3-1

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

Course Title: Principles of Accounting | Course Code: ACN 301 | Credit: 02
Time: 2 Hours | Full Marks: 50

(Answer ALL the Questions.)

1. **(7+4+3 = 14)**

On December 31, 2017, the trial balance of Bangladesh Lamps Limited showed the following.

Account Name	Amount (Tk.)	Account Name	Amount (Tk.)
Purchase	20,000	Purchase returns	1,000
Sales	55,000	Sales returns	500
Transportation in	6,000	Direct labor	1,500
Factory insurance	1,800	Maintenance, factory machinery	3,400
Administrative expense	700	Depreciation, office equipment	2,000
Marketing expense	1,100	Sales salaries	2,300

Inventories	January 1, 2017 (Tk.)	December 31, 2017 (Tk.)
Raw materials	4,000	6,000
Work in process	5,000	2,000
Finished goods	7,000	3,000

Requirements:

a) Prepare a schedule of cost of goods sold on December 31, 2017. **(7)**

b) Prepare an income statement for the year ended December 31, 2017. **(4)**

c) Determine total product cost, fixed cost and conversion cost. **(3)**

2. **(3+2+3+2+2 = 12)**

The sales and expenses of GPH Ispat Ltd. for last month are as follows:

	Total	Per Unit
Sales	Tk. 900,000	Tk. 30
Variable expenses	360,000	12
Contribution margin	540,000	Tk. 18
Fixed expenses	432,000	
Net operating income	Tk. 108,000	

Requirements:

a) What is the monthly break-even point in units sold and in sales taka? **(1.5+1.5 = 3)**

b) Without resorting to computations, what is the total contribution margin at the break-even point? **(2)**

c) How many units would have to be sold each month to earn a target profit of Tk. 1,80,000? Use the formula method. Verify your answer by preparing a contribution format income statement at the target sales level. **(1+2 = 3)**

d) Refer to the original data. Compute the company's margin of safety in both taka and percentage terms. **(2)**

e) What is the company's CM ratio? If sales increase by Tk. 1,00,000 per month and there is no change in fixed expenses, by how much would you expect monthly net operating income to increase? **(2)**

3. **(12+2 = 14)**

The comparative statements of BSRM Steels Limited are presented below.

BSRM Steels Limited

Income Statement

For the Years Ended December 31

Particulars	2017	2016
Net sales	**Tk. 2,97,500**	**Tk. 2,60,000**
Expenses		
Cost of goods sold	(2,07,500)	(1,77,000)
Selling and administrative expense	(60,400)	(57,400)
Interest expense	(3,900)	(3,000)
Income tax expense	(7,500)	(7,000)
Net income	**Tk. 18,200**	**Tk. 15,600**

BSRM Steels Limited

Balance Sheet

December 31

Particulars	2017	2016
Assets		
Cash	Tk. 19,500	Tk. 16,500
Accounts receivable (net)	45,500	37,000
Inventory	42,500	35,000
Total current assets	**1,07,500**	**88,500**
Plant assets (net)	2,11,500	1,91,500
Total assets	**Tk. 3,19,000**	**Tk. 2,80,000**

Liabilities and Shareholder's Equity		
Accounts payable	Tk. 61,000	Tk. 55,000
Income taxes payable	11,500	10,000
Total current liabilities	**72,500**	**65,000**
Bonds payable	60,000	40,000
Total liabilities	**1,32,500**	**1,05,000**
Common share (Tk. 5 par)	75,000	75,000
Retained earnings	1,11,500	1,00,000
Total shareholders' equity	**1,86,500**	**1,75,000**
Total liabilities and shareholders' equity	**Tk. 3,19,000**	**Tk. 2,80,000**

Requirements:

a) Compute the following ratios for 2017 and 2016. **(4*3 = 12)**

i) Current ratio

ii) Asset turnover (Total asset on 31/12/2015 was Tk. 2,60,000.)

iii) Earnings per share

iv) Debt to asset ratio

b) Comment on the findings from the comparison of the liquidity, profitability and solvency ratios between the years. **(2)**

4. **(3+5+2 = 10)**

Aftab Automobiles Limited has three projects under consideration. The cash flows for each project are shown in the following table. The firm has a 15% cost of capital.

	Project A	Project B	Project C
Initial Investment (CF_0)	Tk. 1,00,000	Tk. 1,00,000	Tk. 1,00,000
Year (*t*)	**Cash Inflows (CF_t)**		
1	25,000	15,000	35,000
2	25,000	20,000	30,000
3	25,000	25,000	25,000
4	25,000	30,000	20,000
5	25,000	35,000	15,000

Requirements:

a) Calculate each project's payback period. Which project is preferred based on this method? **(3)**

b) Calculate each project's net present value. Which project is preferred based on this method? **(5)**

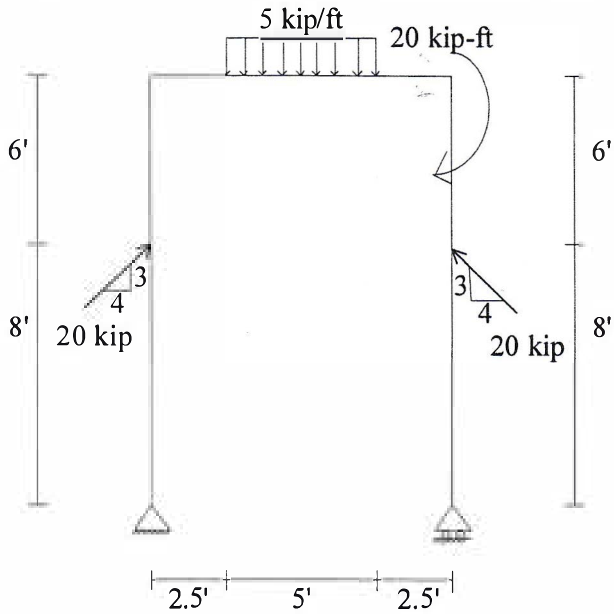
c) Comment on your findings in parts a and b, and recommend the best project with explanation. **(2)**

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

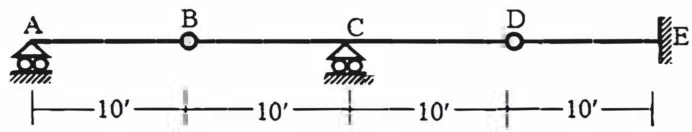
Course Title: Structural Engineering I | Course Code: CE 311
Time: 3.00 Hours | Full Marks: 100 (=10×10)

Answer any ***ten (10)***.
Assume any missing data reasonably.

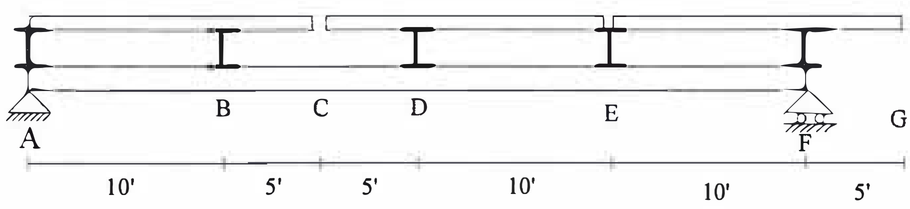
1. Draw the shear force and bending moment diagram of the structure shown in the figure below.



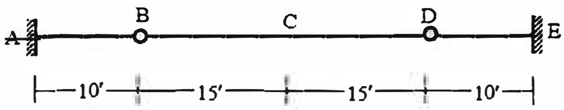
2. For the beam ABCDE carrying a dead load of 3 kip/ft and a moving live load of 1 kip/ft, calculate the following: (i) Maximum reaction at C, (ii) Maximum moment at E, (iii) Maximum shear at D, (iv) Maximum shear just left of C.

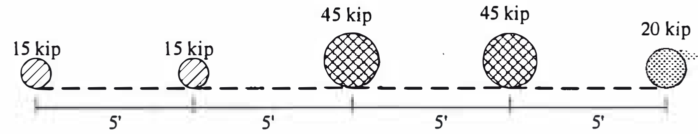


3. Girder AF supports a floor system as shown in the figure below. Draw influence line for
(i) Support reaction at A
(ii) Floor beam reaction at panel point E and F
(iii)Bending moment at point D
(iv)Shear in panel BD

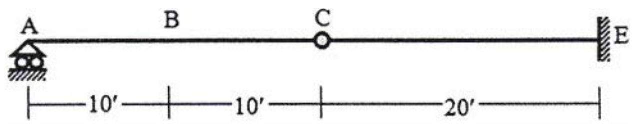


4. Calculate the maximum shear at C of the following beam for the wheel load arrangement shown below.





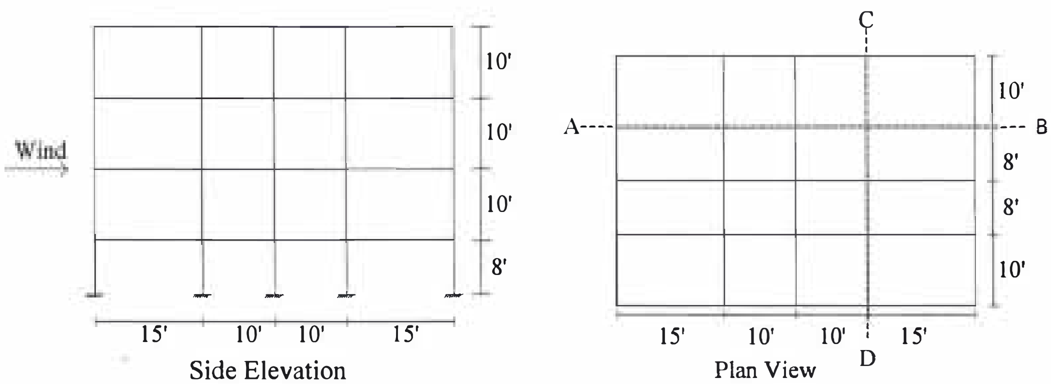
5. Calculate the maximum shear at C of the following beam for the same wheel load arrangement shown in **Question 4.**



6. Calculate the maximum moment at point at E of the beam shown in **Question 5**. Use the same wheel load arrangement as shown in **Question 4**.

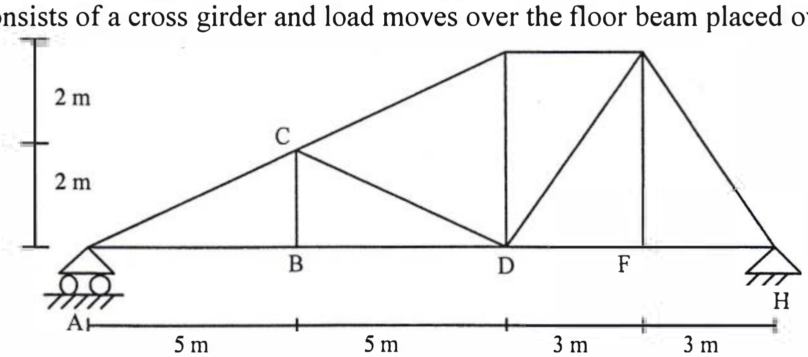
7. Compute the absolute maximum moment in a 40' simply supported beam for the same wheel load arrangement as shown in **Question 4**.

8. Calculate the wind force at **story 4** of frame AB of the concrete made detention building shown below (C_I=1 for special occupancy) located at a flat terrain in Rajshahi (Basic wind speed= 95 mph). Assume the structure to be subjected to Exposure B.

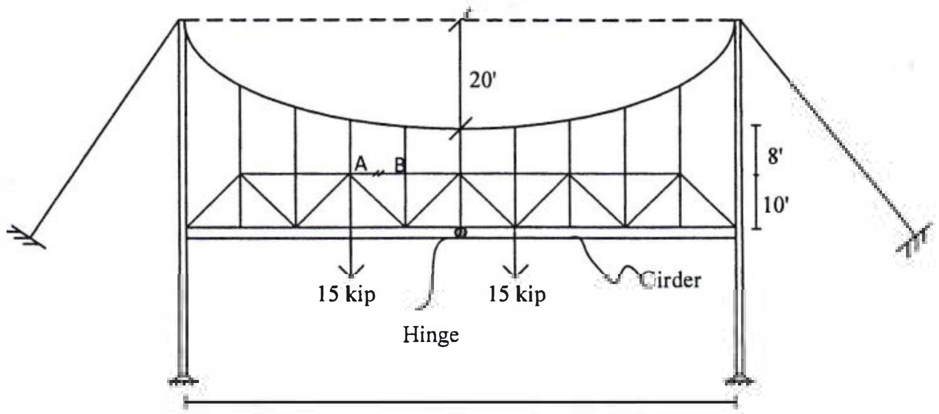


9. Calculate the seismic load at **story 3** of frame CD for the same building as shown in **Question 8,** located in Sylhet (Zone 3). Assume the structure to be Special Moment Resisting Frame (SMRF) built on soil condition S_2, carrying a dead load of 120 lb/ft^2 and live load of 40 lb/ft^2.

10. For the truss shown below, draw influence lines of bar forces CE and GD. Note, each bottom chord joint consists of a cross girder and load moves over the floor beam placed over the girders.

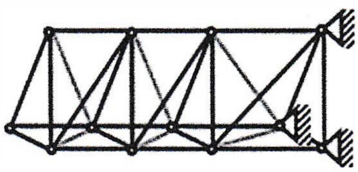


11. Draw bending moment diagram of the girder for the following figure. Also calculate axial force of bar AB.

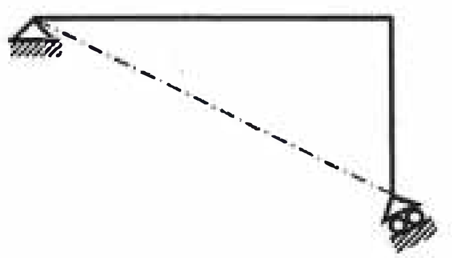


12. Determine whether the structures shown below are statically and geometrically stable or unstable. Also, calculate the degree of statical indeterminacy where applicable.

i.

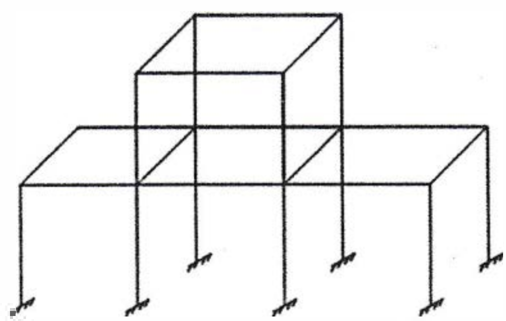


ii.



iii.

iv.



Annexure

Wind load:

$q_z = 0.00256\, C_I\, C_z\, V_b^2$

$p_z = C_G\, C_t\, C_p\, q_z$

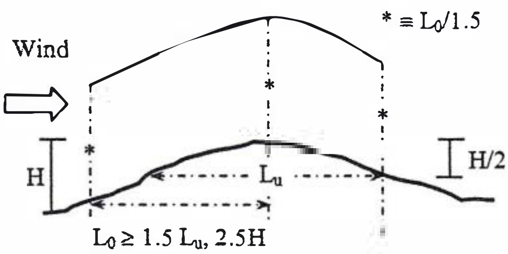
$Fz = B\ heff\ p_z$

Height z (ft)	C_z		
	Exp A	Exp B	Exp C
0~15	0.368	0.801	1.196
50	0.624	1.125	1.517
100	0.849	1.371	1.743
150	1.017	1.539	1.890
200	1.155	1.671	2.002
300	1.383	1.876	2.171
400	1.572	2.037	2.299
500	1.736	2.171	2.404
650	1.973	2.357	2.547
1000	2.362	2.595	2.724

Category	C_I
Essential facilities	1.25
Hazardous facilities	1.25
Special occupancy	1.00
Standard occupancy	1.00
Low-risk structure	0.80

The pressure coefficient C_p for rectangular buildings with flat roofs:

h/B	L/B					
	0.1	0.5	0.65	1.0	2.0	≥ 3.0
≤ 0.5	1.40	1.45	1.55	1.40	1.15	1.10
1.0	1.55	1.85	2.00	1.70	1.30	1.15
2.0	1.80	2.25	2.55	2.00	1.40	1.20
≥ 4.0	1.95	2.50	2.80	2.20	1.60	1.25



$H/2L_u$	C_t
0.05	1.19
0.10	1.39
0.20	1.85
0.30	2.37

Height z (ft)	C_G (for non-slender structures)		
	Exp A	Exp B	Exp C
0~15	1.654	1.321	1.154
50	1.418	1.215	1.097
100	1.309	1.162	1.067
150	1.252	1.133	1.051
200	1.215	1.114	1.039
300	1.166	1.087	1.024
400	1.134	1.070	1.013
500	1.111	1.057	1.005
650	1.082	1.040	1.000
1000	1.045	1.018	1.000

Earthquake Load:

$V = (ZIC/R)\ W$

$Z = 0.075$, 0.15 and 0.25 for Seismic Zones 1, 2 and 3 respectively

$C = 1.25\ S/T^{2/3}$, The value of C need not exceed 2.75, The minimum value of the ratio C/R is 0.075

$T = C_t\ (h_n)^{3/4}$

$C_t = 0.083$ for steel moment resisting frames, 0.073 for RCC moment resisting frames, and eccentric braced steel frames, 0.049 for all other structural systems

$V = F_t + \sum F_i$

$F_t = 0.07\ TV \leq 0.25V$ when $T > 0.7$ second, and = 0, when $T \leq 0.7$ second

$F_j = (V - F_t)\ [w_j h_j / \sum w_i h_i]$

Category	C_I
Essential facilities	1.25
Hazardous facilities	1.25
Special occupancy	1.00
Standard occupancy	1.00
Low-risk structure	0.80

Site Coefficient, S for Seismic Lateral Forces

Soil Type	**S**
S_1	1
S_2	1.2
S_3	1.5
S_4	2

Response Modification Coefficient, R for Structural Systems

Basic Structural System	Description Of Lateral Force Resisting System	R
Moment Resisting Frame System	Special moment resisting frames (SMRF)	
	(i) Steel	12
	(ii) Concrete	12
	Intermediate moment resisting frames (IMRF), concrete	8
	Ordinary moment resisting frames (OMRF)	
	(i) Steel	6
	(ii) Concrete	5

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

Course Code: CE 315	Time: 3 Hours
Course Title: Design of Concrete Structures-I	Full Marks: 100

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

[Use f'_c = 4000 psi, f_y = 60,000 psi , β_1 = 0.85 for all questions]

1. (a) What is transformed RC section? Explain with reference to cracked and uncracked section. (5)

   (b) Explain (with neat sketches) the behavior of reinforced concrete beam under different loading conditions. (5)

2. (a) What is Whitney's stress block? Explain briefly why it is used in design of beam. (5)

   (b) What do you understand by T-beam in RC construction? (5)
   Write down the criteria for selecting effective flange width of T-beam.

3. (a) Explain the terms web shear crack and flexure shear crack. (2.5)
   Write down the types of web reinforcement with appropriate figures. (2.5)

   (b) Sketch the design requirements for hook bars according to BNBC/ACI code for stirrups and main reinforcement. (5)

4. Cross-section of a rectangular beam is shown in **Figure: 1**. (15)
   The concrete tensile strength in bending (i.e. its modulus of rupture) is 475 psi. Consider, modular ratio n=8.

   Determine the stresses caused by a positive bending moment equal to

   (i) 45 kip-ft

   (ii) 120 kip-ft

   Compare and comment on your answer.

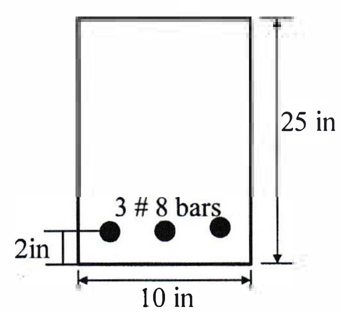


Figure: 1

5. A simply supported rectangular beam with a span of 15 ft has to carry a dead load of 1.27 kips/ft and a service live load of 2.15 kips/ft. Determine the cross section of concrete and the area of steel required for the beam using the design aids of attached Table A.4 and A.5a. (10)
   For economy, use a reinforcement ratio of $0.60\rho_{max}$.

6. Determine the design positive moment capacity of the following T-beam as shown in **Figure: 2**. (10)
(A_s of one #14 bar is 2.25in^2)

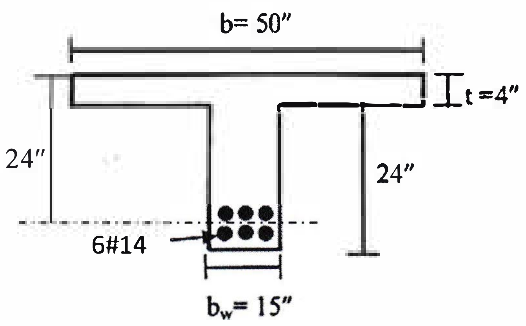


Figure: 2

7. A simply supported rectangular beam of normal weight concrete is loaded as shown in **Figure: 3**. (10)
The effective depth d = 17". It is reinforced with 3 in^{2}of tensile steel.
Using USD method determine which part the beam requires web reinforcement. Use the simplified equation for V_c provided by ACI.

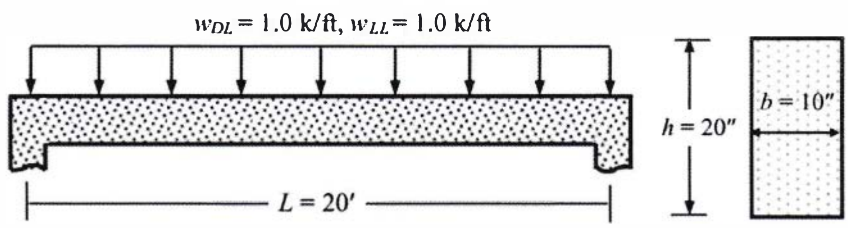


Figure: 3

8. A beam section as shown in **Figure: 4** is made of normal density concrete and reinforced with 2-#11 (10)
bars (d_b = 1.41", A_s= 3.12 in^2), whereas the reinforcement required from structural analysis is 2.90 in^2, in addition to 4-#3stirrups@3"c/c, followed by #3 stirrups @5"c/c.
Calculate the development length l_d of the bars using detailed equation provided by ACI [see **Table 1** attached].

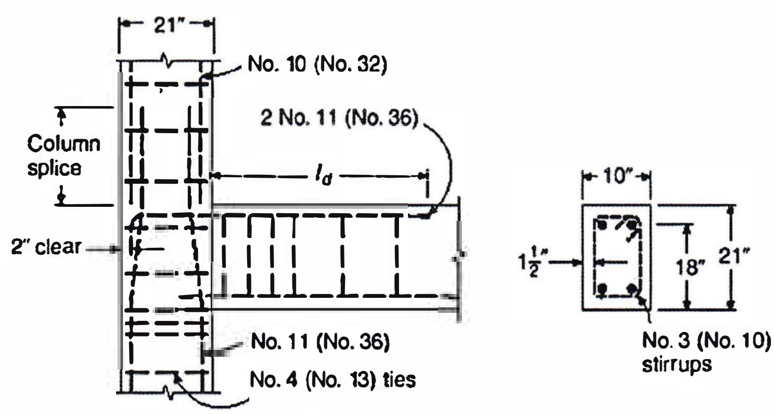


Figure: 4

9. For the uniformly distributed loaded equal spans $L_1 = L_2 = 15$ ft shown below, **Figure: 5(a)** shows the cutoff points while **Figure: 5(b)** shows the bent points of the bars. Determine the required lengths a_1~a_7 and b_1~b_7 in the spans. (5)

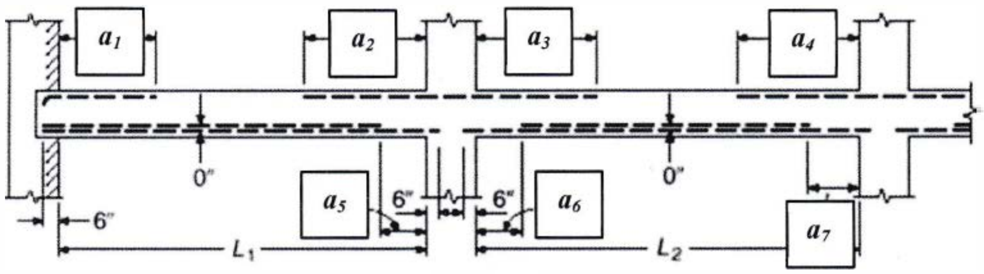


Figure: 5(a)

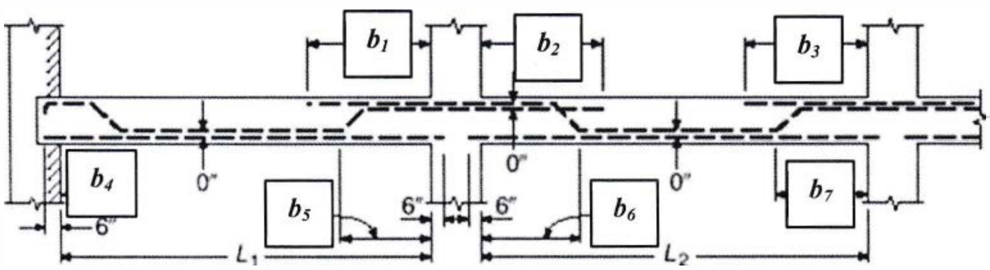


Figure: 5(b)

10. A reinforced concrete slab is built integrally with its supports and consists of two spans, each with a clear span of 20 ft. The service live load is 80 psf and floor finish load is 40 psf. Design the slab for bending only by USD method following the ACI provisions, using the moment coefficient values provided in **Table 2** [see the attachments]. (10)

TABLE A.4
Limiting steel reinforcement ratios for tension-controlled members

f_y, psi	f'_c, psi	β_1	$\rho_{0.005}$[a] $\epsilon_t = 0.005$[b]	ρ_{max}[a] $\epsilon_t = 0.004$[c]	$\rho_{min} = \frac{200}{f_y}$	$\rho_{min} = \frac{3\sqrt{f'_c}}{f_y}$
40,000	3000	0.85	0.0203	0.0232	0.0050	0.0041
	4000	0.85	0.0271	0.0310	0.0050	0.0047
	5000	0.80	0.0319	0.0364	0.0050	0.0053
	6000	0.75	0.0359	0.0410	0.0050	0.0058
	7000	0.70	0.0390	0.0446	0.0050	0.0063
	8000	0.65	0.0414	0.0474	0.0050	0.0067
	9000	0.65	0.0466	0.0533	0.0050	0.0071
50,000	3000	0.85	0.0163	0.0186	0.0040	0.0033
	4000	0.85	0.0217	0.0248	0.0040	0.0038
	5000	0.80	0.0255	0.0291	0.0040	0.0042
	6000	0.75	0.0287	0.0328	0.0040	0.0046
	7000	0.70	0.0312	0.0357	0.0040	0.0050
	8000	0.65	0.0332	0.0379	0.0040	0.0054
	9000	0.65	0.0373	0.0426	0.0040	0.0057
60,000	3000	0.85	0.0135	0.0155	0.0033	0.0027
	4000	0.85	0.0181	0.0206	0.0033	0.0032
	5000	0.80	0.0213	0.0243	0.0033	0.0035
	6000	0.75	0.0239	0.0273	0.0033	0.0039
	7000	0.70	0.0260	0.0298	0.0033	0.0042
	8000	0.65	0.0276	0.0316	0.0033	0.0045
	9000	0.65	0.0311	0.0355	0.0033	0.0047
75,000	3000	0.85	0.0108	0.0124	0.0027	0.0022
	4000	0.85	0.0145	0.0165	0.0027	0.0025
	5000	0.80	0.0170	0.0194	0.0027	0.0028
	6000	0.75	0.0191	0.0219	0.0027	0.0031
	7000	0.70	0.0208	0.0238	0.0027	0.0033
	8000	0.65	0.0221	0.0253	0.0027	0.0036
	9000	0.65	0.0249	0.0284	0.0027	0.0038

[a] $\rho = 0.85\beta_1 \frac{f'_c}{f_y} \frac{0.003}{0.003 + \epsilon_t}$

[b] $\frac{c}{d_t} = 0.375,\ \frac{a}{d_t} = 0.375\beta_1$

[c] $\frac{c}{d_t} = 0.429,\ \frac{a}{d_t} = 0.429\beta_1$

TABLE A.5a
Flexural resistance factor: $R = \rho f_y\left(1 - 0.588\frac{\rho f_y}{f'_c}\right)$ psi

	f_y = 40,000 psi				f_y = 60,000 psi			
	f'_c, psi				f'_c, psi			
ρ	3000	4000	5000	6000	3000	4000	5000	6000
0.0005	20	20	20	20	30	30	30	30
0.0010	40	40	40	40	59	59	60	60
0.0015	59	59	60	60	88	89	89	89
0.0020	79	79	79	79	117	118	118	119
0.0025	98	99	99	99	146	147	147	148
0.0030	117	118	118	119	174	175	176	177
0.0035	136	137	138	138	201	204	205	206
0.0040	155	156	157	157	229	232	233	234
0.0045	174	175	176	177	256	259	261	263
0.0050	192	194	195	196	282	287	289	291
0.0055	211	213	214	215	309	314	317	319
0.0060	229	232	233	234	335	341	345	347
0.0065	247	250	252	253	360	368	372	375
0.0070	265	268	271	272	385	394	399	403
0.0075	282	287	289	291	410	420	426	430
0.0080	300	305	308	310	435	446	453	457
0.0085	317	323	326	329	459	472	479	485
0.0090	335	341	345	347	483	497	506	511
0.0095	352	359	363	366	506	522	532	538
0.0100	369	376	381	384	529	547	558	565
0.0105	385	394	399	403	552	572	583	591
0.0110	402	412	417	421	575	596	609	617
0.0115	419	429	435	439	597	620	634	643
0.0120	435	446	453	457	618	644	659	669
0.0125	451	463	471	476	640	667	684	695
0.0130	467	480	488	494	661	691	708	720
0.0135	483	497	506	511	681	714	733	746
0.0140	499	514	523	529	702	736	757	771
0.0145	514	531	540	547	722	759	781	796
0.0150	529	547	558	565	741	781	805	821
0.0155	545	563	575	582	760	803	828	845
0.0160	560	580	592	600		825	852	870
0.0165	575	596	609	617		846	875	894
0.0170	589	612	626	635		867	898	918
0.0175	604	628	642	652		888	920	942
0.0180	618	644	659	669		909	943	966
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]

Table 1

Symbol	Parameter	Variable	Value
α	Reinforcement Location Factor	* Horizontal Reinforcement over ≥ 12" concrete * Other Reinforcement	1.3 1.0
β	Coating Factor	* Epoxy-coated bars with cover $<3d_b$ or clear spacing $<6d_b$ * All other epoxy-coated bars or wires * Uncoated bars * Maximum value of $\alpha\beta$	1.5 1.2 1.0 1.7
γ	Reinforcement Size Factor	* ≥ #7 bars * ≤ #6 bars and deformed wires	1.0 0.8 (?)
λ	Lightweight Aggregate Concrete Factor	* When lightweight aggregate concrete is used * When normal-weight concrete is used	1.3 1.0
c	Spacing or Cover Dimension (in)	* Bar center to nearest concrete cover * One-half the c/c spacing of bars	Smaller than both
K_{tr}	Transverse Reinforcement Index	S = Maximum spacing of transverse reinforcement A_{tr} = Area of all transverse reinforcement within S f_{tr} = Yield strength of transverse reinforcement, ksi n = No. of bars being developed along the plane of splitting	$A_{tr}f_{tr}/(1.5Sn)$

Table 2

Moment and shear values using ACI coefficients†

Positive moment	
End spans	
If discontinuous end is unrestrained	$\frac{1}{11} w_u l_n^2$
If discontinuous end is integral with the support	$\frac{1}{14} w_u l_n^2$
Interior spans	$\frac{1}{16} w_u l_n^2$
Negative moment at exterior face of first interior support	
Two spans	$\frac{1}{9} w_u l_n^2$
More than two spans	$\frac{1}{10} w_u l_n^2$
Negative moment at other faces of interior supports	$\frac{1}{11} w_u l_n^2$
Negative moment at face of all supports for (1) slabs with spans not exceeding 10 ft and (2) beams and girders where ratio of sum of column stiffness to beam stiffness exceeds 8 at each end of the span	$\frac{1}{12} w_u l_n^2$
Negative moment at interior faces of exterior supports for members built integrally with their supports	
Where the support is a spandrel beam or girder	$\frac{1}{24} w_u l_n^2$
Where the support is a column	$\frac{1}{16} w_u l_n^2$
Shear in end members at first interior support	$1.15 \frac{w_u l_n}{2}$
Shear at all other supports	$\frac{w_u l_n}{2}$

† w_u = total factored load per unit length of beam or per unit area of slab.
l_n = clear span for positive moment and shear and the average of the two adjacent clear spans for negative moment.

Minimum thickness h of nonprestressed one-way slabs

Simply supported	$l/20$
One end continuous	$l/24$
Both ends continuous	$l/28$
Cantilever	$l/10$

Formulae:

*$f_c = My/I$, $f_s = n(My/I)$

*$M = \left[\frac{f_c(kj)}{2}\right] bd^2$

*$M_u = ØRbd^2$

*$M = A_s f_s jd$

* $b\left[\frac{(kd)^2}{2}\right] - nAs(d - kd) = 0$

* $j = 1 - \frac{k}{3}$

* $a = \frac{A_s f_y}{0.85 f_c' b}$

*$A_{sf} = 0.85 f_c'(b - b_w)\frac{h_f}{f_y}$

* $M_{n1} = A_{sf} f_y (d - \frac{h_f}{2})$

* $M_{n2} = (A_s - A_{sf}) f_y \left(d - \frac{a}{2}\right)$

* $a = \frac{(A_s - A_{sf}) f_y}{0.85 f_c' b_w}$

*$c = a/\beta_1$

$M_n = M_{n1} + M_{n2}$

*$M_u = ØM_n$

*$V_c = 2\lambda\sqrt{f_c'} b_w d$

* $l_d/d_b = (3/40)\,(f_y/\sqrt{f_c'})\,(\alpha\beta\gamma\lambda)/\{(c + K_{tr})/d_b\}$

*$\rho_{0.005} = 0.85\beta_1 \frac{f_c'}{f_y} \frac{\epsilon_u}{\epsilon_u + 0.005}$

* $M_u = Ø\rho f_y bd^2 \left(1 - 0.59\frac{\rho f_y}{f_c'}\right)$

*$A_s = M_u/[Øf_y\{d-(a/2)\}]$

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

Course Title: Environmental Engineering I — Course No: CE 331
Time: 3.0 hours — Full Marks: 100

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

1. (a) What are the objectives of a water supply system (WSS)? Draw the figure showing all the elements of a WSS. [5+5]

   (b) A family of 8 persons in an arsenic and saline affected area of Bangladesh have planned to install rain water harvesting system (RWHS) as an alternative water supply option. Calculate the minimum capacity of storage tank required for the purpose with the following data: water demand = 10 lpcd of rainwater; yearly rainfall intensity = 2.5 m and the rainfall distribution is such that at least 35% of the rainwater must be stored for uninterrupted water supply throughout the year.
   What challenges this family may face for choosing this alternative water supply option? [5+5]

OR

2. (a) Draw a neat sketch of pond sand filter (PSF). "Ponds should be selected carefully for efficient operation of PSF"—justify the statement. [5+5]

   (b) For water supply of a town, water is pumped from a river 3 km away into a reservoir. The maximum level difference of river and reservoir is 20 m. Town population is 50,000 and per capita water demand is 120 lpcd. If the pumps operate for a total of 8 hrs and pump efficiency is 85%, calculate pump B.H.P. Assume friction factor as 0.0075 and pipe velocity as 2 m/s and maximum daily demand as 1.5 times avg. daily demand. [10]

3. (a) Explain with chemical reactions the co-precipitation and adsorption process of an arsenic removal plant (figure required). [10]

   (b) Compare between slow sand filter (SSF) and rapid sand filter (RSF) in terms of: i) filter bed ii) filtration efficiency iii) maintenance iv) suitability. [2.5*4=10]

4. (a) "Chlorination is the most common and widely adopted method of disinfection for public water supply" -- why? Explain the following terms of chlorination:
   i) de-chlorination and ii) break point chlorination (with curve). [5+5]

   (b) Discuss the mechanism/theory of following water treatment methods:
   i) Aeration ii) Filtration. [5+5]

5. (a) Explain the term "Water Safety Plan (WSP)". Why this safety plan is necessary for water supply systems? [5+5]

   (b) Write short notes on: i) Fire demand ii) Metering of water iii) Water demand management iv) Potable water. [2.5*4=10]

6. (a) Compare the continuous and intermittent systems of supplying water to consumers with respect to: i) mode of supply ii) contamination of water iii) reliability iv) firefighting. [2.5*4=10]

(b) Calculate the corrected flows in the various pipes of the upper loop of the distribution network as shown in following Fig. 1. The diameters and lengths of the pipes used are given against each pipe. One trial is required. [10]

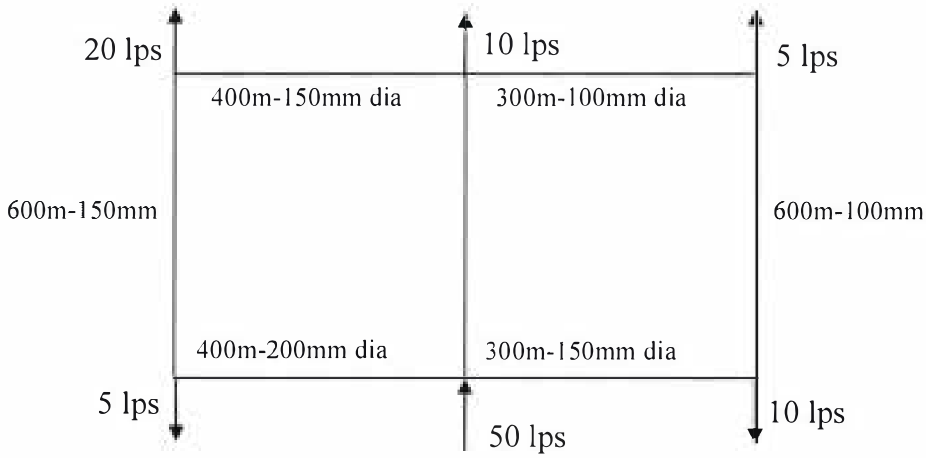


Fig. 1.

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

Course Title: Geotechnical Engineering I — Course Code: CE 341
Time: 3 hours — Full Marks: 100

Answer the following questions.

1. (i) The particle size distribution curve (given in Fig. 1) is extracted from a soil test report. Judge that the soil classified as 'Natural gravel soil' in Fig.1 is correct according to Unified Soil Classification System (USCS). — 8
Determine the symbol for the soil by applying USCS.

(ii) Identify the probable classifications according to USCS for the soil named 'Surface powder soil' in Fig. 1. — 2

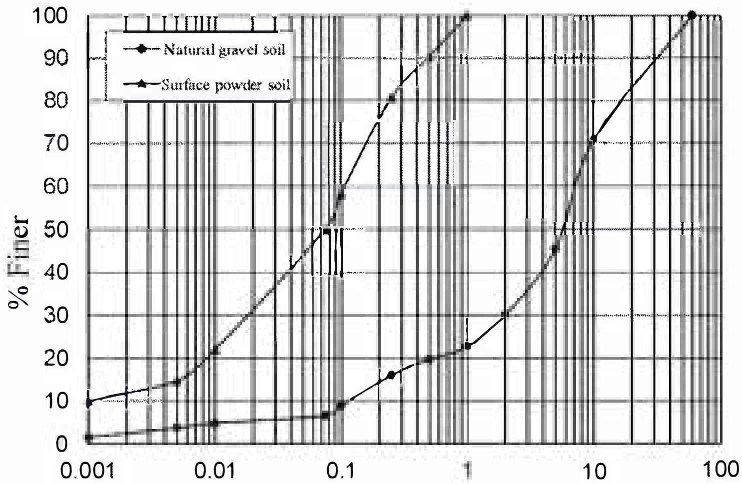


Fig. 1

2. Two types of sand were collected and tested using the machine shown in Fig. 2a. The graphical presentations of test results are given in Fig. 2b. It is to note that Fig.2b(i) and Fig.2b(ii) are obtained from the tests on two different sands.

(i) Identify the test (Test Name) mentioned above and demonstrated in Fig. 2a. — 1

(ii) Identify the relative density of sand (Dense/Medium Dense/Loose) based on the results presented in terms of shear stress vs horizontal displacement, Fig.2b(i). — 2
Sketch typical shape of vertical displacement vs horizontal displacement diagram for this sand specimen.

(iii) Identify the relative density of sand (Dense/Medium Dense/Loose) based on the results presented in terms of vertical displacement vs horizontal displacement, Fig.2b(ii). — 2
Sketch typical shape of shear stress vs horizontal displacement diagram for this sand specimen.

(iv) Determine the shear strength parameters of sand specimen using the test re. Use graph paper for plotting Mohr-Coulomb failure envelopes. 7

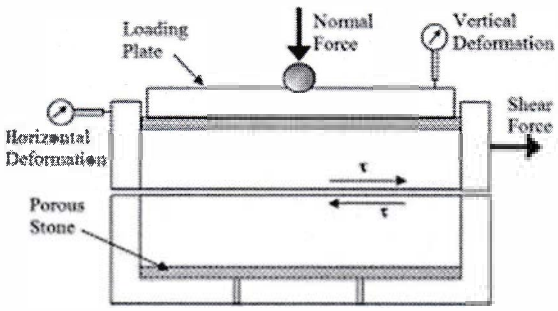


Fig. 2a

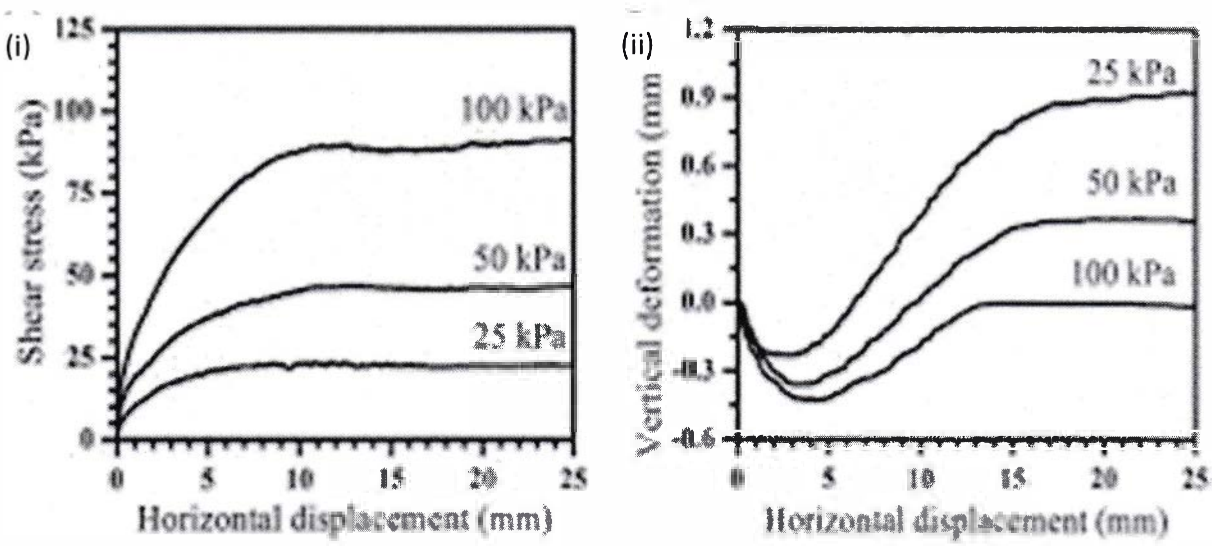


Fig. 2b

3. The results of three CU triaxial tests were given in Table 1.

(i) Plot the effective stress Mohr Circles for the three CU triaxial tests. 7

(ii) Determine shear strength parameters in terms of effective stress analysis. 6

Table 1: CU Triaxial Test Results

Test No.	Confining Pressure (kPa)	Deviator Stress (kPa)	Pore-water Pressure (kPa)
1	100	137	28
2	200	210	86
3	300	283	147

4. The compaction curves obtained from the analysis of standard Proctor test results are given in Fig. 3.

(i) Determine the optimum moisture content and the maximum dry density of Treated Soil. 3

(ii) Specify the range of moisture content for field compaction of Treated Soil. 1

(iii) Plot zero air void line. Given that specific gravity = 2.65. 4

(iv) Calculate bulk density at the optimum moisture content of Treated Soil. 2

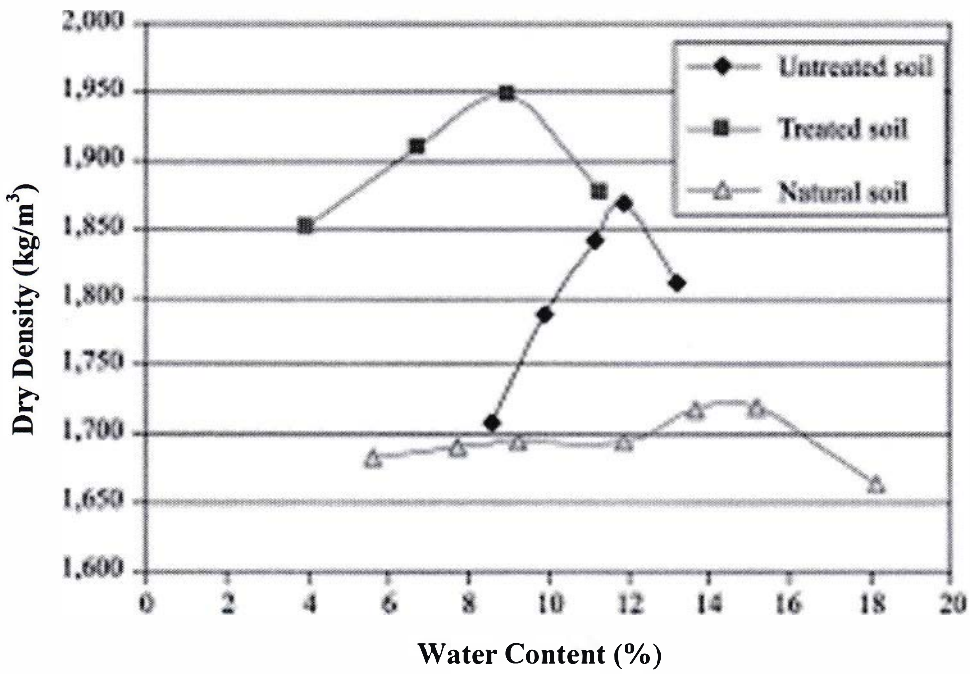


Fig.3

5. Apply Rankine's theory of lateral earth pressure for the following questions. Given that the backfill soils push the retaining wall. Consider up to the dredge line.

(i) Compute the magnitude of lateral force (per unit length of the wall) acting on the earth retaining structure, shown in Fig. 4. 8

(ii) Recalculate the lateral force when water table is at the ground level. 3

(iii) Recalculate the lateral force, if soils of both the layers have 15 kPa of cohesion. Water level is at the depth of 2.2 m below the GL. 4

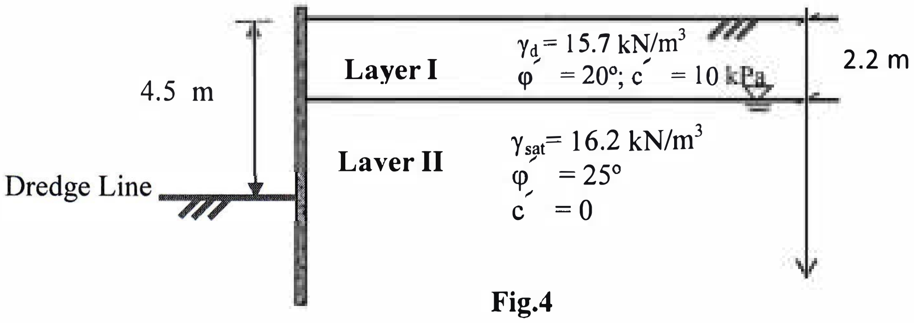


Fig.4

6. (i) A square footing (2.2 m x 2.2 m), in the soil profile in Fig. 5a, transmits UDL to soil below the footing base. Determine the increase in vertical stress ($\Delta\sigma$) at the mid depth of 3 m thick clay layer below points 'A' and 'B' using influence factor and point 'C' using equivalent point load method (Fig. 5b). 12

Given that

$$\sigma_z = \frac{3Q}{2\pi} \cdot \frac{z^3}{(r^2 + z^2)^{5/2}}$$

The chart of Influence Factor is attached.

(ii) Estimate the primary consolidation settlement of the clay layer for the increase in vertical stress ($\Delta\sigma$) below the centre of the footing. 8
Compression index, $C_c = 0.25$

(iii) During one-dimensional consolidation test, a 2 cm thick clay specimen from the mid-depth of clay layer takes 45 hours to reach 55% degree of consolidation.
Calculate the coefficient of consolidation. 2
Also, determine the time required by the clay layer in field condition to reach 45% consolidation. 3

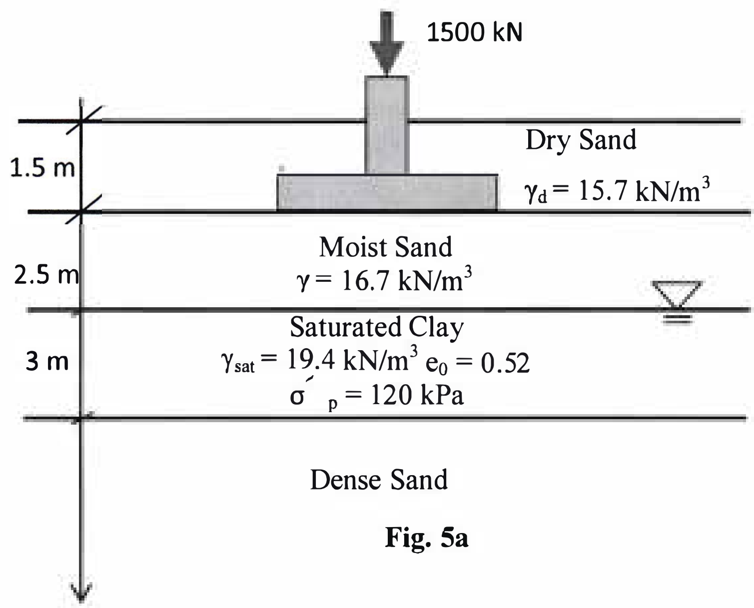


Fig. 5a

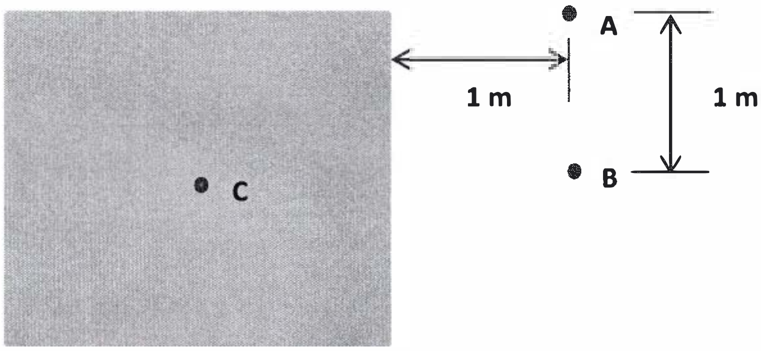


Fig. 5b

7. Two flownet diagrams are drawn (Fig.6a and Fig.6b) for calcularing seepage flow underneath a dam: one with one cut-off sheet pile and the other with two cut-off sheet pile. Seepage flow is occuring due to a head difference (between upstream and downstream end) of 6 m.

(i) Determine the flow rates of water under the dam for both conditions. Assume k = 3.6 $*10^{-3}$ cm/s. 5

(ii) Compute the pressure head at the points A, B, C, D, E, F and G (Fig. 6a and Fig. 6b). 7

(iii) Compare the heads at A, B and D with E, F and G, respectively. 1.5

(iv) Select one of the two design alternatives based on the above calculated values. 1.5

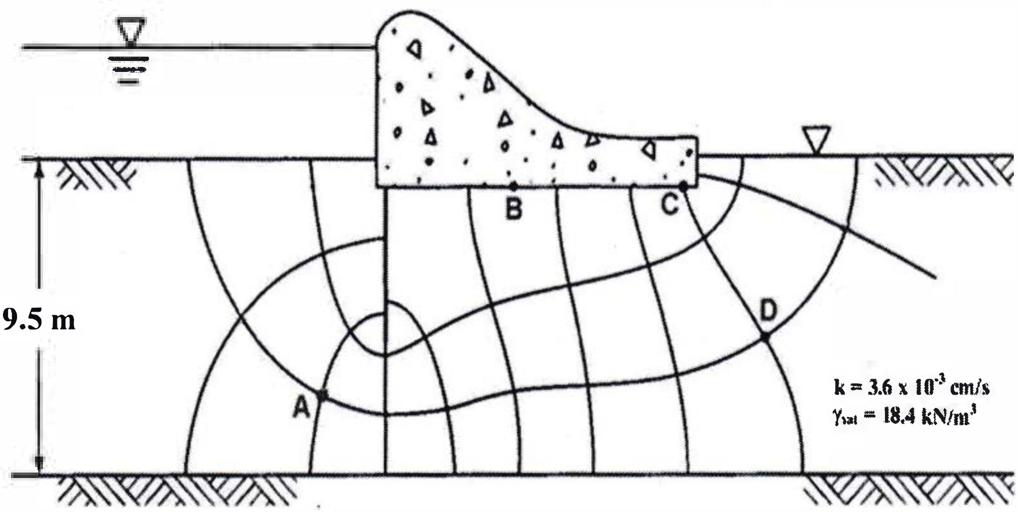


Fig.6a

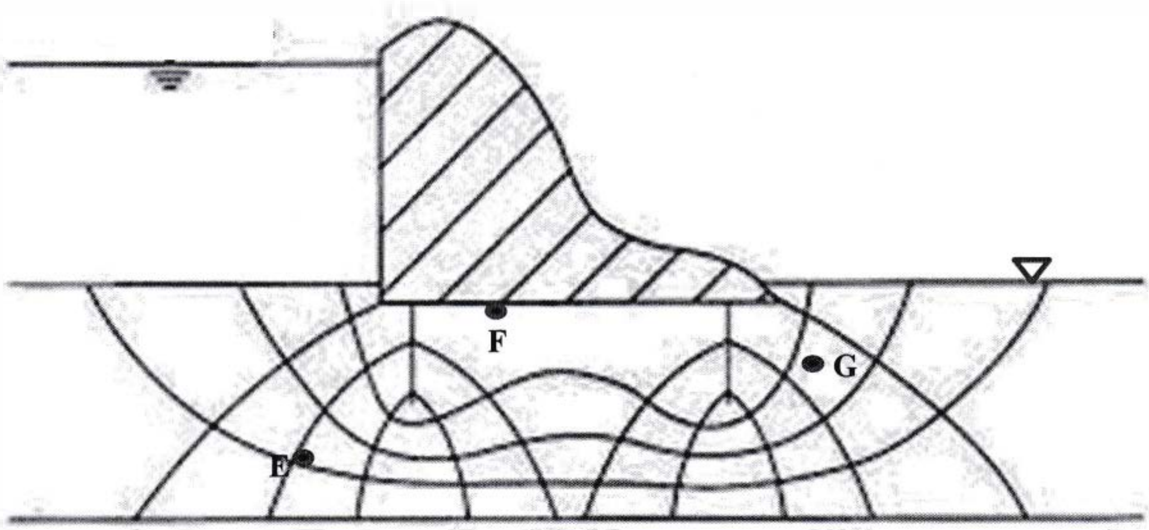


Fig. 6b

Table 2: Influence factor chart under the corner of a uniformly loaded rectangular area

	L / z														
B/z	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.4	2.0	3.0	5.0	∞
0.1	0.0047	0.0092	0.0132	0.0168	0.0198	0.0222	0.0242	0.0258	0.0270	0.0279	0.0301	0.0311	0.0315	0.0316	0.0316
0.2	0.0092	0.0179	0.0259	0.0328	0.0387	0.0435	0.0474	0.0504	0.0528	0.5470	0.0589	0.6100	0.0620	0.0620	0.0620
0.3	0.0132	0.0259	0.0374	0.0474	0.5600	0.0630	0.0686	0.0731	0.0766	0.0794	0.0856	0.0887	0.0898	0.0901	0.0902
0.4	0.0168	0.0328	0.0474	0.0602	0.0711	0.0801	0.0873	0.0931	0.0977	0.1013	0.1094	0.1134	0.1150	0.1154	0.1154
0.5	0.0198	0.0387	0.0560	0.0711	0.0840	0.9470	0.1034	0.1104	0.1158	0.1202	0.1300	0.1350	0.1368	0.1374	0.1375
0.6	0.0222	0.0435	0.0629	0.0801	0.0947	0.1069	0.1168	0.1247	0.1310	0.1361	0.1475	0.1533	0.1555	0.1561	0.1562
0.7	0.0240	0.0474	0.0686	0.8730	0.1034	0.1168	0.1277	0.1365	0.1436	0.1491	0.1620	0.1686	0.1711	0.1719	0.1720
0.8	0.2580	0.0504	0.0731	0.0931	0.1104	0.1247	0.1365	0.1461	0.1537	0.1598	0.1739	0.1812	0.1841	0.1849	0.1850
0.9	0.0270	0.0528	0.0766	0.0977	0.1158	0.1311	0.1436	0.1537	0.1619	0.1684	0.1836	0.1915	0.1947	0.1956	0.1958
1.0	0.0279	0.0547	0.0794	0.1013	0.1202	0.1361	0.1491	0.1598	0.1684	0.1752	0.1914	0.1999	0.2034	0.2044	0.2046
1.4	0.0301	0.0589	0.0856	0.1094	0.1300	0.1475	0.1620	0.1739	0.1836	0.1914	0.2102	0.2206	0.2250	0.2263	0.2266
2.0	0.0311	0.0610	0.0887	0.1134	0.1350	0.1533	0.1686	0.1812	0.1915	0.1999	0.2206	0.2325	0.2378	0.2395	0.2399
3.0	0.0315	0.0618	0.0898	0.1150	0.1368	0.1555	0.1711	0.1841	0.1947	0.2034	0.2250	0.2378	0.2420	0.2461	0.2465
5.0	0.0316	0.0620	0.0901	0.1154	0.1374	0.1561	0.1719	0.1849	0.1956	0.2044	0.2263	0.2395	0.2461	0.2486	0.2491
∞	0.0316	0.0620	0.0902	0.1154	0.1375	0.1562	0.1720	0.1850	0.1958	0.2046	0.2266	0.2399	0.2465	0.2492	0.2500

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

Course Title: Open Channel Flow | Course Code: CE 361

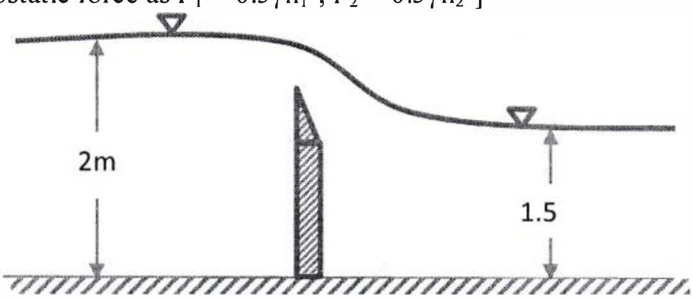
Time: 3 hours | Full marks: 150

Answer all the questions in both of the sections. (25*6= 150)
(Necessary formulae are attached; Assume reasonable data if necessary)

SECTION – A

1 (a) Differentiate between Open channel flow and pipe flow. Discuss the pressure distribution in parallel and curvilinear flow using schematic. (5+7)

(b) The figure shows a sharp-crested weir in a rectangular channel. If the discharge per unit width of the weir is 4 m^2/s, estimate the energy loss due to the weir and force on the weir plate for the submerged flow condition as shown. [For momentum equation, use the expression of hydrostatic force as $F_1 = 0.5\gamma h_1^2$; $F_2 = 0.5\gamma h_2^2$] (13)



OR

In a wide channel the velocity varies along a vertical as $u = 1 + 3z/h$, where h is the depth of flow and u is the velocity at a distance z from the channel bottom. i) Compute the discharge per unit width, ii) determine the state of flow, and iii) compute the velocity distribution coefficients α and β.

[For wide channel, $\overline{U} = \frac{1}{h}\int_0^h u dz$; $\alpha = \frac{1}{\overline{U}^3 h}\int_0^h u^3 dz$; $\beta = \frac{1}{\overline{U}^2 h}\int_0^h u^2 dz$]

2(a) Show the discharge vs depth curve and prove that "at the critical state of flow, the discharge is maximum for a given specific energy". (10)

OR

Prove Horton's formula for composite roughness.

(b) Water is flowing at a velocity of 2 m/s and depth of 2.5 m in a long rectangular channel 6 m wide. Compute the contraction in width of the channel for producing critical flow. (15)

Also, compute the change in water level produced by the contraction. Neglect energy losses and take $\alpha = 1$.

OR

A broad-crested weir is built in a rectangular channel of width 1.5 m. The height of the weir crest above the channel bed is 0.5 m and the head over the weir is 0.5 m. Calculate the discharge.

3(a) An unlined irrigation canal is trapezoidal in shape with b = 6 m, s = 1, n = 0.025, h = 3m and S_0 = 0.0005. (a) Estimate the discharge carried by the canal under normal flow condition. (b) It is proposed to line the canal with cement having n = 0.011. Evaluate the discharge that would be carried by the canal when i) only sides are lined with cement and bottom is unlined, ii) The bottom is lined with cement and the sides are lined with wood with n = 0.015 [use Horton's Formula: attached]. (12)

OR

A trapezoidal channel has a bottom width of 6m, sides slopes of 1.5:1, α = 1.12 and n = 0.025. i) Determine the normal slope at a normal depth of 1m when the discharge is 20 m^3/s. ii) Determine the critical slope when the discharge is 20 m^3/s. iii) Determine the critical slope when the normal depth is 1m.

(b) A triangular channel carrying 20 m^3/s is built with non-erodible bed having a slope of 1 in 1000 and n = 0.025. Design the channel by the concept of best hydraulic section (s = 1). (13)
[For best hydraulic triangular section, $A = h^2$; $P = 2\sqrt{2}h$; $R = \sqrt{2}h/4$; $B = 2h$; $D = h/2$]

OR

Design a stable alluvial channel using the Lacey method. The channel is to carry 10 m^3/s through 1 mm sand.

SECTION – B

4 (a) Identify the advantages of providing lining in channels. Explain why Best Hydraulic Section is not the most economic section. (10)

(b) An irrigation canal has to carry a discharge of 20 m^3/s through a course non-cohesive material having d_{50} = 2.5 cm, d_{75} = 3 cm and n = 0.025. The angle of repose of the perimeter material is 32°. The canal is to be trapezoidal in shape having s = 2 and laid on a slope of 1 in 1000. Determine section dimensions of the channel by following the step by step approach as detailed in Lane's method. (15)

5 (a)	Construct the possible flow profiles in **ANY THREE** of the following serial arrangements of channels or conditions. The flow is from left to right: i) mild – milder mild; ii) steep-steeper mild; iii) critical-mild; iv) mild-critical	(12)
(b)	A 6 m wide rectangular channel and having n = 0.026 has four reaches arranged serially. The bottom slopes of the reaches are 0.0016, 0.015, 0.0096 and 0.0064, respectively. For a discharge of 20 m^3/s through this channel, identify the resulting flow profiles and sketch those accordingly.	(13)
6 (a)	Draw the possible flow profiles for **ANY THREE** of the following conditions (mention the slopes, the name of the profiles and mark CDL, NDL etc.) : i) Different water levels downstream of a mild slope channel; ii) Sluice gate in a steep slope channel; iii) Overflow weir in a mild slope channel iv) Increase of surface roughness; v) Change in channel width	(10)
(b)	Water flows at a depth of 1 m in a horizontal triangular channel having s = 2 and Q = 20 m^3/s. If a hydraulic jump occurs in this channel, evaluate the sequent depth and the energy loss involved in the jump. [For triangular channel, $\bar{z} = h/3$] **OR** Water flows at a velocity of 6.1 m/s and a depth of 1 m in a 6.1 m wide horizontal rectangular channel. Find: i) the downstream depth necessary to form a hydraulic jump, ii) the type of jump, iii) the height of the jump, iv) the length of the jump, v) the horsepower dissipation in the jump, and vi) the efficiency of the jump	(15)

Given Formulae

$\bar{U} = \frac{\int_0^A u\,dA}{A}$	Trapezoidal channel	Circular Channel
$\alpha = \frac{\int_0^A u^3\,dA}{\bar{U}^3 A}$	$A = (b + sh)h$	$h = \frac{d_O}{2}\left[1 - cos\frac{\omega}{2}\right]$
$\beta = \frac{\int_0^A u^2\,dA}{\bar{U}^2 A}$	$P = b + 2h\sqrt{1 + s^2}$	$\omega = 2cos^{-1}(1 - \frac{2h}{d_o})$
	$B = b + 2sh$	$A = (\omega - sin\omega)\frac{d_O^2}{8}$
	Triangular channel	$B = d_O \sin\frac{\omega}{2}$
	$A = sh^2$	$P = \frac{\omega d_O}{2}$
	$P = 2h\sqrt{1 + s^2}$	*Note that ω is in radian*
	$B = 2sh$	

$Z_c = \frac{Q}{\sqrt{g/\propto}}$; $Z = A\sqrt{D}$; $Fr = U/\sqrt{(gD)}$; $Re = UR/\nu$;

Broad Crested Weir: $Q = 1.705b\left(h_1 + \frac{U_1^2}{2g}\right)^{1.5}$

Uniform flow formulae:

$U = CR^{1/2}S_f^{1/2}$; $U = \sqrt{(8g/f)}\, R^{1/2}S_f^{1/2}$; $U = (1/n)\, R^{2/3}S_f^{1/2}$

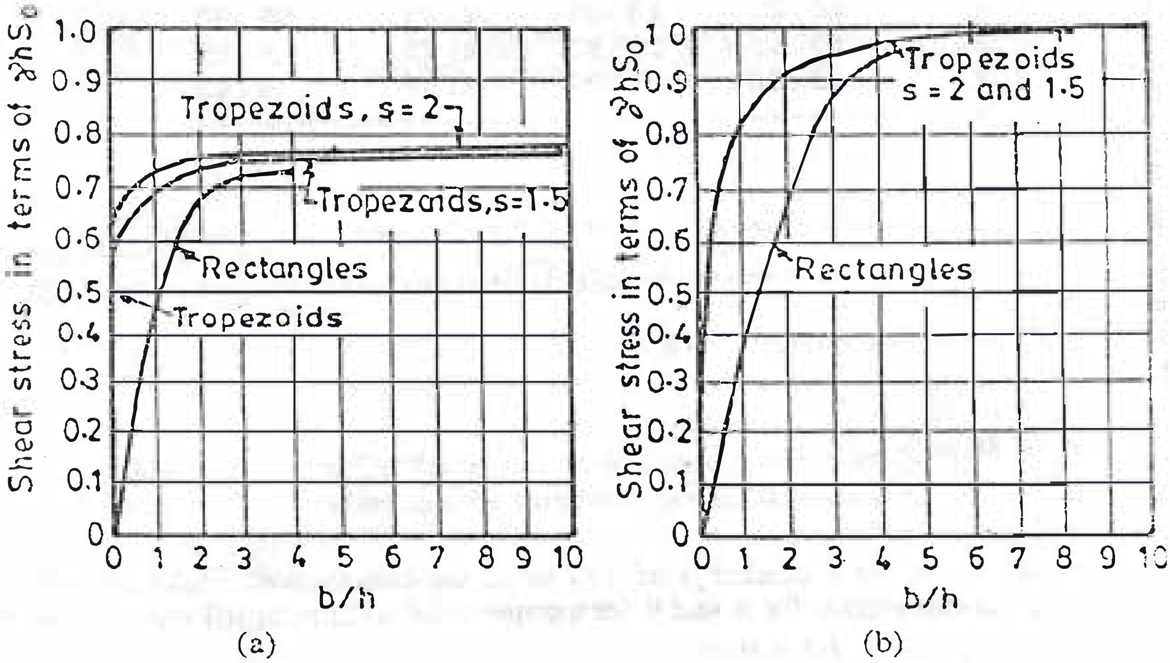
$Z = AR^{2/3}$; $Z = AR^{1/2}$

Governing equation for Gradually Varied Flow: $\frac{dh}{dx} = \frac{S_o - S_f}{1 - Fr^2}$

For wide channel, $h_c = \sqrt[3]{(\frac{q^2}{g})}$; $h_n = \sqrt[3]{q^2 / C^2 S_0}$

Rectangular channel: $h_c = \sqrt[3]{\frac{\alpha Q^2}{gb^2}}$; $S_c = (\frac{nQ}{AR^{2/3}})^2$
$Fr = U/\sqrt{(gD)}$; $Q = K\sqrt{S_f}$; $K = AR^{2/3}/n$

$\alpha = \frac{\alpha_1 K_1^3/A_1^2 + \alpha_2 K_2^3/A_2^2 + \alpha_3 K_3^3/A_3^2}{K^3/A^2}$ $\beta = \frac{\beta_1 K_1^2/A_1 + \beta_2 K_2^2/A_2 + \beta_3 K_3^2/A_3}{K^2/A}$ $n = \left(\frac{P_1 n_1^{3/2} + P_2 n_2^{3/2} + P_3 n_3^{3/2}}{P}\right)^{2/3}$ Rectangular channel: $h_c = \sqrt[3]{\frac{\alpha Q^2}{gb^2}}$; $S_c = (\frac{nQ}{AR^{2/3}})^2$ $Fr = U/\sqrt{(gD)}$; $Q = K\sqrt{S_f}$; $K = AR^{2/3}/n$ **Lane Method:** $\tau_b = 0.40\, d_{75}$ $K = \frac{\tau_s}{\tau_b} = \sqrt{1 - \frac{\sin^2\phi}{\sin^2\psi'}}$ 1 lb/ft^2 = 47.86 N/m^2 **Formula for Lacey's Method:** $f_s = 1.76$ $\quad S_0 = \frac{f^{5/3}}{3340Q^{1/6}}$ $R = 0.47(\frac{Q}{f_s})^{1/3}$ $\quad P = 4.75\sqrt{Q}$	**For Hydraulic Jump:** $\frac{h_2}{h_1} = \frac{1}{2}\left(\sqrt{1 + 8F_{r1}^2} - 1\right)$ $h_L = \frac{(h_2 - h_1)^3}{4h_1 h_2}$ $\frac{E_2}{E_1} = \frac{(1 + 8F_{r1}^2)^{3/2} - 4F_{r1}^2 + 1}{8F_{r1}^2(2 + F_{r1}^2)}$ $\frac{h_j}{E_1} = \frac{\sqrt{1 + 8F_{r1}^2} - 3}{2 + F_{r1}^2}$ $L_j = 9.75h_1(F_{r1} - 1)^{1.01}$ Power dissipation = $\rho g Q h_L$ 1 hp = 745.7 W



Maximum Shear Stress on (a) sides and (b) bottom of channel