Set A

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2017
Program: B.Sc in Civil Engineering

Course Title: Principles of Accounting | Course: ACN 301 | Credit: 2

Time: 2 hours | Full marks: 50

[N.B. Answer All the following Questions]

Question No 01

MCA Corporation is reviewing an investment proposal. The initial cost and estimates of the book value of the investment at the end of each year, the net cash flows for each year, and the net income for each year are presented in the schedule below. All cash flows are assumed to take place at the end of the year. The salvage value of the investment at the end of each year is equal to its book value. There would be no salvage value at the end of the investment's life.

year	Initial Cost	Annual Cash Flows	Annual Net Income
0	105000	-	-
1	70000	45000	16000
2	42000	40000	18000
3	21000	35000	20000
4	7000	30000	22000
5	0	25000	24000

MCA Corporation uses a 15% target rate of return for new investment proposals.

Required:

(a) What is the cash payback period for this proposal? (3)

(b) What is the annual rate of return for the investment? (4)

(c) What is the net present value of the investment? (5.5)

Question No 02

Wales Company sells small commercial spaces of a mall that sell for Tk.3000 each. Each shop has similar floor space and facility. For the coming year, management expects fixed costs to total Tk.200,000 and variable costs to be Tk.2000 per unit.

Required:

(a) Compute the break-even point.
(b) Compute the break-even sales.
(c) Compute contribution margin (CM) ratio.
(d) Compute the margin of safety assuming actual sales are Tk.750,000.
(e) Compute the break-even in units to earn net income of Tk.120,000.
(f) Due to tough market competition management at Wales is thinking of reducing the selling price to Tk.2900 per commercial space. If the selling price is reduced, compute the break-even in units to earn the net income of Tk.120,000.
(g) Prepare income statement assuming 450 unit sold.

(12.5)

Question NO 03

HYKO Corporation's comparative balance sheets are presented below.

HYKO CORPORATION
Balance Sheets
December 31

	2015	**2014**
Cash	Tk.7300	Tk.5700
Accounts receivable	21200	23400
Inventory	9500	7000
Land	20000	26000
Buildings	70000	70000
Accumulated depreciation—buildings	15000	10000
Total	**113000**	**122100**
Accounts payable	12370	33100
Common stock	75500	69000
Retained earnings	25130	20000
Total	**113000**	**122100**

2015 income statement included:

Net sales	Tk.220, 000,
Cost of goods sold	Tk.90, 000,
Net income	Tk.34, 000.

Required:

Compute the following ratios for 2015.

i. Current Ratio = Current Assets/Current Liabilities
ii. Asset turnover = Revenue/ Average total Assets
iii. Return on assets = Net Income/ Average total Assets
iv. Debt to total assets = Total Liabilities/ Total Assets
v. Profit margin = Net income/ Revenue
vi. Acid-test ratio = (Current Assets-inventory)/Current Liabilities
vii. Accounts receivable turnover = Revenue/ Average Accounts Receivable
viii. Return on common stockholders' equity = Net Income/ Average common stockholders' equity
ix. Inventory turnover = Cost of goods sold/ Average Inventories

(12.5)

Question No 04

(a) GPH Ispat Ltd. specializes in manufacturing steel. The product is well accepted by consumers, and the company has a large number of orders to keep the factory production at 10,000 tons per month. GPH's monthly manufacturing cost and other expense data are as follows:

Factory manager's salary	BDT 60,000
Maintenance costs on factory building	8000
Advertising for steel	150,000
Sales commissions	50,000
Depreciation on factory building	7000
Rent on factory equipment	50,000
Insurance on factory building	30,000
Raw materials	100,000
Utility costs for factory	8000
Supplies for general office	2000
Wages for assembly line workers	320,000
Depreciation on office equipment	5000
Miscellaneous materials (lubricants, solders, etc.)	7000

Required:

Prepare an answer sheet with the following column headings:

	Product Costs			
Cost Item	Direct Materials	Direct Labor	Manufacturing Overhead	Period Costs

Enter each cost item on your answer sheet, placing the BDT amount under the appropriate headings. Total the BDT amounts in each of the columns. Calculate the monthly product cost.

(6.5)

(b) An analysis of the accounts of Zuniga Manufacturing reveals the following manufacturing cost data for the month ended June 30, 2017.

Inventories	**Beginning**	**Ending**
Raw materials	Tk.9,000	Tk.13,100
Work in process	5,000	7,000
Finished goods	9,000	6,000

Costs incurred:

Raw materials purchases Tk.54,000
Direct labor Tk.57,000
Indirect labor Tk.5,500
Factory insurance Tk.4,000
Factory Machinery depreciation Tk.4,000
Factory machinery repairs Tk.1,800
Factory utilities Tk.3,100
Miscellaneous factory costs Tk.1,500. Assume that all raw materials used were direct materials.

Required:

Prepare the cost of goods manufactured schedule for the month ended June 30, 2017. (6)

Moderated OK

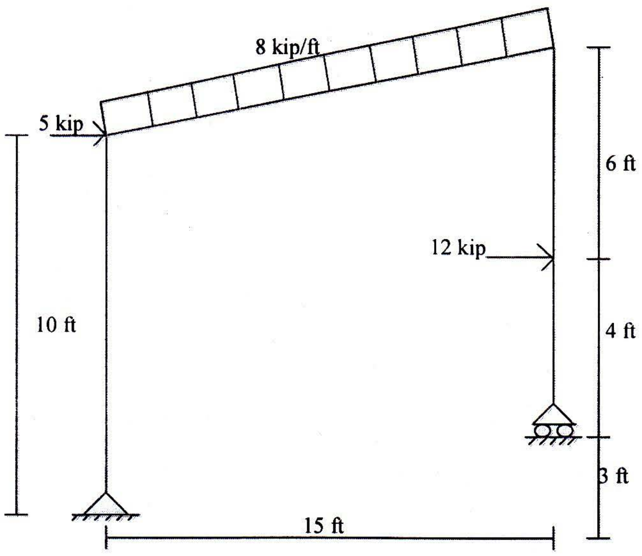
University of Asia Pacific
Department of Civil Engineering
Final Examination Spring 2018
Program: B. Sc. Engineering (Civil)

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

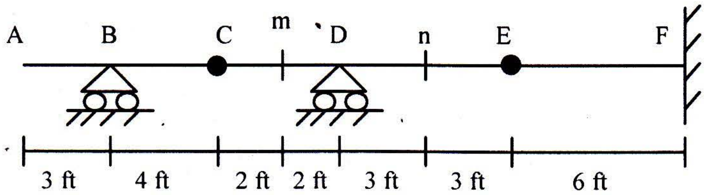
Part A

*There are **fourteen (14)** questions. Answer any **ten (10)**.*
Assume any missing data reasonably.

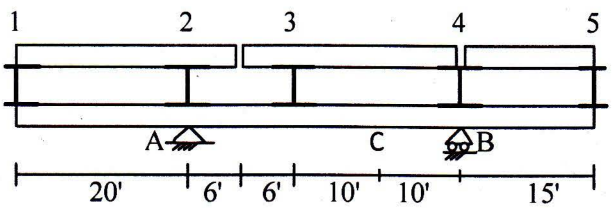
1. Draw the shear force and bending moment diagram for the structure shown in the figure below.



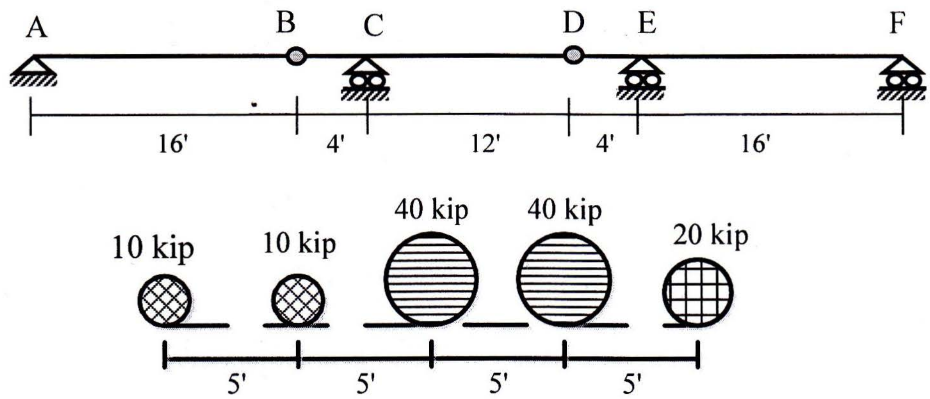
2. Calculate maximum reaction at F, maximum shear just left of D, maximum moment at point m and n for a dead load of 1.5 kip/ft and moving live load of 1 kip/ft.



3. Girder AB 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 1 and 4
(iii)Bending moment at point C
(iv)Shear in panel 2-3

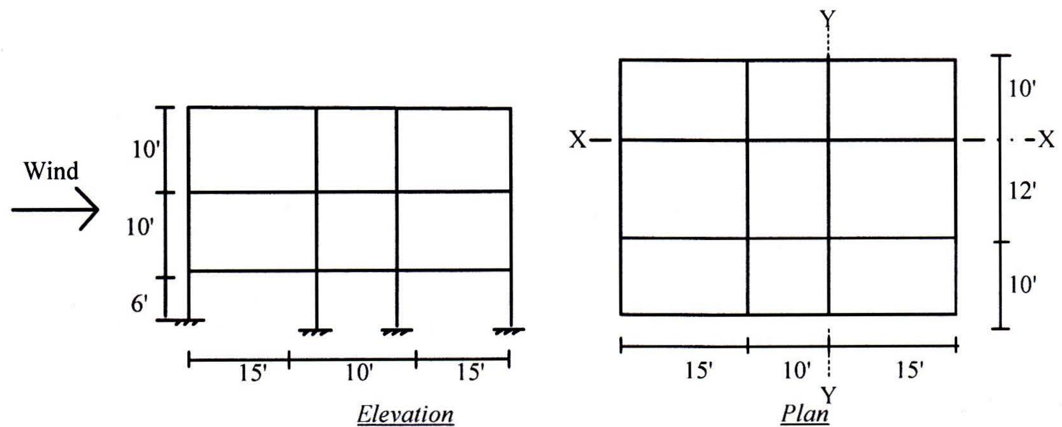


4. Calculate the maximum reaction at support A of the following beam for the wheel load arrangement shown below.



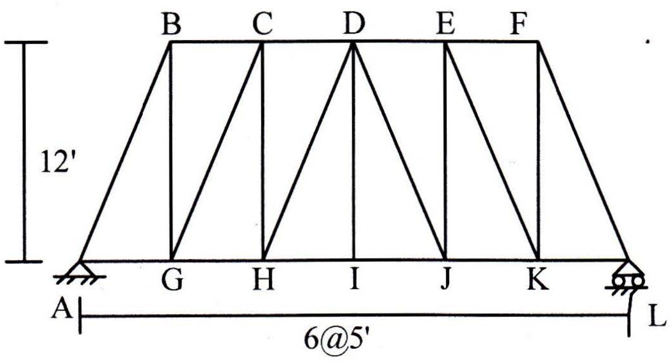
5. For the same beam and same wheel load arrangement shown in Question 4, calculate the maximum moment at point C.

6. Calculate the wind force at each story of frame XX of the three-storied concrete made chemical factory (C_I=1.25) located at a flat terrain in Khulna (Basic wind speed= 150 mph). Assume the structure to be subjected to Exposure A.



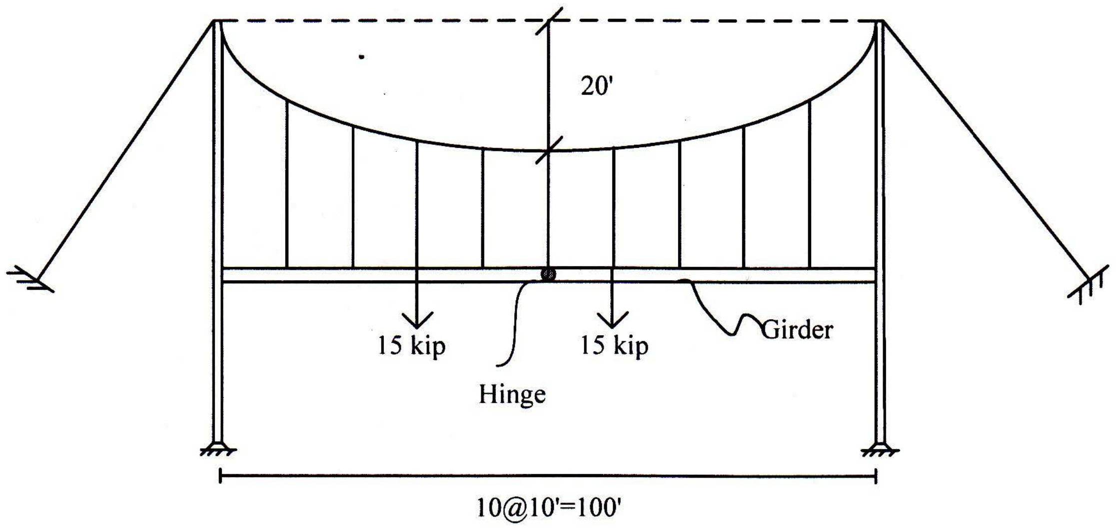
7. Calculate the seismic load at each story of frame YY for the same building shown in Question 6 located in Khulna (Zone 1). Assume the structure to be Intermediate Moment Resisting Frame (IMRF) built on soil condition S_3, carrying a Dead Load of 180 lb/ft^2 and Live load of 60 lb/ft^2.

8. For the truss shown below, draw influence lines of bar HD, DE and EJ. Note, each bottom chord joint consists of a cross girder and load moves over the floor beam placed over the girders.

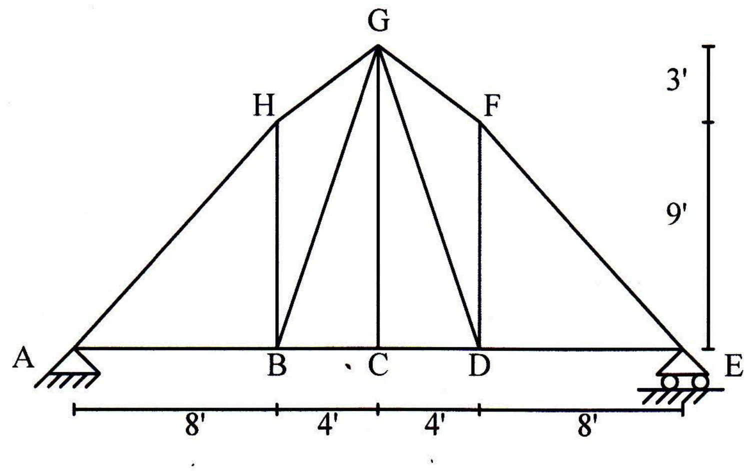


9. State and derive the General Cable Theorem.

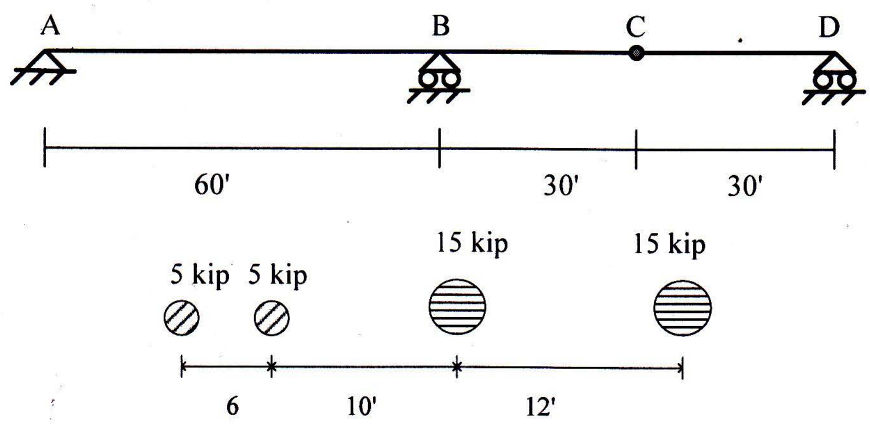
10. Draw bending moment diagram of the girder for the following figure.



11. For the truss shown below, calculate the maximum axial force in member BG for a uniformly distributed dead load of 8 kip/ft and moving live load of 4 kip/ft.
[Note: There are floor beams over bottom chords]



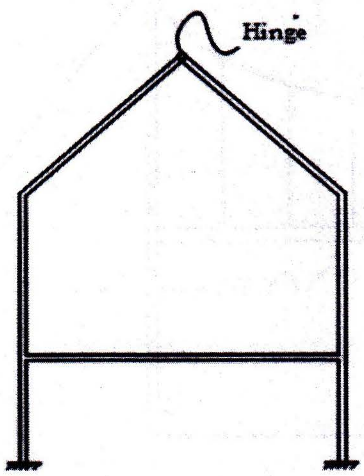
12. Calculate the maximum shear at a distance of 15′ from support D for the following beam and wheel load arrangement shown below.



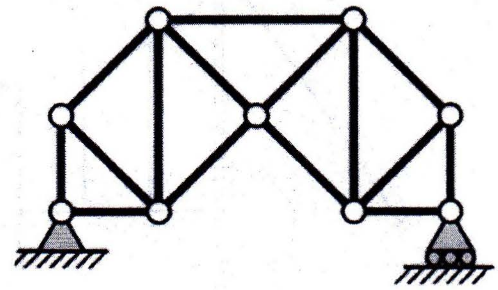
13. Compute the absolute maximum moment in a 40′ simple supported beam for the same wheel load arrangement shown in Question 12.

14. Determine whether the structures are statically and geometrically stable or unstable. Also, calculate the degree of statical indeterminacy.

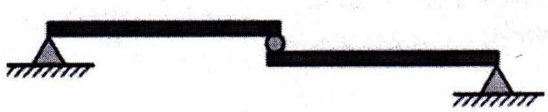
i.



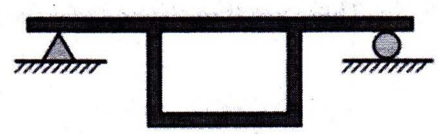
ii.



iii



iv.



Annexure

Wind load:

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

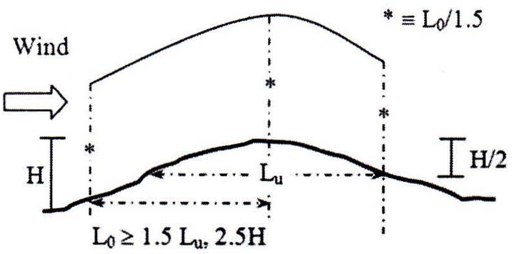
$p_z = C_G\, C_t\, C_p\, q_z$

$F_z = B\, h_{eff}\, p_z$

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

Height z (ft)	C_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



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

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

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

$V = F_t + \Sigma F_i$

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

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

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 2018
Program: B.Sc. Engineering (Civil)

Course Title: Design of Concrete Structures I — Course Code: CE 315

Time- 3 hours — Full marks: 70

Assume any missing data reasonably.

Answer any Seven (07) of the following Nine (09) questions.

Consider material strengths f'_c=4 ksi and f_y=60 ksi for all the problems.

The stress-strain curves of the materials provided in Appendix.

1. (a) What is transformed RC section? Explain with reference to cracked and uncracked section. (03)

   (b) Calculate the ultimate value of W in beam AB if columns A and B are both made of (16" x16") RC sections and eight No.7 bars as shown in Fig. 01. Also, calculate the stresses in concrete and steel when the section is subjected to one-fourth its ultimate load. (07)

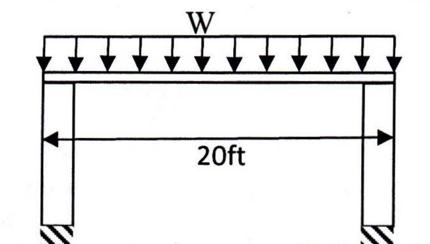


Figure: 01

2. (a) Draw the stress distribution and strain distribution diagrams for flexure in RC beams at uncracked, cracked and ultimate conditions. (02)

   (b) Design and make the details of a RC beam carrying a dead load of 1.27 k/ft and service live load 2.15 k/ft as shown in Fig.02. The moment coefficients are also shown in the figure. Use **WSD** method. (08)

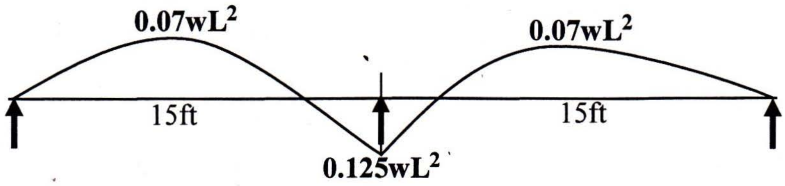


Figure:02

3. (a) Differentiate between singly and a doubly reinforced beam section with stress distribution. (02)

   (b) Calculate the stress in concrete fiber (top and bottom) and steel caused by the moment 45 k-ft of a rectangular RC beam as shown in Fig:03. Also, calculate the cracking moment. Concrete tensile strength in bending is 475 psi. (08)

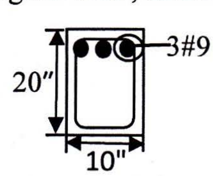


Figure:03

4. Architectural considerations specify the section of a RC beam to be 10 in. wide and 20 in deep. Calculate the required reinforcements of the beam for the applied M_{DL} = 53 k-ft, and M_{LL}= 105 k-ft. Use **USD** method. (10)

5. (a) What do you understand by T-beam in RC construction. Write the criteria for selecting effective flange width of T-beam. (03)

(b) Design the beam **A** as shown in Fig. 04. The slab is subjected to Floor Finish = 20 psf, Partition Wall = 50 psf and Live Load =100 psf. [Machine load on beam is 2.5 k/ft.] (07)

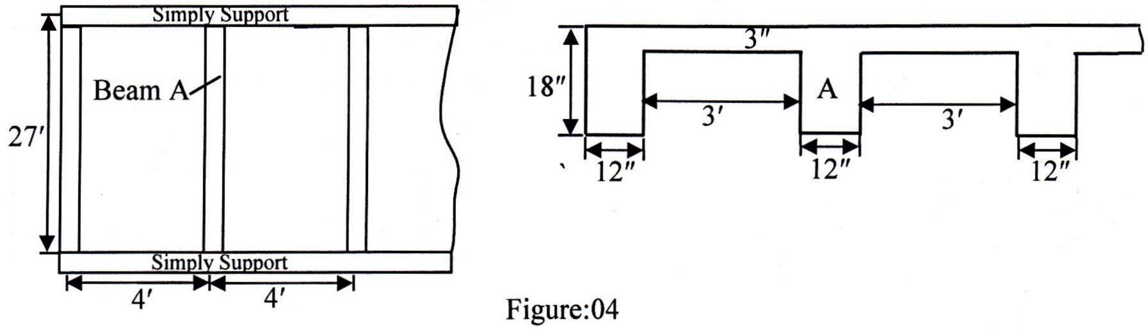


Figure:04

6. (a) Explain why the critical shear to be considered for design is computed at a distance of **"d"** from the face of support. (02)

(b) Figure: 05 shows the SFD of a rectangular beam with a cross-section having 16 in. width and an effective depth of 22 in. It is reinforced with 6 in^2 of tensile steel, which continues uninterrupted into the supports. Design the vertical stirrups for the beam and make the details. All loads are factored load. (08)

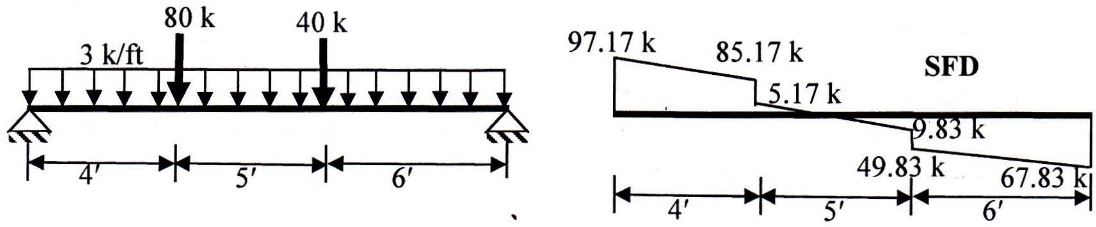


Figure: 05

7. A section of 12″ × 24″ is reinforced with three No.8 and two No.7 bars in two layers at the mid of 22 ft simply supported beam that subjected to dead load 1.5 k/ft and live load 2.2 k/ft. Both two No.7 bars are curtailed at 5 ft from supports. Check whether the bars are curtailed at the appropriate location and adequate development length been provided in the beam according to ACI code. (10)

8. (a) Sketch the design requirements for hook bars according to BNBC/ACI code for stirrups and main reinforcement. (03)

(b) Write down the factors that influence the development length (l_d) of reinforcing bars. (02)

(c) Calculate the lap-splice length of the column. A tied column with (18 in. × 18 in.) cross-section has eight No. 09 longitudinal bars and No.3 ties. (05)

Solve for (i) f_y = 60 ksi, and (ii) f_y = 80 ksi.

9. (a) What is meant by one-way slab. Mention the minimum thickness of one-way slab for various end conditions. (02)

(b) Discuss temperature and shrinkage reinforcements and give the code requirements for slab. (02)

(c) Design (according to BNBC/ACI Code) the slab as shown in Fig. 06 that carry service live load 120 psf, floor finish load 20 psf and partition wall load 50 psf. Also, show the reinforcement details in a cross-section of the slab. (06)

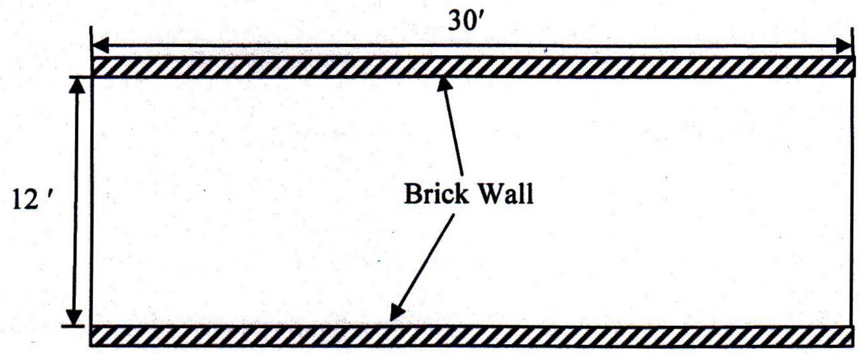


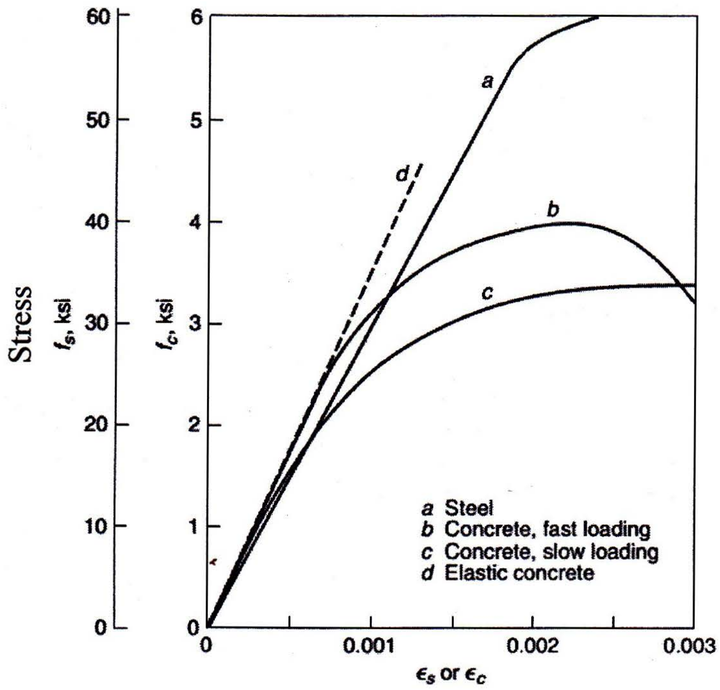
Figure: 06

APPENDIX

$P = f_c A_c + f_s A_{st}$	$As,min = 3\frac{\sqrt{f_c'}}{fy} b_w d \geq 200 \frac{b_w d}{fy}$
$P = f_c[A_g + (n - 1) A_{st}]$	$M_{n1} = As' fy (d - d')$
$P_n = 0.85\ f_c'\ A_c + f_y A_{st}$	$M_{n2} = (As - As') fy (d - \frac{a}{2})$
$M = \frac{f_c}{2} kjbd^2$	$a = \frac{(As - As')fy}{0.85 fc'b}$
$k = \sqrt{(\rho n)^2 + 2 \rho n} - \rho n$	$M_n = M_{n1} + M_{n2}$
$M_n = \rho f_y bd^2(1 - 0.59\frac{\rho f_y}{f'c})$	$\rho_{0.005} = \rho_{0.005} + \rho'$
$f_s = \epsilon_u E_s \frac{d - c}{c}$	$M_{n1} = A_{sf} f_y(d - \frac{hf}{2})$
$c = \frac{\epsilon_u}{\epsilon_u + \epsilon_y} d$	$a = \frac{(As - A_{sf})f_y}{0.85 fc' b_w}$
$\rho_b = \frac{\alpha f_c'}{f_y} \frac{\epsilon_u}{\epsilon_u + \epsilon_y}$	$M_{n2} = (A_s - A_{sf}) f_y (d - \frac{a}{2})$
$\beta 1 = 0.85 - 0.05\frac{f_c' - 4000}{1000}$ $for\ 0.65 \leq \beta 1 \leq 0.85$	$Av,min = 0.75 \sqrt{f_c'} \frac{b_w s}{f_{yt}} \geq \frac{50 b_w s}{f_{yt}}$
$\rho_{0.005} = 0.85\beta_1 \left(\frac{f_c'}{fy}\right) \frac{\epsilon_u}{\epsilon_u + 0.005}$	$s = \frac{\phi A_v f_{yt} d}{Vu - \phi Vc}$
$Mn = A_s f_y (d - \frac{a}{2})$	$s = \frac{\phi Avfytd (\sin\alpha + \cos\alpha)}{Vu - \phi Vc}$
$a = \frac{Asfy}{0.85 f_c' b}$	$s_{max} = \frac{A_v f_{yt}}{0.75 \sqrt{f_c'}\ b_w} \leq \frac{A_v f_{yt}}{50\ bw}; \frac{d}{2}; 24$ in
$l_d = \frac{3}{40} \frac{fy}{\lambda \sqrt{f_c'}} \frac{\psi_t \psi_e \psi_s}{\frac{c_b + K_{tr}}{d_b}}$	

APPENDIX

$$\frac{l_d}{d_b} = \begin{cases} \dfrac{f_y\psi_t\psi_e}{25\lambda\sqrt{f_c'}} & \text{No.6 and smaller bars} \\ \dfrac{f_y\psi_t\psi_e}{20\lambda\sqrt{f_c'}} & \text{No.7 and larger bars} \\ \dfrac{3f_y\psi_t\psi_e}{50\lambda\sqrt{f_c'}} & \text{No.6 and smaller bars} \\ \dfrac{3f_y\psi_t\psi_e}{40\lambda\sqrt{f_c'}} & \text{No.7 and larger bars} \end{cases}$$



Strain

Figure: Stress-strain curve

Symbol	Variable	Value
Ψt	*Horizontal reinforcement, placed>12 in. is below the development length *All other reinforcement	1.3 1.0
Ψe	*Epoxy-coated bars <3d$_b$ or clear spacing<6d$_b$ *Other epoxy-coated bars *Uncoated	1.5 1.2 1.0
Ψs	>= #7 bars <= #6 bars	1.0 0.8
λ	*Light Weight concrete *Normal concrete	1.3 1.0

University of Asia Pacific
Department of Civil Engineering
Final Examination Spring 2018
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. Assume any missing data.

1. (a) Discuss the objectives of water supply system? Draw a figure showing the elements of a water supply system. [5+5]
   (b) Predict the population in the year 2041 from the following data. Use appropriate method. [5]

Year	1981	1991	2001	2011
Population (million)	8	10	14	17

2. (a) Discuss the limitations of following alternative water supply options: i) Pond sand filter; ii) rainwater harvesting system. [5+5]
   (b) With a schematic diagram explain: i) Confined aquifer and ii) Unconfined aquifer. A 100mm diameter tube well is sunk to withdraw water from a 10 m thick confined aquifer having K=0.75 lps/m^2. The drawdown is 2m in the tube well while pumping. Calculate the tube well discharge when radius of circle of influence is 30 m. [5+5]

3. (a) Differentiate between potable water and palatable water. Classify the impurities that are often found in water? [5+5]
   (b) Design a suitable set of pumping unit to deliver 450000 gph from an intake well of a river bank to the treatment plant. Total length of rising main from the intake well to the treatment plant is 800 ft and the static hand is 60 ft. Design also the cast iron main. Assume: Velocity of water = 12 fps; Friction factor = 0.0075; Efficiency = 70%. [10]

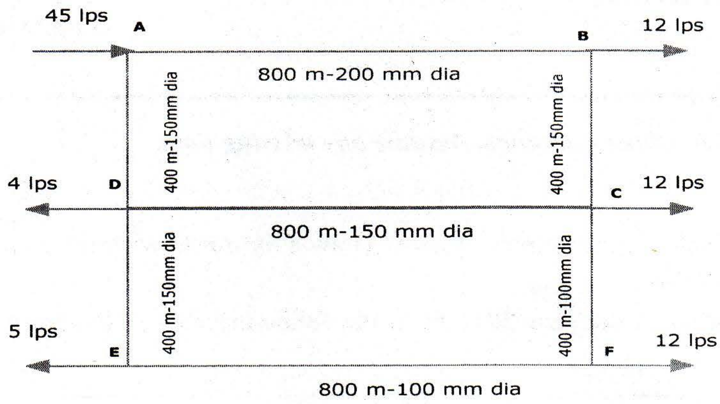
4. (a) With a schematic diagram show different zones in a sedimentation tank. Derive the equation of settling velocity of a spherical particle having diameter of "d" in a sedimentation basin. [5+10]
   (b) Where and how water may loss in a piped water supply system? What are the methods often practiced to reduce the losses of water? [5+5]

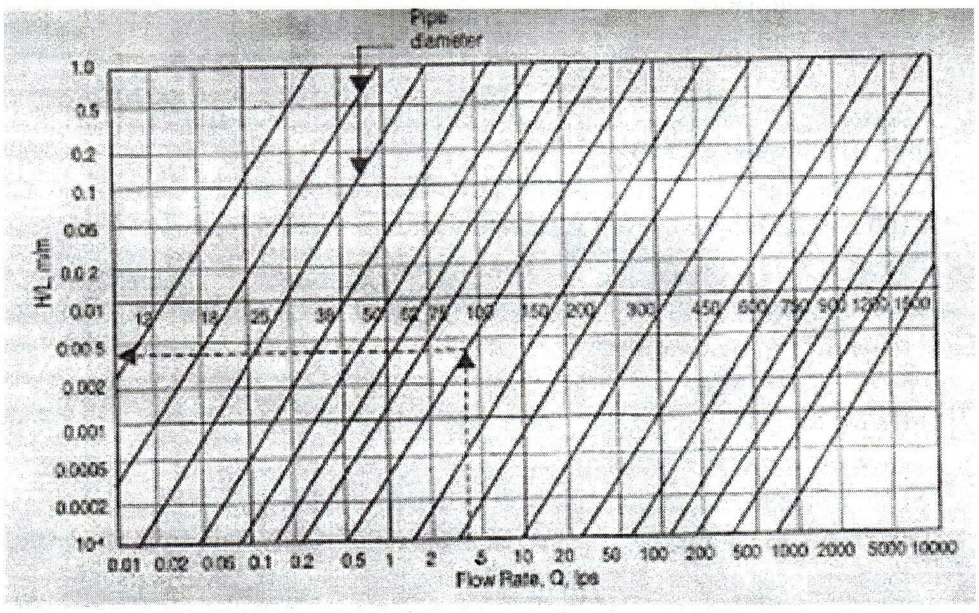
OR

5. (a) What are the objectives of aeration in water treatment? Explain the theories of filtration in water treatment process. [5+10]
   (b) Write short notes on: i) Metering of water ii) Controlling of water use iii) Water demand variation iv) Fire demand [10]

6. (a) What are the requirements of a good distribution system? With schematic diagrams describe different methods of water transmission and distribution systems. [5+5]

(b) Calculate the corrected flows in the various pipes of the upper loop of the distribution network as shown in following figure. The diameters and lengths of the pipes used are given against each pipe (two trials are required). Use the following graph if required. [10]





University of Asia Pacific
Department of Civil Engineering
Final Examination Spring 2018
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. Classify the following soils according to Unified Soil Classification System (USCS) based on the following test data. 12

Soil Parameters	Soil A	Soil B	Soil C
C_u	2.8	2.8	2.8
C_c	0.95	0.95	0.95
LL	45	45	45
I_P	15.5	15.5	15.5
Fine grained particle (%)	3.5	7.5	57.5

2. Apply Rankine's theory of lateral earth pressure for the following questions:

(a) Compute the magnitude of lateral force (per unit length of the wall) acting on the earth retaining structure, shown in Fig. 1. Given that the backfill soils push the retaining wall. Consider up to the dredge line. 10

(b) Calculate the difference in the lateral force (in active case), if soils of both the layers have 10 kPa of cohesion. The depth of water table remains unchanged. Will the force increase? 5

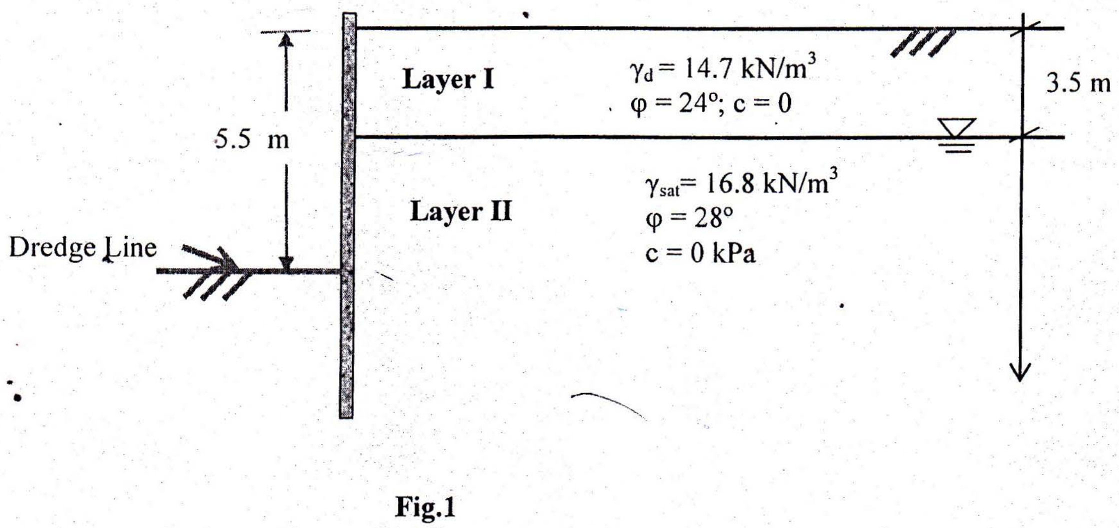


Fig.1

3.(a) A rectangular footing (3 m x 2 m), in the soil profile in Fig. 2a, transmits a pressure of 260 kN/m^2 at the footing base. Determine the increase in vertical stress ($\Delta\sigma$) at the mid depth of the clay layer below the points 'A' and 'B' (Fig. 2b). Both the points are at 4 m below the footing base. The chart for influence factor is given. 8

(b) Estimate the over-consolidation ratio (OCR) for a soil element at the mid- depth of the clay layer in situ condition (i.e., before increase in stress).
Given that pre-consolidation pressure of the clay layer = 125 kPa. 2

(c) Predict the primary consolidation settlement of upper 1 m of the clay layer. Use 2:1 slope for calculating $\Delta\sigma$. Given that Compression index, $C_c = 0.2$, pre-consolidation pressure of the clay layer = 85 kPa 11

(d) Predict the time for the clay layer to settle 5 mm due to the increase in stress from the footing, if the settlement is calculated 16 mm at the end of 100% consolidation.
Given that coefficient of consolidation, $c_v = 0.25$ mm^2/s 4

$$T_v = \frac{\pi}{4}\cdot\left(\frac{U}{100}\right)^2$$

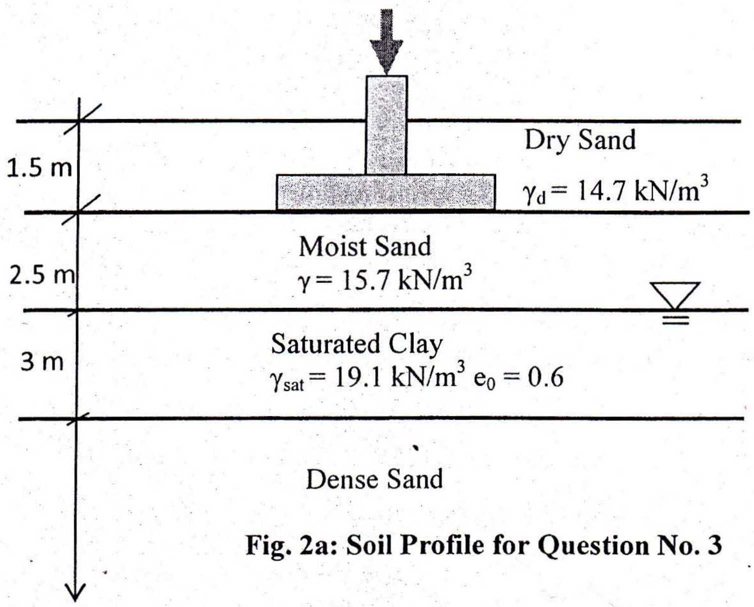


Fig. 2a: Soil Profile for Question No. 3

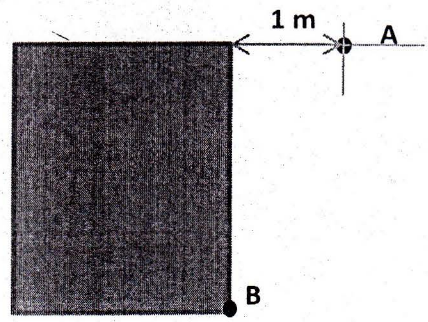


Fig. 2b: Footing Base and points 'A' and 'B' for Question No. 3

4.(a) From a series of triaxial test, Mohr-Coulomb failure envelope of the soil was found as below: $\tau = 30 + \sigma.\tan 25°$. If effective minor principal stress is 300 kPa, determine the following:

(i) Effective major principal stress 5

(ii) Deviator stress at failure 4

(iii) The inclination angle that the failure plane makes with the major principle plane. Show in a Mohr circle. 5

(b) If a consolidated drained triaxial test was conducted on normally consolidated clay specimen under a confining pressure of 375 kPa and failed at a deviator stress of 225 kPa, Compute the effective angle of internal friction. 6

5. A flownet is drawn (Fig.3) for calculating seepage flow underneath the dam.

(a) Estimate the seepage flow rate. Assume $k = 2 * 10^{-4}$ cm/s. 5

(b) Calculate the water pressures at points A, B, C, D, E, F and G on the front side of the sheet pile wall. 7

(c) Calculate the water pressures at points A, B, C, D, E, F and G on the back side of the sheet pile wall. 8

6.(a) Differentiate between compaction and consolidation. 4

(b) Identify the factors influencing the compaction in field. 4

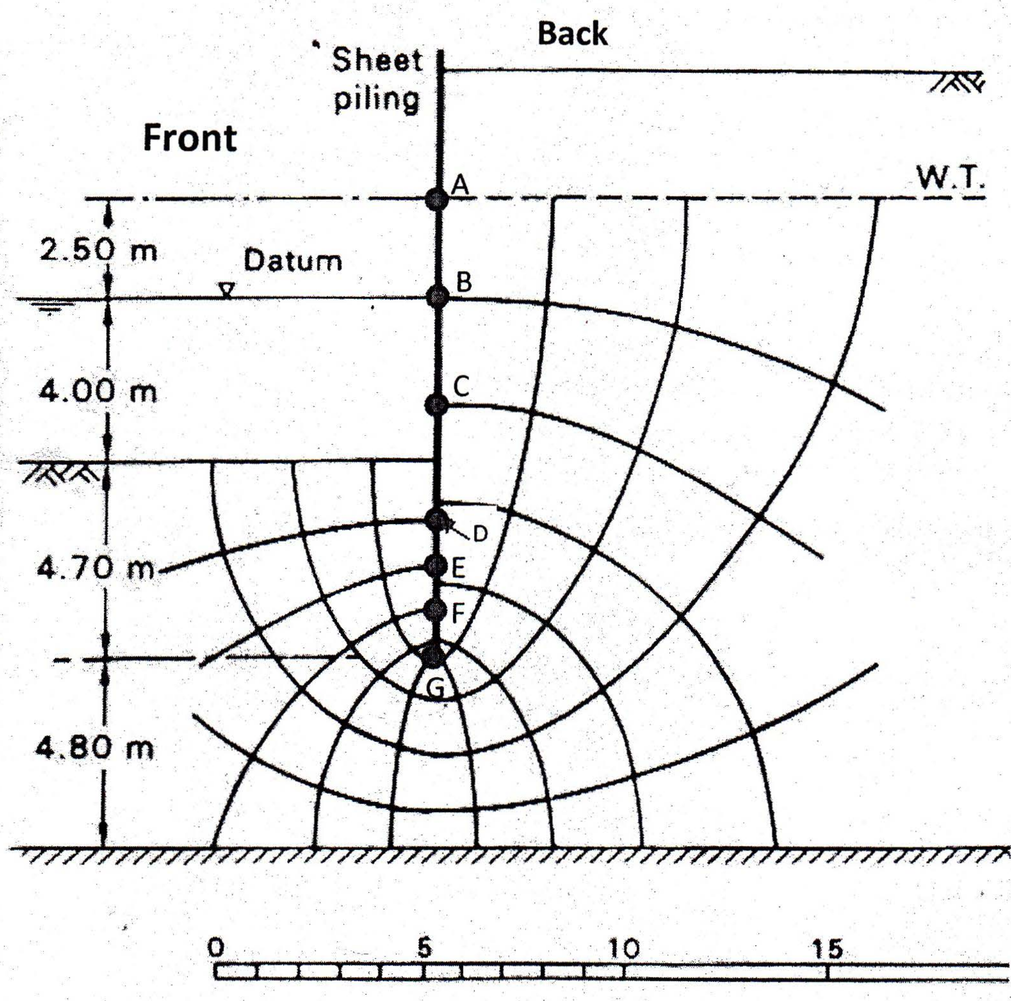


Fig. 3 for Question No. 5

Influence Chart for uniformly loaded rectangular footing

	m_1									
n_1	1	2	3	4	5	6	7	8	9	10
0.20	0.994	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997
0.40	0.960	0.976	0.977	0.977	0.977	0.977	0.977	0.977	0.977	0.977
0.60	0.892	0.932	0.936	0.936	0.937	0.937	0.937	0.937	0.937	0.937
0.80	0.800	0.870	0.878	0.880	0.881	0.881	0.881	0.881	0.881	0.881
1.00	0.701	0.800	0.814	0.817	0.818	0.818	0.818	0.818	0.818	0.818
1.20	0.606	0.727	0.748	0.753	0.754	0.755	0.755	0.755	0.755	0.755
1.40	0.522	0.658	0.685	0.692	0.694	0.695	0.695	0.696	0.696	0.696
1.60	0.449	0.593	0.627	0.636	0.639	0.640	0.641	0.641	0.641	0.642
1.80	0.388	0.534	0.573	0.585	0.590	0.591	0.592	0.592	0.593	0.593
2.00	0.336	0.481	0.525	0.540	0.545	0.547	0.548	0.549	0.549	0.549
3.00	0.179	0.293	0.348	0.373	0.384	0.389	0.392	0.393	0.394	0.395
4.00	0.108	0.190	0.241	0.269	0.285	0.293	0.298	0.301	0.302	0.303
5.00	0.072	0.131	0.174	0.202	0.219	0.229	0.236	0.240	0.242	0.244
6.00	0.051	0.095	0.130	0.155	0.172	0.184	0.192	0.197	0.200	0.202
7.00	0.038	0.072	0.100	0.122	0.139	0.150	0.158	0.164	0.168	0.171
8.00	0.029	0.056	0.079	0.098	0.113	0.125	0.133	0.139	0.144	0.147
9.00	0.023	0.045	0.064	0.081	0.094	0.105	0.113	0.119	0.124	0.128
10.00	0.019	0.037	0.053	0.067	0.079	0.089	0.097	0.103	0.108	0.112

University of Asia Pacific
Department of Civil Engineering
Final Examination Spring 2018
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)
(Assume reasonable data if necessary)

SECTION – A

1 (a) Illustrate the pressure distribution in parallel, concave and convex flows in a figure and mention in each of the cases if the pressure is hydrostatic, less than hydrostatic or more than hydrostatic. (8)

OR

Demonstrate how the expressions for computing the velocity distribution coefficients can be derived.

(b) Produce the derivation process of the momentum equation for steady one-dimensional open channel flow (figure required). (5)

(c) Water flows in an open channel at a depth of 1 m and a mean velocity of 3 m/s. Compute the discharge and determine the states of flow for **any three** of the following channel types: (12)

i) wide; ii) trapezoidal with b = 6m and s = 2 ; iii) rectangular with b = 6m ;
iv) triangular with s =2 ; v) circular whose diameter is 2.5 m.

2(a) Indicate why it is undesirable to design channels at or near critical state. A broad crested weir is built in a rectangular channel of width 2m. The height of the weir crest above the channel bed is 1.2 m and the head over the weir is 0.8 m. Calculate the discharge. (4+10)

(c) Compute the numerical value of the hydraulic exponent for critical flow computation M for a depth of 1 m in a trapezoidal channel with b = 6 m, s = 2 and Q = 20 m^3/s. (11)

OR

Compute the critical depth and velocity in a circular channel with d_0 = 3 m and Q = 5 m^3/s by the trial and error method if $\alpha = 1.12$

3(a) Produce the relationships between Chezy's C, Darcy Weisback's factor f and Manning's n. (8)

OR

Produce Horton's Formula for composite roughness through derivation.

(b) An unlined irrigation canal is trapezoidal in shape with b = 6 m, s = 1, n = 0.025, h = 2m 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 concrete having n = 0.013. Evaluate the discharge that would be carried by the canal when i) only sides are lined, ii) only the bottom is lined [use Horton's Formula]. (12)

OR

A rectangular channel has a bottom width of 6m, α= 1.12 and n = 0.02. i) For h_n = 1 m and Q = 11m^3/s, determine the normal slope. Ii) Determine the critical slope for Q = 11 m^3/s. iii) Determine the critical slope for h_n = 1m.

(c) Identify the considerations in designing channels when best hydraulic sections are modified in practice. (5)

SECTION – B

4 (a) Show that the best hydraulic trapezoidal section is one-half of a regular hexagon. (9)

OR

Design the best hydraulic trapezoidal section to carry a discharge of 20 m^3/s on a slope of 1 in 2500 if s = 1 and n = 0.012. [for best hydraulic trapezoidal section, A = $\sqrt{3}h^2$; P = $2\sqrt{3}h$; R = h/2 ; B = $4\sqrt{3}h/3$; D = 3h/4]

(b) Design a stable alluvial channel using the Lacey method. The channel has to carry a discharge of 25 m^3/s through 1.5 mm sand. (10)

(c) Examine the behavior of flow profiles when i) $h \rightarrow h_n$, ii) $h \rightarrow h_c$ and iii) $h \rightarrow 0$ (6)

5 (a) Construct the possible flow profiles in **ANY TWO** of the following serial arrangements of channels or conditions. The flow is from left to right: (5)

i) mild – milder; ii) critical-steep-mild; iii) steep-mild-milder

(b) A rectangular channel with b = 6 m and n = 0.02 carries a discharge of 24 m^3/s. Evaluate the flow profiles produced in the channel for **any three** of the following changes in the bottom slope. (12)

i) $S_0 = 0.004$ to $S_0 = 0.009$
ii) $S_0 = 0.003$ to $S_0 = 0.005$
iii) $S_0 = 0.0085$ to $S_0 = 0.001$
iv) $S_0 = 0.0095$ to $S_0 = 0.0075$
v) $S_0 = 0.001$ to $S_0 = 0.0045$

OR

A wide rectangular channel with $C = 47\ m^{1/2}/s$ and $S_0 = 0.0001$ carries a discharge of 2 m^2/s. A weir causes the water level to be raised by 0.50 m above the normal depth. Compute the length of the resulting flow profile between the weir site and the location where the depth is 2.9 m by the Bresse method. (drawing required).

(c) Apply the shear stress formulae to derive the ratio between the bottom shear stress and side shear stress in a trapezoidal channel. (8)

6 (a) Classify hydraulic jump explaining the conditions and features of each type of jump (no figure required). (8)

OR

Summarize the types of jumps that occur in sloping channels with figure.

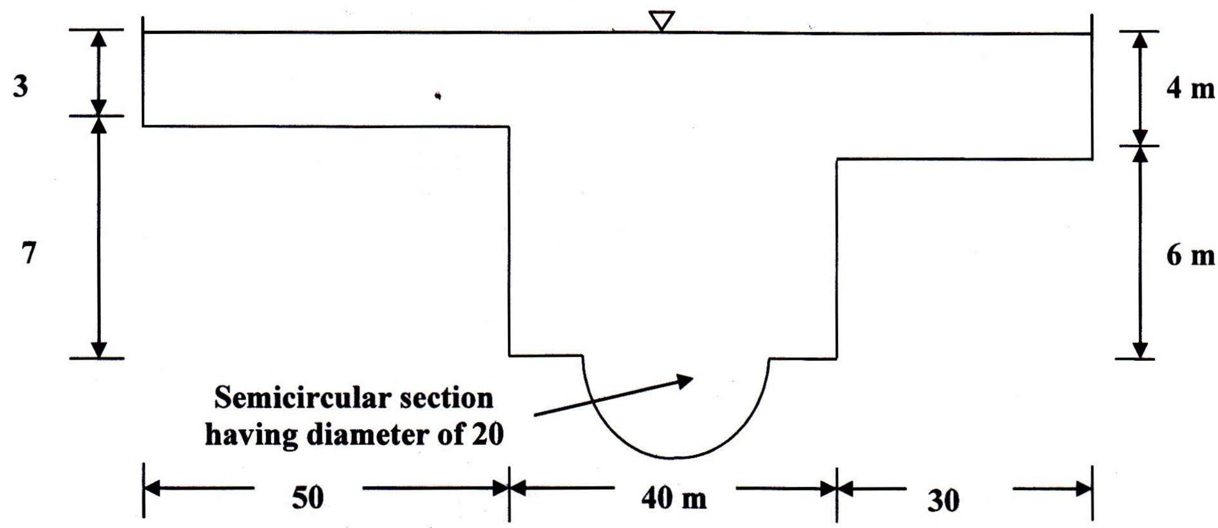
(b) Following the procedure for deriving qualitative flow profiles, show the procedure and draw the profile M2. (4)

(c) Analyze the flood discharge through a river reach 1000 m long having a fall in water surface of 0.85 m (using slope-area method). Neglect the eddy loss. Use the following data: (13)

Section	A (m^2)	P (m)	n	α
Upstream	12,000	2,150	0.03	1.15
Downstream	10,500	2,050	0.03	1.18

OR

A channel consists of a main section and two side sections as shown in the following figure. Calculate the total discharge, the mean velocity of flow and the Manning's n for the entire section when n = 0.025 for the main channel, n = 0.045 for the side channels and S_o= 0.0002. Also calculate the numerical values of α and β for the entire section assuming that $\alpha = \beta = 1.00$ for the main channels and the side sections.



Given Formulae

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

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

1. **Hydraulically smooth surface:** $\frac{U}{u^*} = 5.75\, log\, (\frac{3.64u^*R}{v})$
2. **Hydraulically rough surface:** $\frac{U}{u^*} = 5.75\, log\, (\frac{12.2R}{k_s})$
3. **Transition regime:** $\frac{U}{u^*} = 5.75\, log\, (\frac{12.2R}{k_s + 3.35\frac{v}{u^*}})$

$u^* = \sqrt{(gRS_0)}$; $K = AR^{2/3}/n$

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

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: $\frac{dh}{dx} = \frac{S_o - S_f}{1 - Fr^2}$

Bresse function: $\emptyset = \frac{1}{6}\ln\frac{u^2+u+1}{(u-1)^2} - \frac{1}{\sqrt{3}}\tan^{-1}\frac{\sqrt{3}}{2u+1}$; Where $u = h/h_n$

$L = x_2 - x_1 = \frac{h_n}{S_0}[(u_2 - u_1) - (1 - \frac{h_c^3}{h_n^3})(\Phi_2 - \Phi_1)]$

For wide channel,

$h_c = \sqrt[3]{(\frac{q^2}{g})}$; $h_c = \sqrt{q^2 / C^2 S_0}$; $U = \frac{1}{n} R^{2/3} S_f^{1/2}$

$$\alpha = \frac{\alpha_1 K_1^3/A_1^2 + \alpha_2 K_2^3/A_2^2 + \alpha_3 K_3^3/A_3^2}{K^3/A^2}$$

$$\beta = \frac{\beta_1 K_1^2/A_1 + \beta_2 K_2^2/A_2 + \beta_3 K_3^2/A_3}{K^2/A}$$

$$n = \left(\frac{P_1 n_1^{3/2} + P_2 n_2^{3/2} + P_3 n_3^{3/2}}{P}\right)^{2/3}$$

Formula for Lacey's Method:

$f_s = 1.76$ $\quad S_0 = \frac{f^{5/3}}{3340 Q^{1/6}}$

$R = 0.47(\frac{Q}{f_s})^{1/3}$ $\quad P = 4.75\sqrt{Q}$

Rectangular channel: $h_c = \sqrt[3]{\frac{\alpha Q^2}{g b^2}}$; $S_c = (\frac{nQ}{AR^{2/3}})^2$

$Fr = U/\sqrt{(gD)}$; $Q = K\sqrt{S_f}$; $K = AR^{2/3}/n$

$\Delta x = E_2 - E_1/(S_0 - S_f bar)$

$S_f bar = (S_{f1} + S_{f2})/2$

For Hydraulic Jump:

$$\frac{h_2}{h_1} = \frac{1}{2}\left(\sqrt{1 + 8F_{r1}^2} - 1\right)$$

$$h_L = \frac{(h_2 - h_1)^3}{4 h_1 h_2}$$

$$\frac{E_2}{E_1} = \frac{(1 + 8F_{r1}^2)^{3/2} - 4F_{r1}^2 + 1}{8F_{r1}^2(2 + F_{r1}^2)}$$

$$\frac{h_j}{E_1} = \frac{\sqrt{1 + 8F_{r1}^2} - 3}{2 + F_{r1}^2}$$

$$L_j = 9.75 h_1 (F_{r1} - 1)^{1.01}$$

$$F_2 = \frac{Q^2}{g A_2} + \bar{z}_2 A_2$$

For trapezoidal channel, $\bar{z} = \frac{h}{6}(\frac{3b + 2sh}{b + sh})$