University of Asia Pacific
Department of Civil Engineering
Final Examination Spring 2015
Program: B.Sc. Engineering(Civil)

Course Title: Structural Engineering II | Credit Hours: 3.0 | Course Code:CE 313
Time: 3 Hours | Full Marks: 100(10x10)

There are **14** Questions. Answer any **10**. Assume any reasonable value if necessary. All the notations have their usual meanings.

1. The frame shown in **Figure 1** is subjected to vertical loads as shown. Draw Shear force & Bending moment diagram for the entire structure using **Approximate method**.

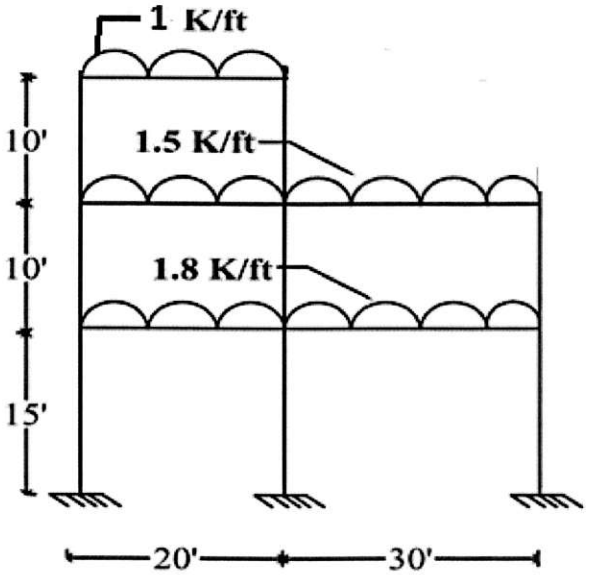


Figure 1

2. For the cross braced truss shown in **figure 2**, calculate bar forces of a,b,c and d using **Approximate Approach**. Assume diagonals can not carry compression.

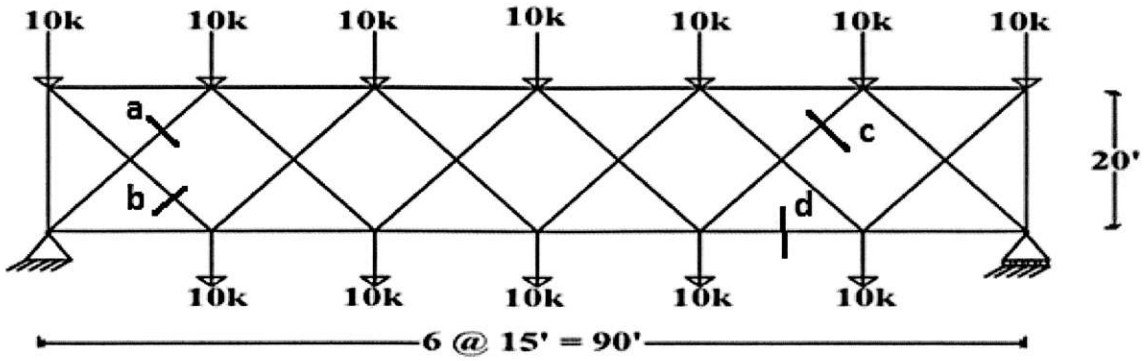


Figure2

3. Draw Shear force & Bending moment diagram for the frame shown in **Figure 3** using **Cantilever Method.**

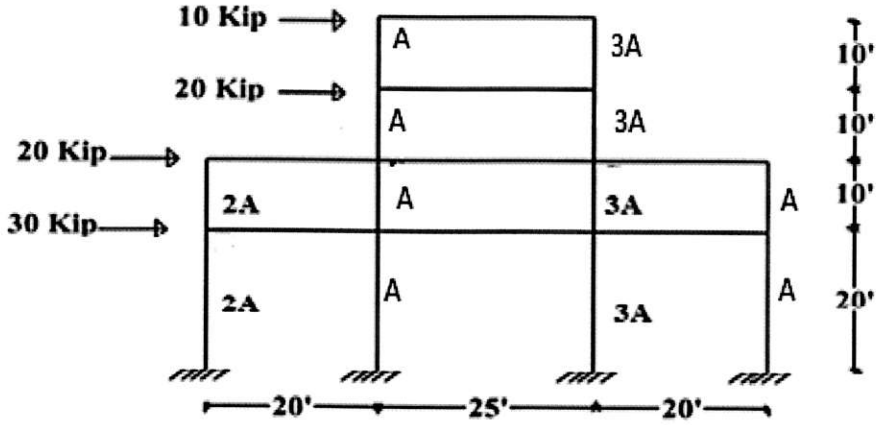


Figure 3

4. Using **Approximate Method**, draw shear force and bending moment diagrams for columns ABC and DEF of the mill bent shown in **Figure 4**.

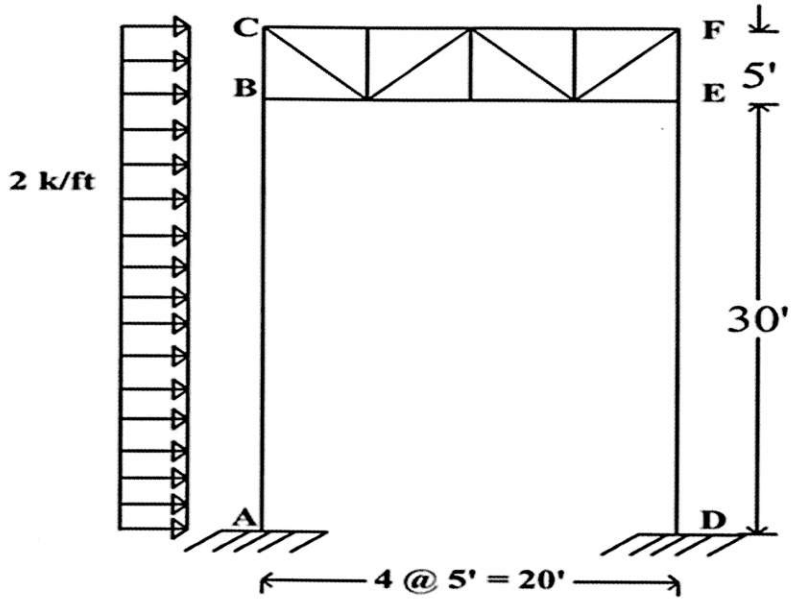


Figure 4

5. Compute vertical deflection of joint 'F' of the truss shown in **Figure 5**, E = 30000 ksi, A = 10 in^2 for all members.

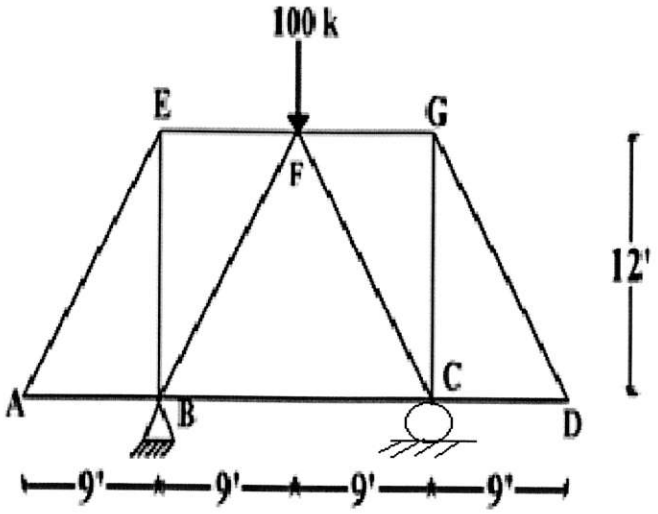


Figure 5

6. Draw bending moment diagram of the beam shown in **Figure 6**. Use **Flexibility Method**. Assume EI =Constant.

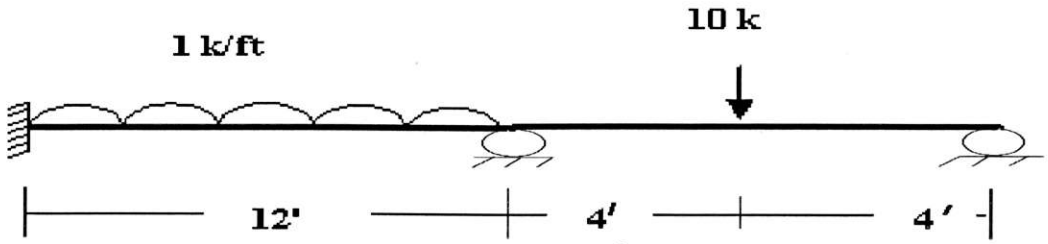


Figure 6

7. Using method of **Consistent Deformation**, compute the bar forces in the member of truss shown in **Figure 7**. Assume EA= constant for all members.

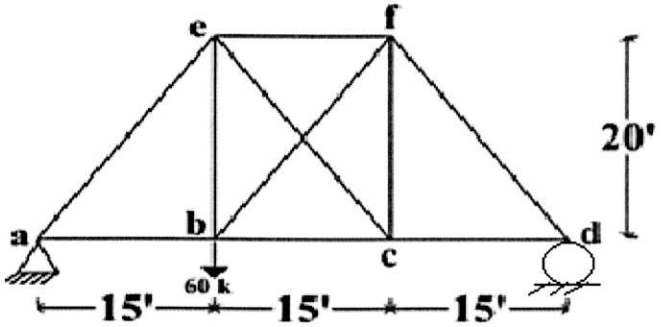


Figure 7

8. Using method of **Consistent Deformation**, analyze and draw SFD and BMD of the frame shown in **Figure 8**. E= constant.

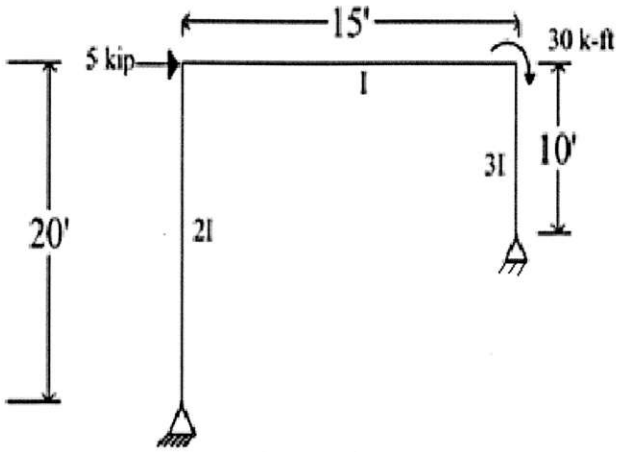


Figure8

9. Analyze the beam of **Figure 9** using **Moment Distribution Method** and draw shear force and bending moment diagram.

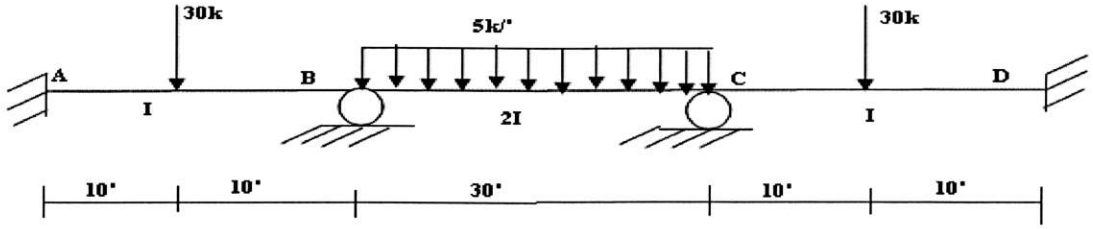


Figure 9

10. Analyze the beam of **Figure 10** using **Moment Distribution Method** and draw shear force and bending moment diagram.

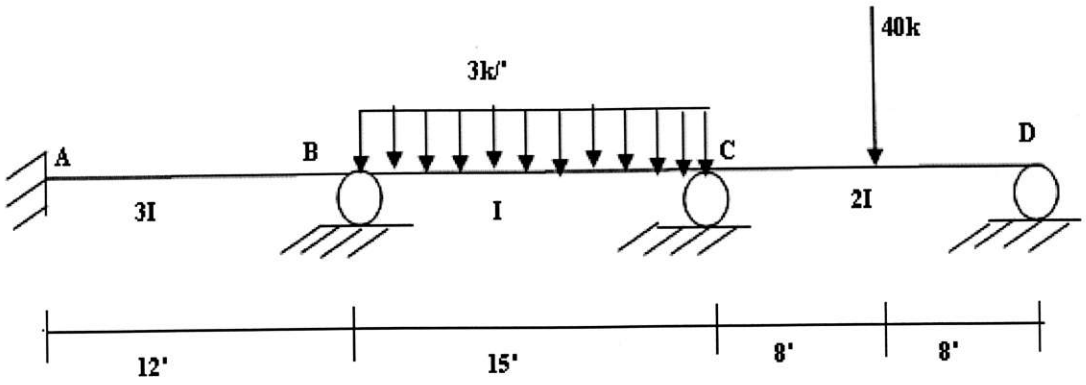


Figure 10

11. Analyze the frame of **Figure 11** using **Moment Distribution Method** and draw shear force and bending moment diagram. Support E moves 1' upward and support D roates 0.15 rad anticlockwise. EI= 8000 k-ft^2.

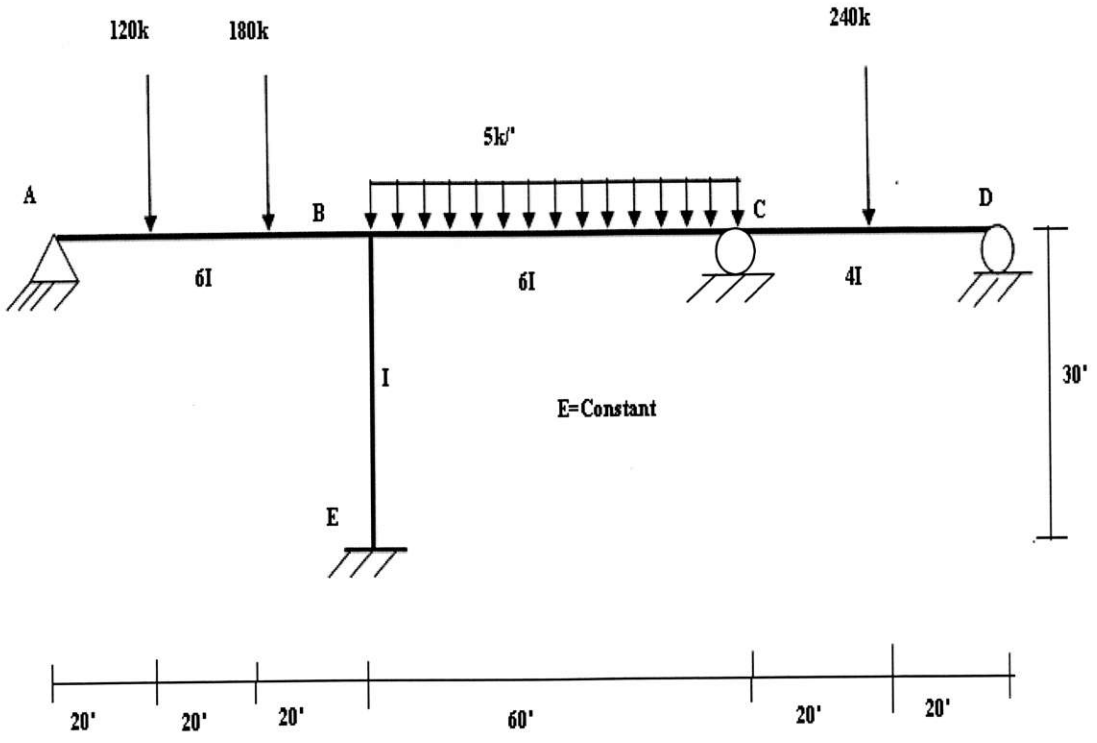


Figure 11

12. Analyze the frame of **Figure 12** using **Moment Distribution Method** and draw shear force and bending moment diagram.

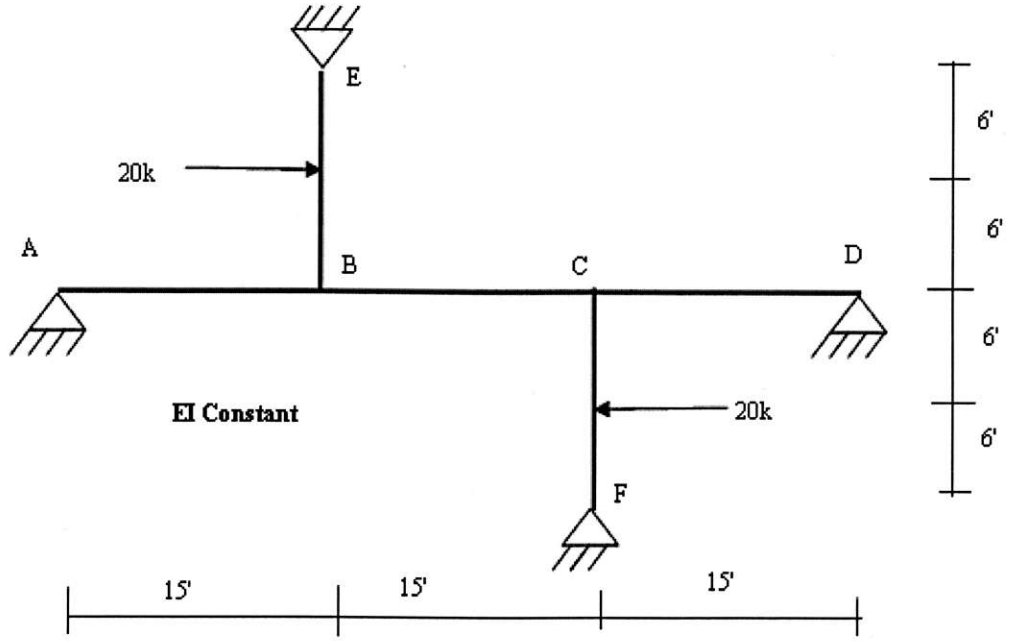


Figure 12

13. Determine the ordinate of **Influence Line** at location 1 and 2 for Moment at 'B' for the continuous beam shown in **Figure 13**.

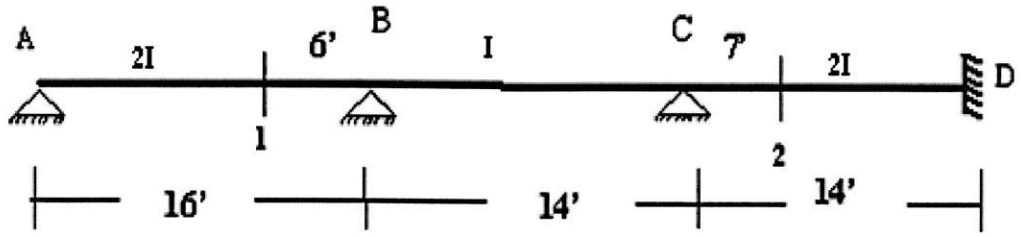


Figure 13

14. Determine the ordinate of **Influence Line** at location 1 and 2 for reaction at 'A' for the continuous beam shown in **Figure 13**.

List of Useful Formulae for CE 313

*Portal Method for multi-storied frames assumes
- The shear force in an interior column is twice the shear force in an exterior column.
- There is a point of inflection at the center of each column, and at the center of each beam.

* Cantilever Method is based on three assumptions
- The axial force in each column of a story is proportional to its horizontal distance from the gravity of all the columns of the story.
- There is a point of inflection at the center of each column, and at the center of each beam.

*Vertical Analysis based on approximate location of hinges

$M_{(+)} = 0.08\ wL^2$, $M_{(-)} = 0.045\ wL^2$,

$V_{(+)} = 0.50wL$, and $V_{(-)} = -0.50wL$

*Vertical Analysis using ACI Coefficients

$M_{(+)}$ (i) For end spans, if discontinuous end is (a) unrestrained = $wL^2/11$, (b) restrained = $wL^2/14$
(ii) For interior spans = $wL^2/16$

$M_{(-)}$ (i) At the exterior face of first interior supports for (a) Two spans = $wL^2/9$, (b) More spans =
(ii) At the other faces of interior supports = $wL^2/11$
(iii) For spans not exceeding 10′, of where columns are much stiffer than beams = $wL^2/12$
(iv) At the interior faces of exterior supports, if the support is (a) a beam = $wL^2/24$,
(b) a column = $wL^2/16$

V (i) In end members at first interior support = ± 1.15wL/2, (ii) At all other supports = ± wL/2

*Deflection of truss due to load, temperature change and misfit, $\Delta = \Sigma N_1\ dL = \Sigma N_1 (N_0L/EA + \alpha\Delta T$

*Deflection of beams/frames due to axial, shear and flexural deformation,

$\Delta = \int (x_1 x_0/EA)\ dS + \int (v_1 v_0/GA^*)\ dS + \int (m_1 m_0/EI) dS$

Integration of Product of Functions ($I = \int f_1 f_2\ dS$)

f_2 \ f_1	A, L	B, L	A, L	A, B, L	A, C, B, L
a, L	AaL	BaL/2	AaL/2	(A+B)aL/2	[A+4C+B]aL/6
b, L	AbL/2	BbL/3	AbL/6	[A+2B]bL/6	[2C+B]bL/6
a, L	AaL/2	BaL/6	AaL/3	[2A+B]aL/6	[A+2C]aL/6
a, b, L	A(a+b)L/2	B(a+2b)L/6	A(2a+b)L/6	[A(2a+b)+B(a+2b)]L/6	[Aa+Bb+ 2C(a+b)]L/6

Shape Functions

$$\Psi_1 = 1 - 3(x/L)^2 + 2(x/L)^3$$
$$\Psi_2 = x(1 - x/L)^2$$
$$\Psi_3 = 3(x/L)^2 - 2(x/L)^3$$
$$\Psi_4 = x^2/L(x/L - 1)$$

Section A

University of Asia Pacific
Department of Civil Engineering
Final Examination Spring 2015
Program: B.Sc. Engineering (Civil)

Course Title: Design of Concrete Structures II | Course Code: CE 317
Time: 3.0 hr | Full Marks: 100

Part A

[Answer any Three(03) out of following Five (05) questions]

Full Marks: 30 [=3*(10)]

1. (a) Write the ACI guideline for corner reinforcement.
   (b) What is flat slab? Mention advantages and disadvantages of flat slab
2. What is pre-stressed concrete? Discuss the stages of pre-tensioning and post tensioning with diagram
3. What is interaction diagram? Draw a typical Interaction diagram showing the effect of bending and axial load.
4. Classify pile foundations based of their construction process as well as resistance mechanism.
5. What is retaining wall? Explain why it is important to prevent the accumulation of water behind retaining wall and mention some possible measures to be taken.

Part B

[Answer any seven (07) out of following ten (10) questions]

Full Marks: 70 [=7*10]

[Given: $f_c' = 3$ ksi, $f_y = 60$ ksi, $f_{c,all} = 1.35$ ksi, $f_{s,all} = 30$ ksi

Use DL factor = 1.4 and LL factor =1.7 respectively for all questions]

[Assume reasonable values for any missing data]

[All Symbols have their usual meaning]

6. A 30″ × 30″ column carrying working loads DL = 350 k, and LL = 250 k is underlain by soil with allowable bearing capacity = 3 ksf. The column also carries biaxial moments (due to LL) of M_x = 150 k-ft and M_y = 170 k-ft. Use Ultimate Strength Design (USD) method to determine all pile forces and design the piles showing detailed diagrams (Figure 1)

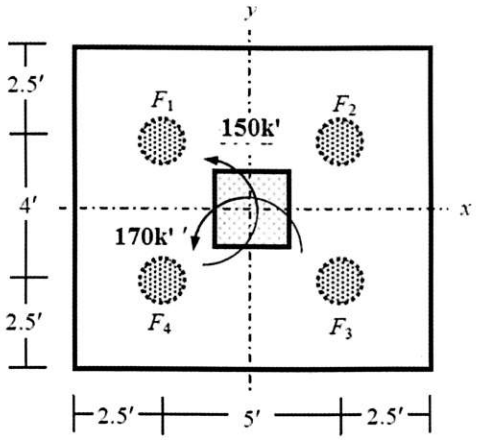


Figure: 1

7. Use Ultimate Strength Design (USD) method to determine required depth for moment ($d_{req,m}$) and reinforcement for the rectangular footing for the 12″x18″ RC columns supporting RC slabs (t = 8″) in a 4-storied building with 12′-high stories as shown in Figure 2, if they carry loads including FF = 40 psf, RW = 55 psf and LL = 40 psf

[Given: Depth of footing = 6 ft, Allowable soil bearing pressure = 4 ksf, soil unit weight =110 pcf]

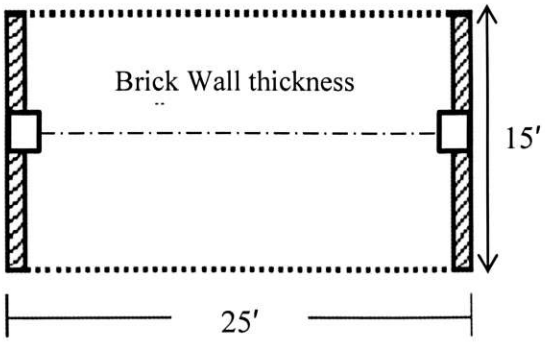


Figure: 2

8. A gravity wall is to retain a bank 11.5ft high whose horizontal surface is subject to a live load surcharge of 650psf. The soil is a mixture of soft clay with silt and the allowable bearing capacity is 7500psf. Determine whether the retaining wall designed below is safe against overturning and sliding. (Figure 3)

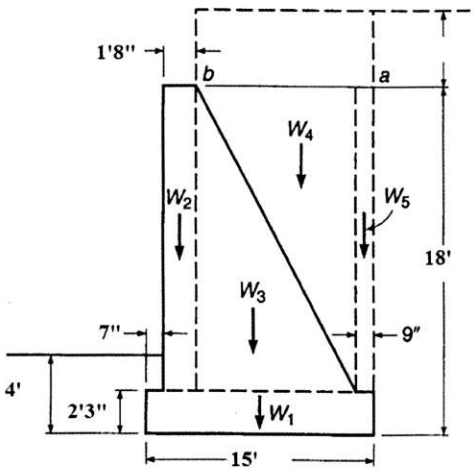


Figure: 3

9. A pre-stressed concrete beam of 650 mm by 850 mm has a simple span of 9.50 m and loaded by a uniform load of 65kN/m including its own weight. The pre-stressing tendon produces an effective pre-stress of 2350kN. Compute fiber stresses in the concrete at the mid span section using 2nd concept. (Figure 4)

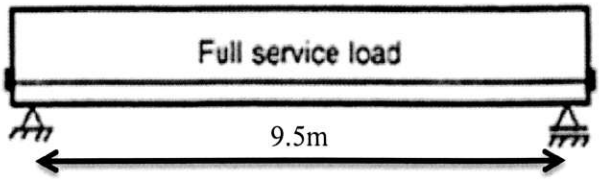
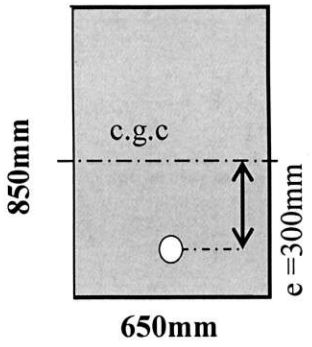


Figure: 4

Resulting stress distribution, $f = -\frac{F}{A} \pm \frac{Fey}{I} \mp \frac{My}{I}$



10. Figure 5 shows the working load arrangement of 15″×15″ columns C_1, C_2, C_3 and boundaries of other footings (firm lines for property lines and dotted lines for adjacent footing boundaries). Check which footing would be suitable for this site condition. Using USD method, determine d_{reqm} and d_{reqt} for the footing , also show detailed reinforcement diagram in a neat sketch [Given: Allowable soil bearing pressure = 3.5 ksf]

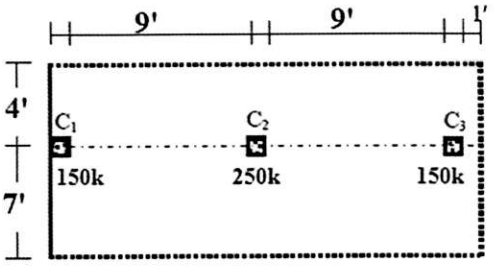
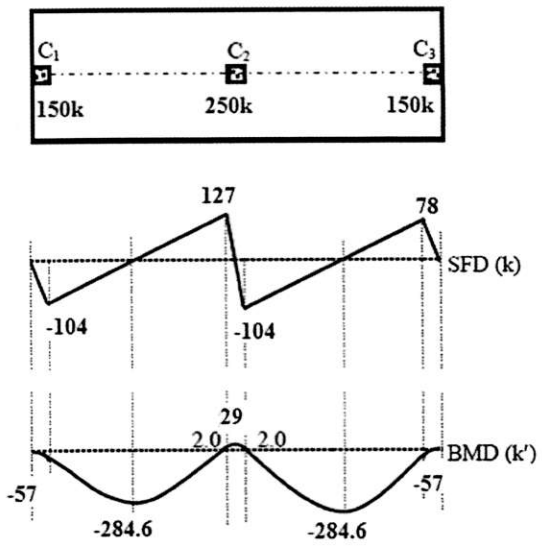


Figure: 5



11. For the column section shown in Figure 6, select reinforcing bars using Ultimate Strength Design (USD) method. Take P_D =250k, P_L=120k, M_D= 90k-ft, M_L=90 k-ft. Assume section is compression controlled. (Use f'_c=4 ksi, f_y=60ksi and take ϕ=0.7 for tied column)

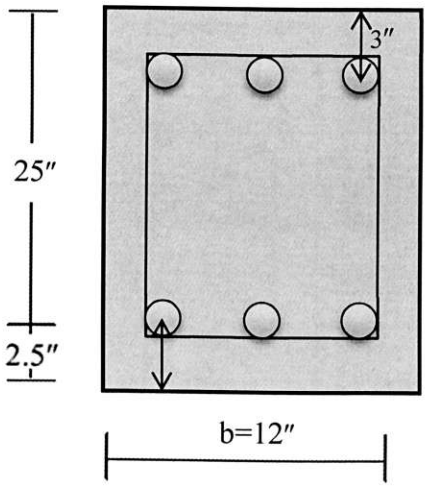


Figure: 6

12. For the tied column section shown in Figure 9, use the Working Stress Design method (WSD) method to
(i) Draw the interaction diagram about y-axis.
(ii) Verify if the section is allowed to take P = 650 k, at an eccentricity e = 8″ about y-axis.

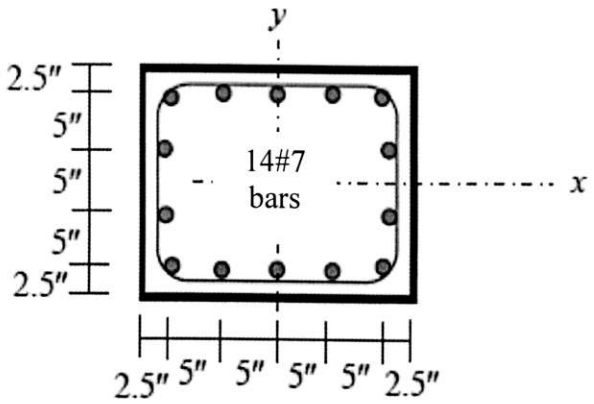


Figure: 9

13. Refer to the following slab system of a two-storied building (**Figure: 10**). For the slab consider LL = 60 psf, Partition Wall = 30 psf, Floor Finish = 20 psf, f'_c = 3000 psi, f_y = 40,000 psi.

$+C_{A(DL)}$= 0.027, $+C_{A(LL)}$= 0.032, $-C_A$= 0.050

$+C_{B(DL)}$= 0.027, $+C_{B(LL)}$= 0.032, $-C_B$= 0.050

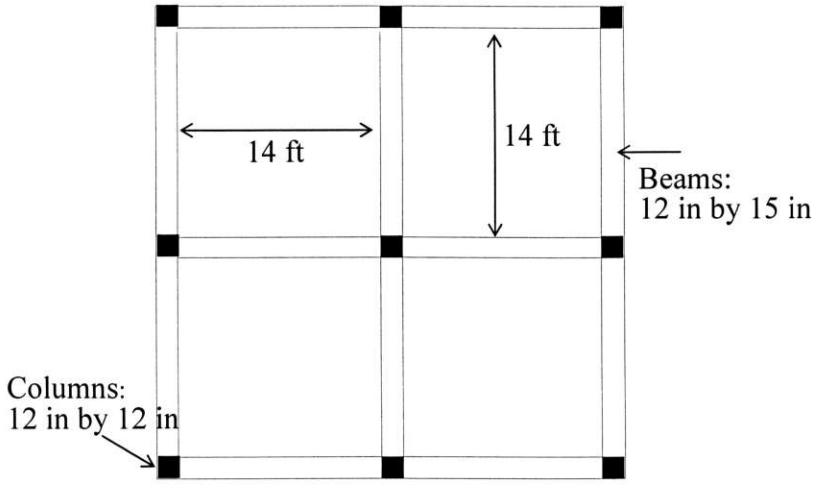


Figure: 10

Show the detailed calculations of the following steps using WSD method:

(i) Minimum slab thickness
(ii) Calculation for design moments
(iii) Calculation for reinforcements for moments
(iv) Calculation for temperature and shrinkage reinforcements and comparison with the reinforcements required for moments (step iii).

14 Calculate the axial load carrying capacity of the following section (**Figure: 11**) of a circular column by WSD and USD methods. Make comments on the results. Given: f'_c = 3,000 psi, and f_y = 60,000 psi.

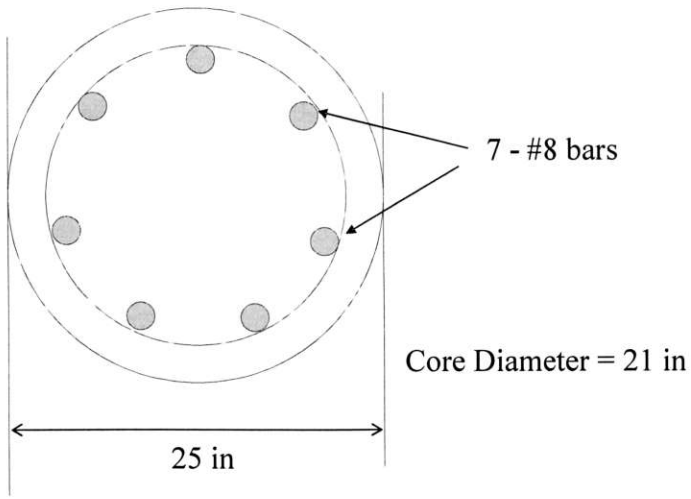


Figure: 11

15. A building is to be designed as a flat plate structure. A plan of the building is shown in **(Figure:12)** and dimension of all columns is12"X12" .Using WSD, check column $\mathbf{C_1}$ of the slab shown in **Figure: 12** for punching shear and calculate shear reinforcements [Given, slab thickness = 6 inch, FF = 25 psf, RW = 20 psf, LL = 40 psf, $f_c' = 3$ ksi and $f_y = 40$ ksi, $f_{c,all} = 1.35$ ksi and $f_{s,all} = 18$ ksi]

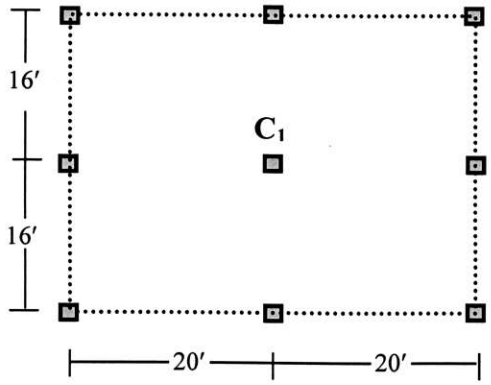


Figure:12

List of Useful Formulae for CE 317

Two way Slab

*$-M_A = C_{A-} \times W_T \times A^2$, *$-M_B = C_{B-} \times W_T \times B^2$

*$+M_A = C_{A(dl)} \times W_{DL} \times A^2 + C_{A(LL)} \times W_{LL} \times A^2$, *$+M_B = C_{B(dl)} \times W_{DL} \times B^2 + C_{B(LL)} \times W_{LL} \times B^2$ *$A_s = M/f_s jd$

* $f_c = 0.85 f_c'$, $A_s = (f_c/f_y)\,[1 - \sqrt{\{1 - 2M_u/(\phi f_c\, bd^2)\}}]\, bd$

Column-Supported Slabs

*$A_v = (V_n - V_c)/(f_y \sin\alpha)$ *$S = A_v f_v\, d/(V - V_c)$ * β_c (= Long/Short side of column)

* α_s = 40, 30, 20 for interior, edge and corner columns respectively

*$V_c = 4\sqrt{f'_c}\, b_o d$ * $V_c = (2 + 4/\beta_c)\sqrt{f'_c}\, b_o d$ * $V_c = (2 + \alpha_s d/b_o)\sqrt{f'_c}\, b_o d$ [Use half of the values for WSD]

Short Column

*$P_n = 0.85 f_c' A_c + f_y A_s = A_g [0.85 f_c' + \rho_s (f_y - 0.85 f_c')]$ *$P_u = \alpha \phi A_g [0.85 f_c' + \rho_s (f_y - 0.85 f_c')]$

*$P_{all} = \phi'(0.25 f_c' A_g + f_{sall} A_s) = \phi' A_g (0.25 f_c' + \rho_s f_{sall})$ *$\rho_s = 0.45(A_g/A_{core} - 1)\,(f_c'/f_y)$ *$S = 4A_{sp}/(\rho_s d_{core})$

Short column Interaction Diagram

*$P/(P_a) + M/(M_f) = 1$ *$P_a = 0.34 f'_c(1 + \rho_g m)A_g$ *$M_f = 0.45 f'_c S_{ut}$

$I_{utx} = bh^3/12 + (2n - 1)\,\Sigma A_s(y - y)^2$

$S_{utx} = I_{utx}/c$, $m = f_y/0.85 f_c'$

*For symmetrical tied columns, $M_o = 0.40 A_s f_y (d - d')$ and $e_b = (0.17 + 0.67\rho_g m)d$

* For spiral columns, $M_o = 0.12 A_{sTotal} f_y (D_s)$ and $e_b = (0.14 + 0.43\rho_g m)d$

* $P/(P_a) + M_x/(M_{fx}) + M_y/(M_{fy}) \le 1$ *$1/P_{xy} = 1/P_x + 1/P_y - 1/P_0$

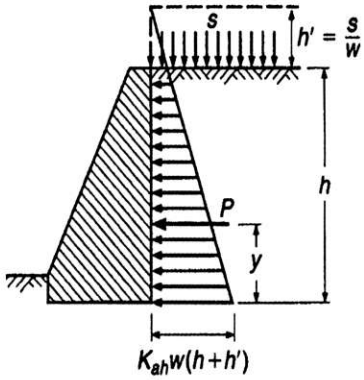
Retaining Wall:

TABLE 17.1

Unit weights w, effective angles of internal friction ϕ, and coefficients of friction with concrete f

Soil	Unit Weight w, pcf	ϕ, deg	f
1. Sand or gravel without fine particles, highly permeable	110–120	33–40	0.5–0.6
2. Sand or gravel with silt mixture, low permeability	120–130	25–35	0.4–0.5
3. Silty sand, sand and gravel with high clay content	110–120	23–30	0.3–0.4
4. Medium or stiff clay	100–120	25–35[a]	0.2–0.4
5. Soft clay, silt	90–110	20–25[a]	0.2–0.3

[a] For saturated conditions, ϕ for clays and silts may be close to zero.



Co-efficient of active earth pressure = $K_{ah} = \dfrac{1 - \sin\phi}{1 + \sin\phi}$

$K_{ph} = \dfrac{1 + \sin\phi}{1 - \sin\phi}$

$y = \dfrac{h^2 + 3hh'}{3(h + 2h')}$

$P = \dfrac{1}{2} K_{ah} wh(h + 2h')$

Design Table for Pile

Parameter	Equation
d_p (")	$F = \phi(a_p f_{call} + a_s f_{sall})$
a_s (in^2)	$a_s = (P/\phi - a_p f_{call})/f_{sall}$
S_t (")	0.2% of Pile volume; i.e., $S_t = (100/0.2)(a_t/a_p)\pi d_c$
L_p (')	$L_p = P/\{\alpha_2 (\pi d_p)\tau_u\}$

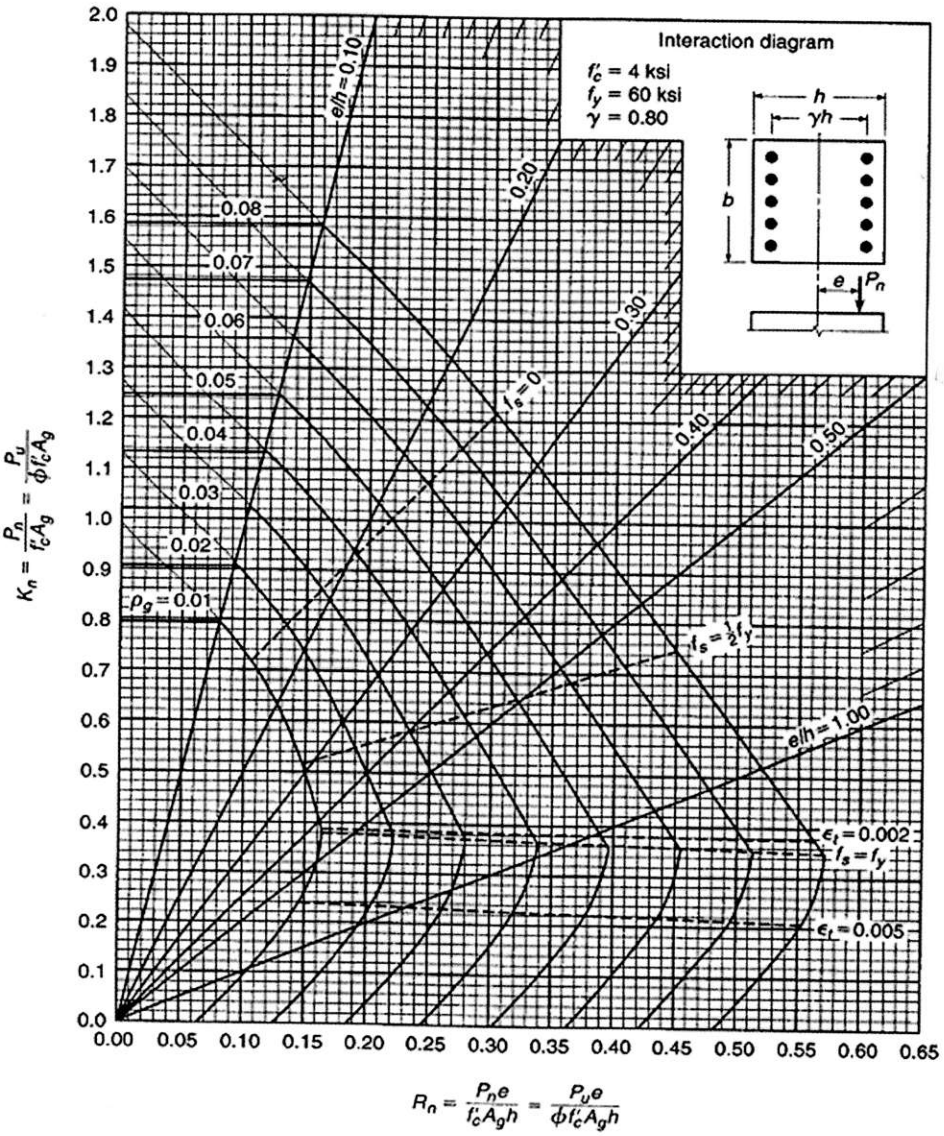
a_t= tie bar diameter
Ó=0.85
α_2= 0.8
$\tau_{u=}$ (bearing capacity)/2
d_c= pile diameter -3"

Design Table For Rectangular Footing	
Parameter	Equation
M_{max} (k'/')	$q_{net}\ \{(B-c_1)/2\}^2/2$
d_{reqm} (")	$\sqrt{(M_{max}/Rb)}$
d (")	$\geq d_{req}$
t (")	$d+3.5$
A_s (in^2/ft)	$M_{max}/(f_{sall}jd)$, OR $0.85f_c'/f_y[1-\sqrt{(1-2M_n/(0.85f_c'bd^2)}]bd$
A_{st}, A_{smin} (in^2/ft)	$0.003bt$, $(200/f_y)bd$
$A_{s(band)}$ (in^2)	$\{2/(1+\beta)\}A_{s(short)}$
L_d (")	$0.050\ f_y/\sqrt{f_c'}\ d_b$ [Un-Anchored]
$\sigma_{bearing}$ (ksi)	$P/A_c = 2\times 0.375f_c'$, OR $P_u/A_c = 2\phi 0.85f_c'$

For USD, $\rho_b = 87/(87+f_y)\ (\alpha f_c'/f_y)$:
$\Rightarrow R_u = \phi\,\rho_{max} f_y\,(1-0.59\rho_{max} f_y/f_c')$
Also $v_{cu} = 2\phi\sqrt{f_c'}$: $\rho_{max} = 0.75\rho_b$:

Design table for Combined footing

Parameter	Equation
M_{max} (k')	*From BMD*
d_{reqm} (")	$\sqrt{(M_{max}/Rb)}$
w_{tbm} (k/')	P_{c2}/B, P_{c1}/B
M_{tbm} (k')	$w_{tbm}L^2/2$
d_{reqt} (")	$\sqrt{(M_{tbm}/Rb)}$
d (")	$\geq d_{req}$
t (")	$d+4.5$, OR $d+3.5$
A_s (in^2/ft)	$M_{max}/(f_{sall}jd)$, OR $0.85f_c'/f_y[1-\sqrt{(1-2M_n/(0.85f_c'bd^2)}]bd$
A_{st}, A_{smin} (in^2/ft)	$0.003bt$, $(200/f_y)bd$
$A_{s(tbm)}$ (in^2)	$M_{max}/(f_{sall}jd)$, OR $0.85f_c'/f_y[1-\sqrt{(1-2M_n/(0.85f_c'bd^2)}]bd$
$\sigma_{bearing}$ (ksi)	$P/A_c = 2\times 0.375f_c'$, OR $P_u/A_c = 2\phi 0.85f_c'$



University of Asia Pacific
Department of Civil Engineering
Final Examination Spring 2015
Program: B.Sc. Engineering (Civil)
Final Quiz, CE 333

Course Title Environmental Engineering II **Course Code CE-333.**
Time-3 hours **Full marks: 120**

(ANSWER ALL PARTS (i.e.a,b,c) OF EACH QUESTION TOGETHER)

(Assume reasonable value for any missing data)

Section-A

[Answer any 3(three) from the following 4 (four) questions]

1. (a) What are the different methods of sludge treatment, dewatering and disposal system? (8)
   (b) What are the advantages of aerobic digestion over anaerobic digestion? (3)
   (c) Show the different phases during digestion process through flow diagram. (6)
   (d) Write down the negative effects of effluent disposal by irrigation. (3)

2. (a) Describe the growth process of microorganisms in the biological treatment. (6)
   (b) Write down the significance of Food/microorganism ratio in activated sludge process. (8)
   (c) Describe various steps in the activated sludge process with schematic diagram. (6)

3. (a) What are sewage collection systems? Describe the methods along with the advantages and disadvantages of each system. (10)
   (b) Classify different types of sewer. (5)
   (c) Define (i) ADWF, (ii) PDWF, (iii) PWWF. (5)

4. (a) List the different phases of a treatment process. Draw the schematic diagram of cutting screen . (5)
   (b) What are the chemical unit operations? Which processes are used in chemical operation? (5)
   (c) Write down the sources of the following waste and classify them.
   Carbohydrates, Pesticides, Heavy metals, Phosphorous, H2S, Methane, Protista, Chlorides, Phenols, Animals. (10)

Section-B

[Answer any 3 (three) from the following 4 (four) questions]

(NB: Question Number 8 is mandatory)

5. (a) Which phase of bacterial growth is important for sewage treatment and why? (6)
   (b) What is waste stabilization pond? What are the processes involved in this natural process. (6)
   (c) What are the purposes of Treatment? (3)

6. (a) Define (i) Sullage ,(ii)Storm water, (iii)Inflitration (3)
   (b) Estimate the maximum hourly, average daily and minimum hourly residential sewage flows from an area occupied by 950 people having average per capita sewage flow of 72 gpcd. Consider the length of the sewer and house connections to be 1.4 miles and infiltration to be 35,000 gpd per miles. (7)
   (d) Write down the factors influencing sedimentation. (5)

7. A 7 unit apartment building houses.100 residents generating an average wastewater flow rate of 280 lt. per capita per day. Design a ***double chamber septic tank*** for the building that will be desludged every 2 yrs. For ensuring better effluent quality, it is recommended that the minimum hydraulic retention time for the tank be 1.0 (one) day. Due to space constraints, specific tank area has to be restricted within 12 m^2. Assume wastewater temperature within the tank to be 45°C. Check clear space depth. Draw a net sketch showing details of septic tank dimensions and depth of different zones. (15)

8. Calculate sewer diameter/dimensions for the given area detailed in Figure 1. (Table 1& Table 2 for further information) (30)

Table: 1. Information Regarding Area and Water Demand

Sub Area	Zone Type	Area (ha)	Demand (m3/d)	Peak factor	Cumulative Infiltration Allowance (m3/d)
1	Residential	200	2000	1.5	1200
2	Commercial	400	2500	4	1000
3	Residential	250	3500	1.5	1300
4	Industrial	450	1500	2	1000
5	Commercial	500	4500	4	800
6	Residential	300	1500	1.5	1100
7	Industrial	350	3800	2	700

Table: 2.Sewer Load calculation and diameter identification.

Line	From	To	Sub Area	Demand	Peak Demand	Cumulative Peak Demand	Cumulative Infiltration Allowance	Total design Cumulative flow	Sewer Diameter	Slope

Table: 3. Description of flow

Description of flow	Ratio to average
Maximum daily	2.5 to 1
Maximum hourly	3 to 1
Minimum daily	0.67 to 1
Minimum hourly	0.33 to 1

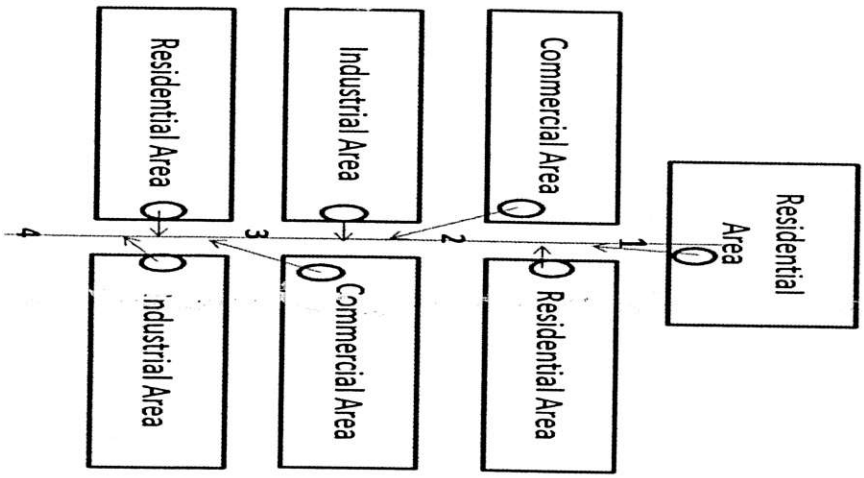


Figure 1: For Problem 8

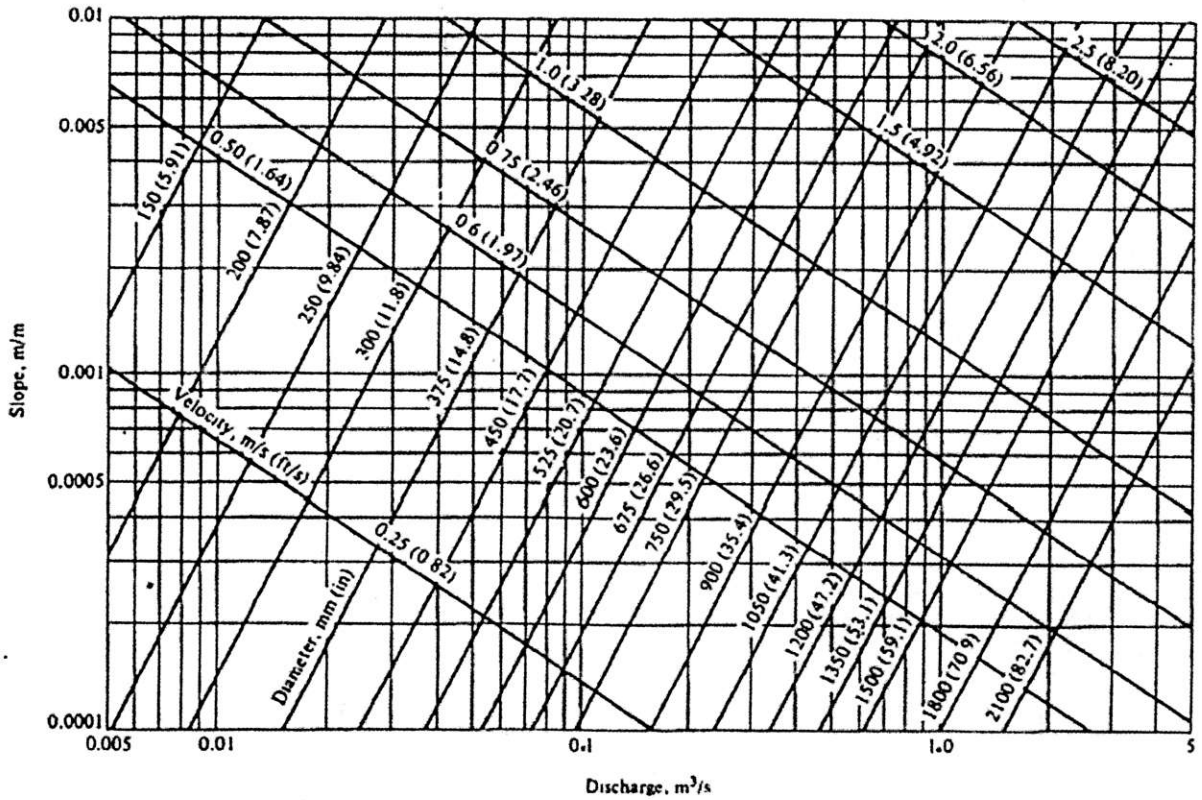


Figure 2: Nomo-Graph for solution of Mannings Equation for n=0.013

University of Asia pacific
Department of Civil Engineering
Final Examination Spring 2015
Program: B.Sc. Engineering (Civil)

Course Title: Transportation Engineering I (Transport and Traffic Design) Course Code: CE 351
Time: 3 Hours Full Marks: 100

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

1. a) What does the parking studies include? Differentiate between on-street and off-street parking. 6
   b) Discuss some measures to reduce the traffic congestion in Dhaka city. 7
   c) Calculate the AADT for the following data. Data was collected on Wednesday in September. MEF for September is 0.632. Necessary Table is provided herewith. 7

Hour	Volume
6:00-7:00 a.m.	900
7:0000 -8:00 a.m.	855
8:00-9:00 a.m.	620
9:00-10:00 a.m.	780
10:00-11:00 a.m.	690

2. a) Write short note on any **four**: 10
   (i) Origin-destination (O-D) survey
   (ii) Non-recurrent delay
   (iii) Warning Sign
   (iv) Variable Message Sign (VMS)
   (v) Time-mean and space-mean speeds
   b) Design a two-phase signal at an isolated cross-junction for the following data: 10
   Intergreen for N-S: 7 sec and E-W: 8 sec.
   Lost time due to starting and end delays : 3 sec (N-S) and 2 sec (E-W)

	N	S	E	W
Flow(q), veh/hr	850	720	670	770
Saturation flow(s) veh/hr	2450	2550	2390	2750

Assume amber period to be 3 sec. Draw bar diagram.

3. a) What are the objectives of using traffic calming devices? 4
   b) Briefly describe the vertical deflection techniques for traffic calming. 8
   c) Two straight sections of a highway meet at an angle of 160^0. If the radius of simple circular curve is 700m, find 8
   i) Mid-ordinate
   ii) Apex distance
   iii) Tangent distance and
   iv) Length of long chord

4. a) While descending a -7% grade at a speed of 90 km/h, a driver notices a large object in the roadway ahead of him. Without thinking about any alternatives, he stabs his brakes 10

and begins to slow down. Assuming that he is so paralyzed with fear that he won't engage in an avoidance maneuver, calculate the minimum distance at which he must have seen the object in order to avoid colliding with it.

b) Write short notes on any **four**: 10

i)	Cone of vision	ii)	Depth perception
iii)	Braking distance	v)	Glare recovery
iv)	Skid resistance		

5. a) Briefly explain different types of transportation related problems in Bangladesh. 10
   b) Explain the function of transportation in economic and social development of Bangladesh. 10

6. a) A freeway has a 70mph design speed. There is a 2% grade followed by a negative 3% grade. Assume height of driver's eye to be 3.5ft and object height to be 0.5 ft. What is the required length of vertical curve needed to satisfy design stopping sight distance? Assume the stopping sight distance to be 850ft. 10
   b) A large grain elevator is located 50 feet from the centerline of a two-lane highway, which has 12-feet wide lanes. The elevator is situated on the inside of a horizontal curve with a radius of 600 feet. Assuming that the elevator is the only sight restriction on the curve, what is the minimum sight distance along the curve? Assume a perception reaction time of 2.5 seconds. 10

Table for Question 1(c)

Table 1 Hourly Expansion Factors for a Rural Primary Road

Hour	Vol.	HEF	Hour	Vol.	HEF
6:00-7:00 a.m.	294	42.01	6:00-7:00 p.m.	743	16.6
7:00-8:00 a.m.	426	28.99	7:00-8:00 p.m.	706	17.5
8:00-9:00 a.m.	560	22.05	8:00-9:00 p.m.	606	20.4
9:00-10:00 a.m.	657	18.8	9:00-10:00 p.m.	489	25.3
10:00-11:00 a.m.	722	17.11	10:00-11:00 p.m.	396	31.2
11:00-12:00 p.m.	667	18.52	11:00-12:00 a.m.	360	34.3
12:00-1:00 p.m.	660	18.71	12:00-1:00 a.m.	241	51.2
1:00-2:00 p.m.	739	16.71	1:00-2:00 a.m.	150	82.3
2:00-3:00 p.m.	832	14.84	2:00-3:00 a.m.	100	124
3:00-4:00 p.m.	836	14.77	3:00-4:00 a.m.	90	137
4:00-5:00 p.m.	961	12.85	4:00-5:00 a.m.	86	144
5:00-6:00 p.m.	892	13.85	5:00-6:00 a.m.	137	90.2
Total daily volume =		12350			

Table 2 Daily Expansion Factors for a Rural Primary Road

Day of Week	Volume	DEF
Sunday	7,895	9.515
Monday	10,714	7.012
Tuesday	9,722	7.727
Wednesday	11,413	6.582
Thusrday	10,714	7.012
Friday	13,125	5.724
Saturday	11,539	6.51
Total weekly volume =		75,122

Necessary equations:

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

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

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

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

University of Asia Pacific
Department of Civil Engineering
Semester Final Examination Spring 2015

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: (2.5x4=10)

i) Φ-Index
ii) Infiltration capacity
iii) Permanent wilting point
iv) Pan coefficient

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

Volume of ocean water = 1,401,000,000 km^3
Precipitation rate on ocean = 440,000 km^3 / yr
Precipitation rate on land = 121,000 km^3 / yr
Evaporation from ocean = 505,000 km^3 / yr
Evaporation from land = 72,000 km^3 / yr

1(c). Calculate in one step the precipitable water in a saturated air column of 1000 m high above 1 m^2 of ground surface. The surface pressure is 101.3 kPa, the surface air temperature is 30°C and the lapse rate is 6.5°C/km. (10)

2(a). Describe the recommendations for rain gauge networking. (5)

2(b). There are 5 rain gauges in an area as shown in the Figure 1. Annual rainfall recorded in A, B, C, D and E are 132, 136, 93, 81 and 124 cm respectively. Find average annual rainfall in the catchment area using Thiessen Polygon method where 1 small square = 10 km^2 in Figure. (15)

2(c). There were 7 rain gauge stations namely M, N, O, P, Q, R, and S where station P was inoperative for the month. At that month rainfall recorded in the other six stations were 6.2, 7.5, 9.1, 5.9, 8.3, 5.7 cm respectively. If the average annual rainfall for the stations are 91, 67, 75, 86, 77, 69, 72 cm. Estimate the missing rainfall at station P. (5)

3(a). Describe Horton's equation. What are the initial losses of precipitation? (5+5=10)

3(b). Annual rainfall data are available below for four rain gauges E, F, G and H. Gauge H was relocated permanently at the end of 1981. Therefore rainfall data for gauge H for the period 1979-1981 must be adjusted to the rainfall characteristics at the new location. Find adjusted rainfall data at H. (15)

Year	Annual Rainfall (in)			
	E	F	G	H
1979	22	26	23	28
1980	21	26	25	33
1981	27	31	28	38
1982	25	29	29	31
1983	19	22	23	24
1984	24	25	26	28
1985	17	19	20	22
1986	21	22	23	26

4(a). Discuss the factors affecting Evapotranspiration? (5)

4(b). Estimate the daily potential Evapotranspiration from the following data, using Penman's formulae. (10)

slope of the saturation vs temperature at the mean air temperature =	1.4	mm/°C
net radiation =	5	mm of water per day
relative humidity =	80	%
saturated vapor pressure, e_w=	5.34	mm of Hg
wind velocity at 4 m height =	90	km/day
psychometric constant =	0.49	mm of Hg

4(c). A storm with 10 cm precipitation produced a direct runoff of 8.7 cm. The time distribution of the storm is as follows. Estimate Φ index of the storm. (10)

Time from start (hr)	1	2	3	4	5	6	7	8
Incremental rainfall (cm)	0.6	1.35	2.25	3.45	2.7	2.4	1.5	0.75

Part B

There are FOUR questions answer any THREE

5(a). Show different components of hydrograph in a neat sketch. Describe different methods of base flow separation. (5+5=10)

5(b). The following are the ordinates of the hydrograph of flow from a catchment of 780 km^2 due to a 6-hr rainfall. Derive the ordinates of 6-hr unit hydrograph for the basin. Make suitable assumptions regarding base flow: (15)

Time	6	12	18	24	30	36	42	48	54	60	66	72	78
Discharge (cumec)	40	64	215	360	405	350	270	205	145	100	70	50	42

6(a). Describe the procedure of Snyder's method to develop synthetic unit hydrograph. (5)

6(b). The ordinates of a 4-h unit hydrograph are as given below: (10)

Time	0	2	4	6	8	10	12	14	16	18
ordinates of 4-hr UH (cumec)	0	25	50	85	125	160	185	172.5	160	110

If two storms, each of 4-hr duration and having rainfall excess values of 3-cm and 4-cm respectively, then calculate Direct Runoff Hydrograph. The 4 cm ER rain follows the 3 cm ER rain.

6(c). Using the 12-hr unit hydrograph given below, compute the ordinates of a 6-hr unit hydrograph. (10)

Time	0	6	12	18	24	30	36	42	48	54	60	66	72
Discharge (cumec)	0	10	37	76	111	136	150	153	146	130	114	70	30

7(a). Derive the required expression and different steps for reservoir routing. What data are required for reservoir routing? (10)

7(b). The inflow and outflow hydrographs for a reach of a river are given below:

Time (hrs)	Inflow (cumec)	Outflow (cumec)
0	20	20
12	191	30
24	249	120
36	164	176
48	110	164
60	82	135
72	62	116
84	48	90
96	32	68
108	28	52

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

8(a). Describe the procedure of flow measurement using current meter. (5)

8(b). Annual maximum recorded floods in a river for the period 1978 to 2004 is given below. Estimate flood discharge with recurrence interval of 100 years using Gumble extreme value distribution with 90% confidence limit. (20)

Year	1978	1979	1980	1981	1982	1983	1984	1985	1986
Max. Flood (m3/s)	2947	3521	2399	4124	3496	2947	5060	4903	3757

Year	1987	1988	1989	1990	1991	1992	1993	1994	1995
Max. Flood (m3/s)	4798	4290	4652	5050	6900	4366	3380	7826	3320

Year	1996	1997	1998	1999	2000	2001	2002	2003	2004
Max. Flood (m3/s)	6599	3700	4175	2988	2709	3873	4593	6761	1971

Question: 2(b).

Figure 1: