharge for Padma Bridge for a probability of 1%? (15)

7(b). List the climatic factors affecting a flood hydrograph? Explain rational method of computing the peak discharge of a small catchment. (5+5=10)

8(a). The inflow and outflow hydrograph for a reach of a channel are given below:

Time (hrs)	Inflow (cumec)	Outflow (cumec)
0	20	20
6	191	30
12	249	120
18	164	176
24	110	164
30	82	135
36	62	116
42	48	90
48	32	68

Determine the Muskingum coefficients k and x for the reach. (15)

8(b). The following data are obtained in a stream-gauging operation. A current meter with a calibration equation V= (0.32Ns+0.032) m/s was used to measure the velocity at 0.6 depth. (10)

Using the mid-section method, calculate the discharge in the stream.

Distance from right bank (m)	Depth (m)	Number of revolutions	Observation Time (s)
0	0	0	0
2	0.5	80	180
4	1.1	83	120
6	1.95	131	120
9	2.25	139	120
12	1.85	121	120
15	1.75	114	120
18	1.65	109	120
20	1.50	92	120
22	1.25	85	120
23	0.75	70	150
24	0	0	0

Figure 1:

Question: 2(b).

Enclose the figure with your answer script.