University of Asia Pacific
Department of Civil Engineering
Final Examination, Spring-2016
Program: B.Sc. Engg (3rd year 1st semester)

Course Title : Principles of Accounting **Course Code: ACN 301**
Time : 2 hrs. **Full marks : 50**

[Answer any four questions from the followings]

Q.1. Jaime Developers Ltd., that has a production division of hallow bricks, is currently producing 18,000 units per month, which is 80% of its production capacity. Variable manufacturing costs are currently $8.00 per unit. Fixed manufacturing costs are $56,000 per month. Jaime pays a 9% sales commission to its sales people, has $30,000 in fixed administrative expenses per month, and is averaging $360,000 in sales per month.

A special order received from a foreign company would enable Jaime Ltd. to operate at 100% capacity. The foreign company offered to pay 75% of Jaime's current selling price per unit. If the order is accepted, Jaime will have to spend an extra $2.00 per unit to package the product for overseas shipping. Also, Jaime Company would need to lease a new stamping machine to imprint the foreign company's logo on the product, at a monthly cost of $2,500. The special order would require a sales commission of $3,500.

INSTRUCTIONS:

a. Compute the number of units involved in the special order and the foreign company's offered price per unit. **(2.0)**
b. What is the manufacturing cost of producing one unit of Jaime's product for regular customers? **(3.0)**
c. Prepare an incremental analysis of the special order. Should management accept the order? **(5.5)**
d. What is the lowest price that Jaime could accept for the special order to earn net income of $1.20 per unit? **(2.0)**

Q.2. Theta Company is considering three capital expenditure projects. Relevant data for the projects are as follows:

Project	Investment	Annual Income	Life of the Project
22A	$240,000	$13,300	6 years
23A	270,000	21,000	9 years
24A	288,000	20,000	8 years

Annual income is constant over the life of the project. Each project is expected to have zero salvage value at the end of the project. Theta Company uses the straight-line method of depreciation.

INSTRUCTION:

If Theta Company's required rate of return is 11%, which projects are acceptable? **(12.5)**

Q.3. Lopez Corporation manufactures a single product. The standard cost per unit of product is as follows.

Direct materials—	2 pounds of plastic at $5 per pound	$10
Direct labor—	2 hours at $12 per hour	24
Variable manufacturing overhead	8	
Fixed manufacturing overhead	6	
Total standard cost per unit	$48	

P.T.O.

Actual costs for November in producing 9,700 units were as follows.

Direct materials (20,000 pounds)	$ 98,000
Direct labor (19,600 hours)	239,120
Variable overhead	79,100
Fixed overhead	59,000
Total manufacturing costs	$475,220

The purchasing department normally buys the quantities of raw materials that are expected to be used in production each month. Raw materials inventories, therefore, can be ignored.

INSTRUCTIONS:

A. Compute the followings and make comments:
   - Material price variance, where MPV= AQ(AP-SP)
   - Material quantity variance, where MQV= SP(AQ-SQ)
   - Labor price variance, where LPV= AH(AR-SR)
   - Labor quantity variance, where LQV=SR(AH-SH)

B. Comment on the reasons behind unfavorable variance, if any. **(12.5)**

Q.4. The following data has been taken from the records of Emaar Ltd. for the year ended December 31, 2015.

Raw Material, 1/1/15	$47,000	Factory Insurance	$7,400
Raw Material, 31/12/15	44,200	Factory Machinery-Depreciation	7,700
Finished Goods, 1/1/15	85,000	Factory Utilities	12,900
Finished Goods, 31/12/15	77,800	Office Utilities Expense	8,600
Work in process, 1/1/15	9,500	Sales	475,000
Work in process, 31/12/15	8,000	Sales discount	2,500
Direct labor	145,100	Plant Manager's Salary	30,000
Indirect labor	18,100	Factory Property Taxes	6,100
Cash	28,000	Raw material purchases	67,500
Accounts Receivable	27,000	Factory repairs	800

INSTRUCTIONS:

A. **Prepare a cost of goods manufactured schedule for Superior Development Company Ltd.for the year ended, December 31, 2015. (6.5)**

B. **Prepare an income statement for the year ended, December 31, 2015. (6.0)**

Q.5. The bank statement for Jose Orozco Company shows a balance per bank of **$4,150** on June 30, 2014. On this date the balance of cash per books is **$3,969.85.**

Items to be reconciled:

1) There were bank service charges for June of $25.
2) A bank memo stated that Bao Dais note for $900 plus interest earned $36; less bank collection fee $5.50 has been collected on June 26. No entry has been made on Orozco's book regarding this transaction.
3) **Deposits in transit:** June 30 deposit (received by bank on July 2). $2,890.
4) **Outstanding checks:** $2,136.05.
5) NSF check from J. R. Baron for $453.20.
6) **Book Errors:** A customer's check for $90 has been entered as $60 in the cash receipts journal by Orozco on June 15.

7) **Book Errors:** Check no. 742 in the amount **$491** had been entered in the cashbook as **$419**, and check no 747 in the amount **58.20** had been entered as **$582**. Both checks had been issued to **pay** for purchase of equipment.

INSTRUCTION:

Prepare a bank reconciliation statement for the month of April. (12.5)

Q.6. Wales Company sells small commercial spaces of a mall that sell for $3000 each. Each shop has similar floor space and facility. For the coming year, management expects fixed costs to total $200,000 and variable costs to be $2000 per unit.

INSTRUCTION:

(a) Compute the break-even point in dollars.
(b) Compute the margin of safety percentage assuming actual sales are $750,000.
(c) Compute the sales required in units to earn net income of $120,000.
(d) Due to tough market competition management at Wales is thinking of reducing the selling price to $2900 per commercial space. If the selling price is reduced, compute the sales required in units to earn the net income of $120,000. **(3+3+3+3.5)**

TABLE 2 Present Value of $1

$$PV = \frac{\$1}{(1+i)^n}$$

n/i	1.0%	1.5%	2.0%	2.5%	3.0%	3.5%	4.0%	4.5%	5.0%	5.5%	6.0%	7.0%	8.0%	9.0%	10.0%	11.0%	12.0%	20.0%
1	0.99010	0.98522	0.98039	0.97561	0.97087	0.96618	0.96154	0.95694	0.95238	0.94787	0.94340	0.93458	0.92593	0.91743	0.90909	0.90090	0.89286	0.83333
2	0.98030	0.97066	0.96117	0.95181	0.94260	0.93351	0.92456	0.91573	0.90703	0.89845	0.89000	0.87344	0.85734	0.84168	0.82645	0.81162	0.79719	0.69444
3	0.97059	0.95632	0.94232	0.92860	0.91514	0.90194	0.88900	0.87630	0.86384	0.85161	0.83962	0.81630	0.79383	0.77218	0.75131	0.73119	0.71178	0.57870
4	0.96098	0.94218	0.92385	0.90595	0.88849	0.87144	0.85480	0.83856	0.82270	0.80722	0.79209	0.76290	0.73503	0.70843	0.68301	0.65873	0.63552	0.48225
5	0.95147	0.92826	0.90573	0.88385	0.86261	0.84197	0.82193	0.80245	0.78353	0.76513	0.74726	0.71299	0.68058	0.64993	0.62092	0.59345	0.56743	0.40188
6	0.94205	0.91454	0.88797	0.86230	0.83748	0.81350	0.79031	0.76790	0.74622	0.72525	0.70496	0.66634	0.63017	0.59627	0.56447	0.53464	0.50663	0.33490
7	0.93272	0.90103	0.87056	0.84127	0.81309	0.78599	0.75992	0.73483	0.71068	0.68744	0.66506	0.62275	0.58349	0.54703	0.51316	0.48166	0.45235	0.27908
8	0.92348	0.88771	0.85349	0.82075	0.78941	0.75941	0.73069	0.70319	0.67684	0.65160	0.62741	0.58201	0.54027	0.50187	0.46651	0.43393	0.40388	0.23257
9	0.91434	0.87459	0.83676	0.80073	0.76642	0.73373	0.70259	0.67290	0.64461	0.61763	0.59190	0.54393	0.50025	0.46043	0.42410	0.39092	0.36061	0.19381
10	0.90529	0.86167	0.82035	0.78120	0.74409	0.70892	0.67556	0.64393	0.61391	0.58543	0.55839	0.50835	0.46319	0.42241	0.38554	0.35218	0.32197	0.16151
11	0.89632	0.84893	0.80426	0.76214	0.72242	0.68495	0.64958	0.61620	0.58468	0.55491	0.52679	0.47509	0.42888	0.38753	0.35049	0.31728	0.28748	0.13459
12	0.88745	0.83639	0.78849	0.74356	0.70138	0.66178	0.62460	0.58966	0.55684	0.52598	0.49697	0.44401	0.39711	0.35553	0.31863	0.28584	0.25668	0.11216
13	0.87866	0.82403	0.77303	0.72542	0.68095	0.63940	0.60057	0.56427	0.53032	0.49856	0.46884	0.41496	0.36770	0.32618	0.28966	0.25751	0.22917	0.09346
14	0.86996	0.81185	0.75788	0.70773	0.66112	0.61778	0.57748	0.53997	0.50507	0.47257	0.44230	0.38782	0.34046	0.29925	0.26333	0.23199	0.20462	0.07789
15	0.86135	0.79985	0.74301	0.69047	0.64186	0.59689	0.55526	0.51672	0.48102	0.44793	0.41727	0.36245	0.31524	0.27454	0.23939	0.20900	0.18270	0.06491
16	0.85282	0.78803	0.72845	0.67362	0.62317	0.57671	0.53391	0.49447	0.45811	0.42458	0.39365	0.33873	0.29189	0.25187	0.21763	0.18829	0.16312	0.05409
17	0.84438	0.77639	0.71416	0.65720	0.60502	0.55720	0.51337	0.47318	0.43630	0.40245	0.37136	0.31657	0.27027	0.23107	0.19784	0.16963	0.14564	0.04507
18	0.83602	0.76491	0.70016	0.64117	0.58739	0.53836	0.49363	0.45280	0.41552	0.38147	0.35034	0.29586	0.25025	0.21199	0.17986	0.15282	0.13004	0.03756
19	0.82774	0.75361	0.68643	0.62553	0.57029	0.52016	0.47464	0.43330	0.39573	0.36158	0.33051	0.27651	0.23171	0.19449	0.16351	0.13768	0.11611	0.03130
20	0.81954	0.74247	0.67297	0.61027	0.55368	0.50257	0.45639	0.41464	0.37689	0.34273	0.31180	0.25842	0.21455	0.17843	0.14864	0.12403	0.10367	0.02608
21	0.81143	0.73150	0.65978	0.59539	0.53755	0.48557	0.43883	0.39679	0.35894	0.32486	0.29416	0.24151	0.19866	0.16370	0.13513	0.11174	0.09256	0.02174
24	0.78757	0.69954	0.62172	0.55288	0.49193	0.43796	0.39012	0.34770	0.31007	0.27666	0.24698	0.19715	0.15770	0.12640	0.10153	0.08170	0.06588	0.01258
25	0.77977	0.68921	0.60953	0.53939	0.47761	0.42315	0.37512	0.33273	0.29530	0.26223	0.23300	0.18425	0.14602	0.11597	0.09230	0.07361	0.05882	0.01048
28	0.75684	0.65910	0.57437	0.50088	0.43708	0.38165	0.33348	0.29157	0.25509	0.22332	0.19563	0.15040	0.11591	0.08955	0.06934	0.05382	0.04187	0.00607
29	0.74934	0.64936	0.56311	0.48866	0.42435	0.36875	0.32065	0.27902	0.24295	0.21168	0.18456	0.14056	0.10733	0.08215	0.06304	0.04849	0.03738	0.00506
30	0.74192	0.63976	0.55207	0.47674	0.41199	0.35628	0.30832	0.26700	0.23138	0.20064	0.17411	0.13137	0.09938	0.07537	0.05731	0.04368	0.03338	0.00421
31	0.73458	0.63031	0.54125	0.46511	0.39999	0.34423	0.29646	0.25550	0.22036	0.19018	0.16425	0.12277	0.09202	0.06915	0.05210	0.03935	0.02980	0.00351
40	0.67165	0.55126	0.45289	0.37243	0.30656	0.25257	0.20829	0.17193	0.14205	0.11746	0.09722	0.06678	0.04603	0.03184	0.02209	0.01538	0.01075	0.00068

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

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

Section A

There are 5 questions. Answer any 4. **(4x13=52 marks)**

1. (a) Three direct shear tests were conducted on a dense sand for three different normal stresses of 80 kPa, 150 kPa and 330 kPa. Given that peak shear strengths are obtained 60 kPa, 112 kPa and 248 kPa and ultimate shear strengths are obtained 50 kPa, 94 kPa and 207 kPa. (i) Draw typical shear stress vs shear displacement curves (on the same plot) for the tests conducted under a constant normal stress. (ii) Plot the Mohr-Coulomb failure envelop for peak shear strength and ultimate shear strength. (iii) Calculate φ values of the soil samples both for peak and ultimate shear strengths. 6

   (b) Draw the typical shapes of compaction curves for the following soils: 3
   - (i) Moderately plastic soil
   - (ii) Highly plastic silt
   - (iii) Non-plastic silt

   (c) Consider a soil element existing at a depth of 4.5 m below the ground level within an 8 m thick deposit of homogeneous sand (γ = 16.5 kN/m^3 and φ = 30°). Draw Mohr circles (with co-ordinates on the x axis) for at-rest, active and passive earth pressure conditions, and also the Mohr-Coulomb failure envelope of this soil element. 4

2. (a) In an unconfined compressive strength test, a clay sample failed under an axial compressive force of 50 N. The axial deformation is 11 mm. The sample had a diameter of 38 mm and length 76 mm. Calculate unconfined compressive strength. Also draw the Mohr circle and the Mohr-Coulmb failure envelop. 3

   (b) Derive two expressions of settlement calculation for a normally consolidated clay, utilizing compression index (C_c) and coefficient of volume compressibility (m_v). 8

   (c) Derive the expression for obtaining corrected area, required for the interpretation of unconfined compression test results. 3

3. (a) In a laboratory test, a 2 cm thick soil sample takes 1 hour time to reach degree of consolidation of 35%. Find the time taken for a 5 m thick clay layer in field to reach 40% consolidation. Assume one way drainage in field condition. Calculate the coefficient of consolidation. 4

   (b) Compute OCR and pre-consolidation pressure at point A in each of the following timeline. 5

   (a) In the year 2007,
   $\sigma_{present}'$ = 320 kPa
   maximum pressure (in its life history till 2007) = 350 kPa

   (b) In 2010, due to partial demolition, $\sigma_{present}'$ = 250 kPa.

   (c) In January 2011, due to further demolition, $\sigma_{present}'$ = 210 kPa.

(d) In 2014, due to further expansion project, $\sigma_{present}' = 360$ kPa.

(c) Calculate the maximum dry unit weight of the soil, if it has bulk unit weight of 17.5 kN/m^3 at optimum moisture content. From a laboratory compaction test on a sample of the soil, the optimum moisture content is found to be 13.28%. Also calculate the dry unit weight at optimum moisture content for zero air void condition. 4

4. (a) Draw the typical shapes of the following distributions due to a point load acting on the ground level. Here, 'z' is the depth below the ground level and 'r' is the radial distance. 4
   (i) Horizontal stress distributions at z = 3 m and z = 6 m
   (ii) Vertical stress distributions for r = 1 m and r = 3 m

(b) Draw the typical relations between void ratio and effective stress in a semilogarithmic plot during loading, unloading and reloading paths. 3

(c) Determine compression index, swelling index, coefficient of compressibility, coefficient of volume compressibility, coefficient of permeability and coefficient of consolidation for the following records. 6
In a consolidation test, the pressure on a sample was increased from 250 to 480 kN/m^2. The void ratio after 100% consolidation under 250 kN/m^2 was 0.745 and that under 480 kN/m^2 was 0.52. The coefficient of permeability was 25×10^{-6} mm/s. A mathematical relation that you may need is given below.

$$k = c_v \, . \, m_v \, . \, \gamma_w$$

5. (a) Derive the expression for calculating 'k'value of coarse-grained soil from a laboratory test. 3

(b) Derive the following relation of total flow rate utilizing the concept of flownet: 5

$$q = k.H.\, N_f/N_d$$

All the symbols carry usual meaning.

(c) Derive the equation of zero air void line. Plot zero air void line in plain paper. 5

Section B

There are seven questions. Answer any 6. (6x8 = 48 marks)

6. Calculate saturated unit weights of the soil layers existing below the ground water table for the soil profile shown in Figure 1. Draw the effective stress, total stress and pore water pressure diagrams up to a depth of 14 m below the ground level.

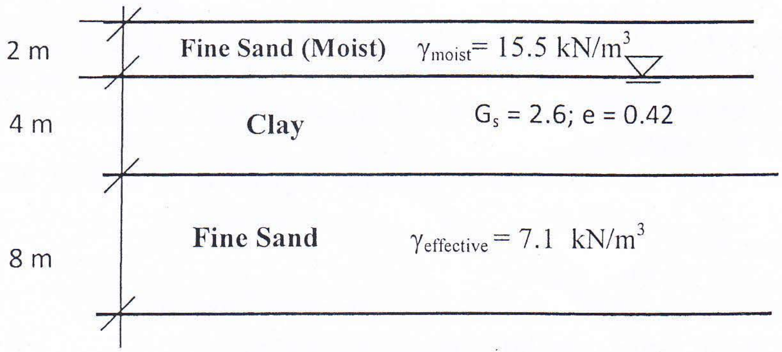


Figure 1

7. A rectangular flexible footing (2.5 m x 2 m) transmits a pressure of 225 kN/m^2. Determine the vertical stress at a depth of 5 m below the centroid (O) of the footing and the point E. AE = 1.5 m.

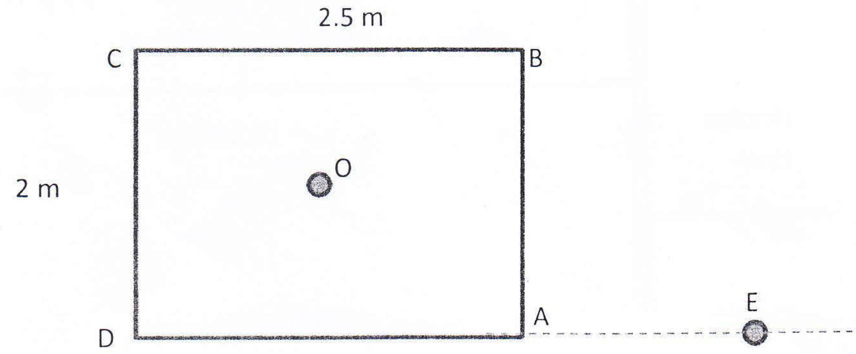


Figure 2

Table: Influence factor chart

n	m							
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8
0.3	0.01323	0.02585	0.03735	0.04742	0.05593	0.06294	0.06858	0.07308
0.4	0.01678	0.03280	0.04742	0.06024	0.07111	0.08009	0.08734	0.09314
0.6	0.02223	0.04348	0.06294	0.08009	0.09473	0.10688	0.11679	0.12474
0.8	0.02576	0.05042	0.07308	0.09314	0.11035	0.12474	0.13653	0.14607

8. Classify the following soils:

(a) The properties of a subgrade soil (A) are found as follows:
Percent finer than 0.075 mm = 8%
Percent finer than 0.425 mm = 28%
Percent finer than 0.6 mm = 30%
Percent finer than 1 mm =60 %
Percent finer than 4.75 mm = 90%
Effective size = 0.063 mm
Liquid limit = 52% & Plastic limit = 28%

(b) The properties of a subgrade soil (B) are found as follows:
Percent of soil material in the pan = 63%
60% of the total soil material having a diameter less than 4.75 mm
30% of the total soil material having a diameter less than 0.425 mm
10% of the total soil material having a diameter less than 0.2 mm
Liquid limit = 40% & Plastic limit = 20%

9. If the backfill soil pushes the retaining wall, find the magnitude of the lateral force (per unit width) on the retaining wall, shown in Figure 3. Consider up to the dredge line. The wall penetrates 2.5 m below the dredge

line. Calculate the change in active force if the cohesion of the top layer is 10 kPa. Also calculate the depth of tension crack.

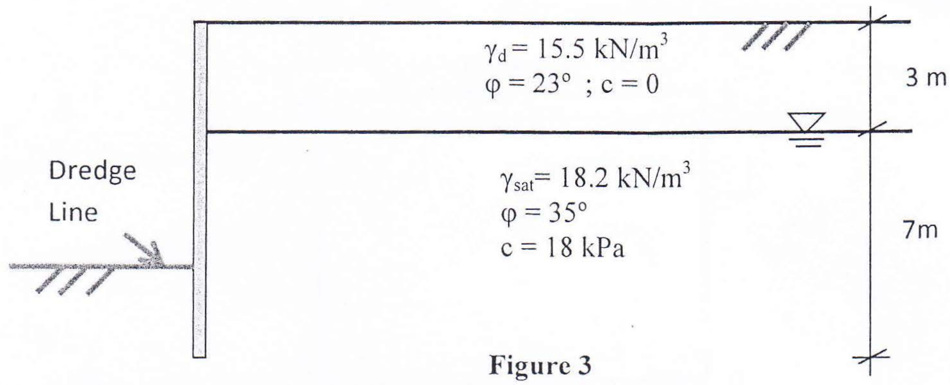


Figure 3

10. A consolidated undrained test was conducted on a clay sample and the following results were obtained.

Cell pressure (kN/m^2)	Deviator stress at failure (kN/m^2)	Pore water pressure at failure (kN/m^2)
200	118	110
400	240	200
600	350	315

Draw the Mohr circles (at failure) of all the tests. Determine the shear strength parameters with respect to total stress and effective stresses. Use graphical method.

11. A flownet is drawn, as shown in Figure 4, for calcularing seepage flow underneath the dam.
    (i) Find the volumetric flow rate of water under the dam. Assume the width of dam is 75 m and k = 5 *10^{-3} cm/s.
    (ii) Compute the uplift pressures (kPa) along the base of the dam at points A, B, C, D and E. Point A is just to the right of the sheet pile.
    (iii) Assuming points A through E are equally spaced along the base of the dam, compute the hydraulic gradient between points B and C. Assume the distance from A to E is 50 m.

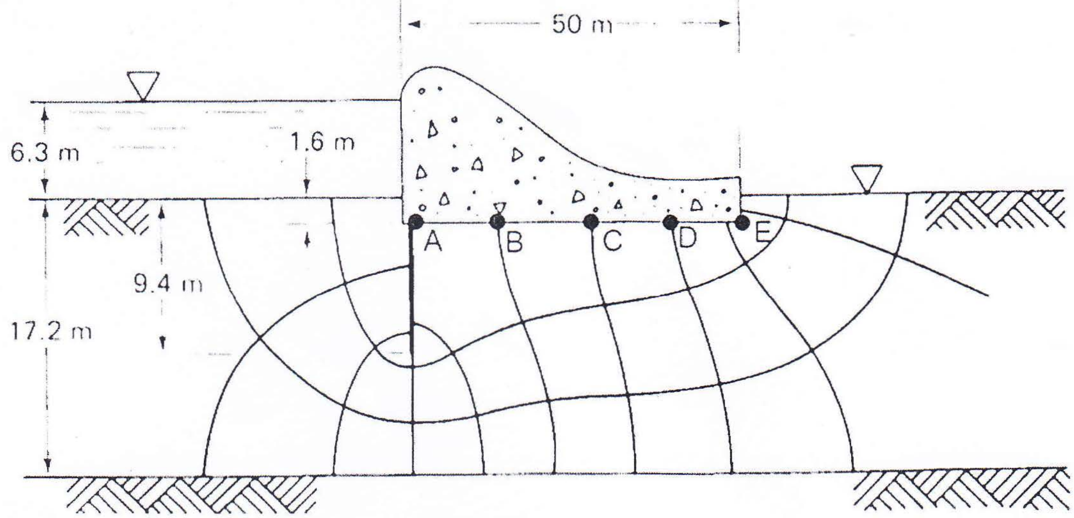


Figure 4

12. Calculate the primary consolidation settlement due to the stress transmitted to the soft clay layers from the foundation (as shown in Figure 5). The square footing size was 2 m x 2 m. The clay is normally consolidated. Given that: $Cc = 0.009(LL - 10)$

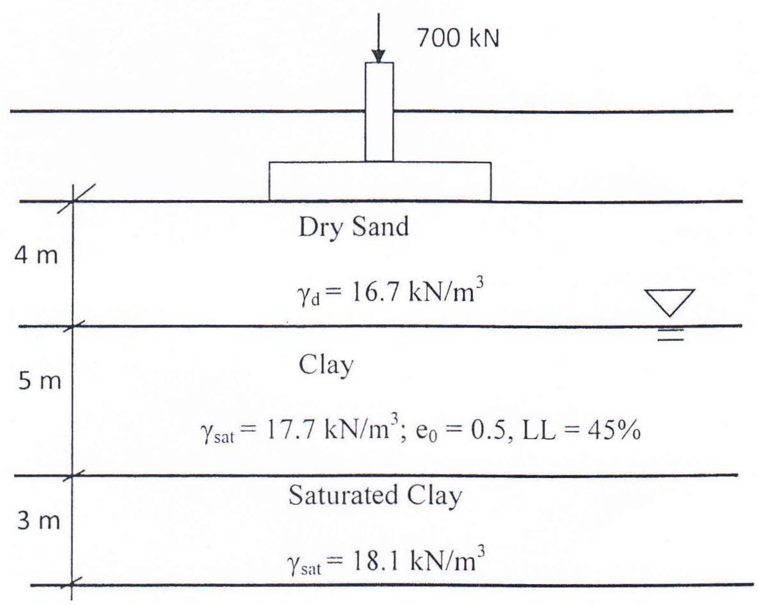


Figure 5

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

Course Title: Design of Concrete Structures I — Course Code: **CE 315 (A)**

Time: 3 hours — Full Marks: 70

Part A

[Answer any **three** (03) out of following **four** (04) questions]

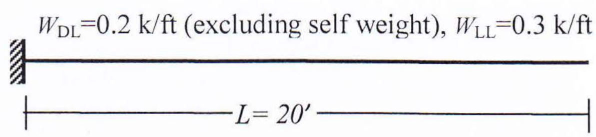
Full Marks: 30 [=3*(10)]

[Assume reasonable values for any missing data]

1. (a) Explain stress-strain behavior of a RC in different stages under flexure loads. [2.0]

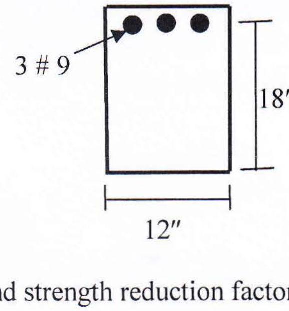
   (b) A rectangular column of 14″x18″ has 6#9 bars. Determine the axial compressive load if concrete undergoes a strain of 0.00025. Also determine the ratio of axial compressive strength and axial tensile strength of the column. Given that $f_c' = 4$ ksi, $f_y = 60$ ksi. [08]

2. Use WSD or USD Method to design the singly reinforced RC cantilever beam for working loads as shown below (for flexure only). Given that $f_c' = 4$ ksi, $f_y = 60$ ksi, $f_{call} = 1.8$ ksi, $f_{sall} = 24$ ksi. [10]



3. A rectangular beam must carry an unfactored dead load of 1.2 k/ft and an unfactored live load of 2.2 k/ft on a 18 ft simple span. The beam section is limited to 10″ width and 18″ height due to architectural reasons. Design the beam for flexure if $f_y = 60$ ksi and $f_c' = 3$ ksi. [10]

4. (a) Calculate the 'Cracking' negative moment capacity of the RC cross-sectional area shown below. Also calculate corresponding compressive stress in concrete and tensile stress in steel. Given that $f_y = 60$ ksi and $f_c' = 3$ ksi. [07]

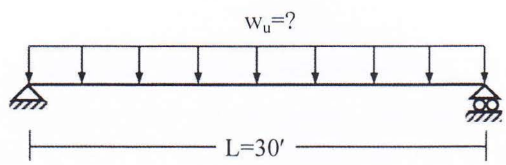


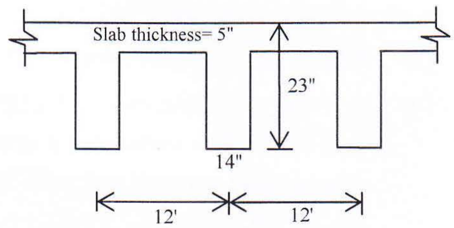
   (b) What are the load and strength reduction factors? Explain why they are used in USD. [03]

Part B

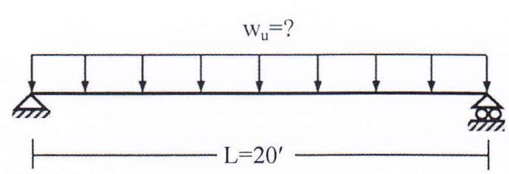
[Answer any **four** (04) out of following **Six** (06) questions]
Full Marks: 40 [=4*(10)]

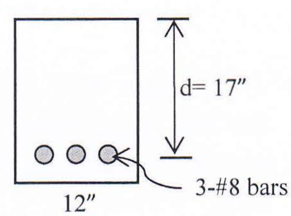
5. Use **USD method** to design the simply supported T-beam as shown in the following figures. In addition to self-weight, beam has to carry FF= 30 psf, PW= 40 psf and LL= 90 psf [Given f_y = 60 ksi and f_c' = 4 ksi]. (10)





6. (a) A simply supported beam of 20 ft span is reinforced with 3 - #8 bars as shown in the figures below. Calculate the maximum total distributed load (factored) $\mathbf{w_u}$ allowed on the beam **(use USD method)** when — (05)
   i. No web reinforcement is provided.
   ii. Only minimum web reinforcement is provided.

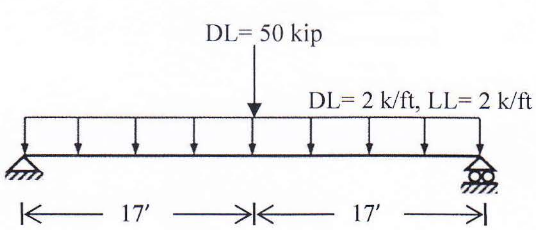


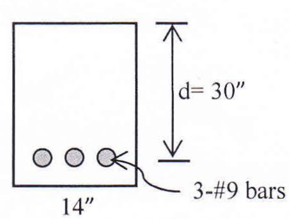


(b) Explain with example why critical section considered for shear design is computed at distance 'd' from support? (03)

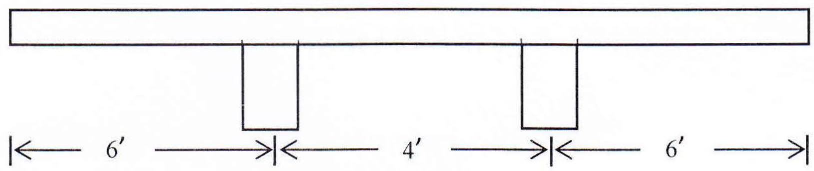
(c) Explain the terms Web-Shear Crack and Flexure-Shear Crack. (02)

7. A rectangular beam of 14"×32" section is reinforced with 3-#9 bars. Neglecting self weight of the beam design it for shear with loading and support conditions shown in the following figures. Given that f_y = 60 ksi and f_c' = 4 ksi. (10)



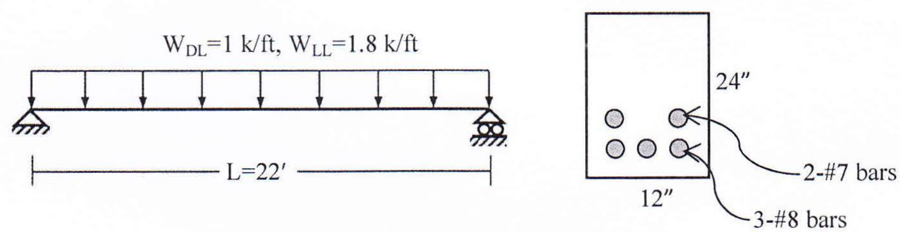


8. A RCC one way slab (simply-supported on 10″ brick walls) is to carry FF = 30 psf, PW = 50 psf, LL = 60 psf in addition to self-weight. Calculate critical moments and corresponding reinforcements of the slab. Given f_y = 60 ksi and f_c' = 3 ksi and use **USD or WSD method.** (10)



Slab Span

9. A section of 12"×24" is reinforced with 3-#8 and 2-#7 bars in two layers at the mid span of a 22 ft simply supported beam. Both #7 bars are cut off at 5 ft from supports. Check whether the bars are cut off at the appropriate location and adequate development length been provided in the beam according to ACI code. (10)
Given f_y = 50 ksi and f_c' = 3 ksi. Follow **USD method.**



Section at mid span

10. (a) Explain why flexural reinforcement bars are not cut off exactly where they are not theoretically required. (02)
 (b) List the factors influencing development length of deformed bars in tension. (02)
 (c) Explain why shear reinforcements are usually not provided in the design of RC slabs. (02)
 (d) Explain the effects of Web Reinforcement on the shear resistance of RC beams with necessary sketch. (04)

List of Useful Formulae for CE 315

Fundamentals

* Tensile strength of concrete $f_t' = 7.5\sqrt{f_c'}$ $E_s = 29 \times 10^6$ psi Modular ratio, $n = E_s/E_c$
* Within elastic limit, Flexural stress $f_c = M\,\bar{y}/\,\bar{I}$
* Steel Ratio $\rho_s = A_s/bd$ Minimum Steel Ratio $\rho_{min} = 3\sqrt{f_c'}/f_y$, often taken as $= 200/f_y$

$Ec = 57000\sqrt{f'c}$(psi)

WSD

* 'Cracked' elastic section Analysis: $k = -n\rho_s + \sqrt{[2n\rho_s + (n\rho_s)^2]}$ $j = 1 - k/3$

  Design: $k = n/(n + r)$ [where $r = f_{s(all)}/f_{c(all)}$] $j = 1 - k/3$
* Singly Reinforced Beam: $M_s = A_s f_s jd$ and $M_c = (f_c kj/2)\, bd^2 = R\, bd^2$
* Balanced Stress Steel Ratio $\rho_{sb} = k/2r$, when $M_s = M_c$
* Doubly Reinforced Beam: $M_1 = Rbd^2$, $A_{s1} = M_1/(f_s jd)$

  $M_2 = M - M_1$, $A_{s2} = M_2/[f_s(d-d')]$ and $A_s' = M_2/[f_s'(d-d')]$, where $f_s' = 2f_s(k-d'/d)/(1-k)$

USD

* $\alpha = 0.72 - 0.04(f_c' - 4)$, and $0.56 \le \alpha \le 0.72$, while $\beta = 0.425 - 0.025(f_c' - 4)$, and $0.325 \le \beta \le 0.425$

$$\rho_{max} = 0.85\beta_1 \frac{f_c'}{f_y} \frac{\epsilon_u}{\epsilon_u + 0.004} \qquad \rho_{max} = 0.85\beta_1 \frac{f_c'}{f_y} \frac{\epsilon_u}{\epsilon_u + 0.005}$$

* Design conditions: $M_u < \phi M_n$, $V_u < \phi V_n$, $P_u < \phi P_n$ [$\phi = 0.483 + 83.3\varepsilon_t$]

* Singly Reinforced Analysis: $a = A_s f_y/(0.85 f_c' b)$ $M_n = A_s f_y (d - a/2) = \rho_s f_y (1 - 0.59\, \rho_s f_y / f_c')\, bd^2$

  $c = a/\beta_1$
* Doubly Reinforced Analysis:

  $a = A_{s1} f_y/(0.85 f_c' b)$ [where $A_{s1} = A_s - A_{s2}$, and can be taken as $= A_s - A_s'$ to begin with]

  $A_{s2} = A_s' f_s'/f_y$, where $f_s' = E_s \times \varepsilon_1$

  from which A_{s1} can be revised as $= A_s - A_{s2}$ and a can also be revised accordingly

  $M_n = A_{s1} f_y (d - a/2) + A_{s2} f_y (d - d')$
* Design: Singly Reinforced if $M_n = \rho f_y (1 - 0.59\, \rho f_y / f_c')\, bd^2$

  $a = d\,[1 - \sqrt{\{1 - 2M_n/(f_c bd^2)\}}]$, $A_s = (0.85 f_c' ab)/f_y$

  Doubly Reinforced $M_1 = M_{max}$ $A_{s1} = \rho_{max}\, bd$,

  $M_2 = M_n - M_1$ $A_{s2} = M_2 / f_y (d - d')$

  $c = A_{s1} f_y/(\alpha f_c' b)$ $c/d' = \varepsilon_c/(\varepsilon_c + \varepsilon_t)$ $A_s' = M_2/\{f_s'(d - d')\}$
* T-beam b_{eff} is the minimum of $L/4$, $(16t + b_w)$, and (c/c distance between adjacent beams)

  L-beam b_{eff} is the minimum of $(L/12 + b_w)$, $(6t + b_w)$, and (b_w + half the clear distance between adjacent beams)
* WSD Analysis: $k = \{n\rho_s + (t/d)^2/2\}/\{n\rho_s + (t/d)\}$ where $\rho_s (= A_s/b_{eff} d)$ $z = (3kd - 2t)/(2kd - t)\, t/3$

  $M_s = A_s f_s (d - z)$ $M_c = f_c\{1 - t/(2kd)\}(b_{eff} t)(d - z)$

  Design can start with $A_s \cong M_s/\{f_s(d - t/2)\}$ and follow the same equations
* USD Analysis: $A_{sf} = 0.85 f_c' (b_{eff} - b_w)t / f_y$ $M_{nf} = A_{sf} f_y (d - t/2)$

  $A_{sw} = A_s - A_{sf}$ $a = A_{sw} f_y / (0.85 f_c' b_w)$ $M_{nw} = A_{sw} f_y (d - a/2)$ $\Big\}$ $\boxed{M_n = M_{nf} + M_{nw}}$

  Design: $A_{sf} = 0.85 f_c' (b_{eff} - b_w)t / f_y$, $M_{nf} = A_{sf} f_y (d - t/2)$; while A_{sw} can be obtained from $M_{nw} = M_n - M_{nf}$

Parameters of Development Length of Tension Bars

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	$A_{tr}f_{tr}/(1.5Sn)$

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

where the term $(c + K_{tr})/d_b$ is ≤ 2.5.

Simplified Equations for <u>Basic</u> Development Length (Tension)

Condition	$(c + K_{tr})/d_b$	l_d
Avoid pullout failure (Experimentally derived limit)	2.5	$0.03\,(f_y/\sqrt{f_c'})d_b$
* Clear cover and Clear spacing ≥ d_b + Code required stirrups * Clear cover and Clear spacing ≥ $2d_b$	1.5	$0.05\,(f_y/\sqrt{f_c'})d_b$ (≥ #7 Bars) $0.04\,(f_y/\sqrt{f_c'})d_b$ (≤ #6 Bars and deformed wires) (?)

<u>Bar Diameter and area</u>

d (No.)	2	3	4	5	6	7	8	9	10
A_s (in^2)	0.05	0.11	0.20	0.31	0.44	0.60	0.79	1.00	1.27
d (mm)	8	10	12	16	19	22	25	28	31
A_s (in^2)	0.08	0.12	0.18	0.31	0.44	0.59	0.76	0.95	1.17

<u>Shear Design</u>

* $S = A_v f_v d/(V_{ext} - V_{cr}) = A_v f_v/\{(v_{ext} - v_c) b\}$ for vertical stirrups, and

$S = A_v f_v d (\sin\alpha + \cos\alpha)/(V_{ext} - V_c) = A_v f_v (\sin\alpha + \cos\alpha)/\{(v_{ext} - v_c) b\}$ for inclined stirrups

Summary of ACI Shear Design Provisions (Vertical Stirrups)

	WSD	USD	Additional Provisions
Design Shear Force	V_w	$V_n = V_u/\phi$ [$\phi = 0.75$]	Calculated at d from Support face
Min^m Section Depth	$V_w/5\sqrt{f_c'}b_w$	$V_n/8\sqrt{f_c'}b_w$	$f_y \le 60$ ksi
Concrete Shear Strength v_c	$1.1\sqrt{f_c'}$	$2\sqrt{f'c}$	$\sqrt{f_c'} \le 100$ psi $Vd/M \le 1.0$
No Stirrup	$V_w \le V_c/2$	$V_n \le V_c/2$	
Max^m Spacing	d/2, 24″ $S = A_v f_y/50b_w$	d/2, 24″ $S = A_v f_y/50b_w$	To be halved if $V_n \ge 4\sqrt{f_c'}b_w d$ OR $V_w \ge 2\sqrt{f_c'}b_w d$ in WSD

Temperature and shrinkage reinforcement

Slabs with f_y = 40 or 50 ksi	0.0020
Slabs with f_y ≥ 60 ksi	$0.0018 \times (60/f_y) \ge 0.0014$

Minimum Thickness of One way Slab

Simply Supported	One end continuous	Both ends continuous	Cantilever
$L/20$	$L/24$	$L/28$	$L/10$

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

Course Title: Design of Concrete Structures I — Course Code: **CE 315 (B)**
Time: 3 hours — Full Marks: 70

Part-A

[Answer any **three (03)** out **four** (04) questions]
Full Marks: 30 [=3*10]
[Assume reasonable values for any missing data]

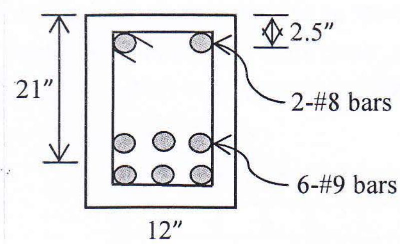
1. (a) A beam of 12″ width and 16″effective depth is reinforced with 4 - #9 bars in a single layer. Using **USD method** and f_y = 60 ksi , f_c' = 3 ksi [07]
   i. Check whether the strength of the beam is controlled by tension or compression according to ACI code.
   ii. Calculate design strength of the beam.

   (b) List fundamental assumptions of reinforced concrete behavoiur. [03]

2. (a) Use **WSD or USD Method** to design (for flexure only) a singly reinforced rectangular RC beam with 25 ft simply supported span and service dead load of 1.2 k/ft (excluding self-weight) and service live load of 1 k/ft [08]
   [Given that f_c' = 4 ksi, f_y = 50 ksi, f_c = 1.80 ksi, f_s = 20 ksi].

   (b) What are the load and strength reduction factors? [02]

3. Calculate design moment capacity of the doubly reinforced beam using **USD method** [Given f_c' = 5 ksi and f_y = 60 ksi]. [10]

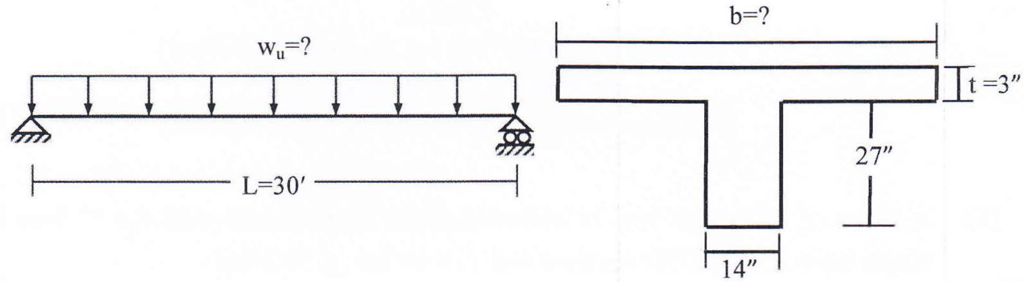


4. A rectangular beam has width (b) = 12″, depth (h) =23″ and effective depth (d) = 20″. It is reinforced with 3- #9 bars. Given f_c' = 4 ksi, f_y = 60 ksi and Modulus of rupture f_r = 400 psi [10]
   Calculate-
   i. Stresses at top fiber of concrete (f_c) and steel (f_s) at cracking moment.
   ii. Moment that will stress concrete up to f_c=0.45 f_c' and steel to f_s=0.4f_y.

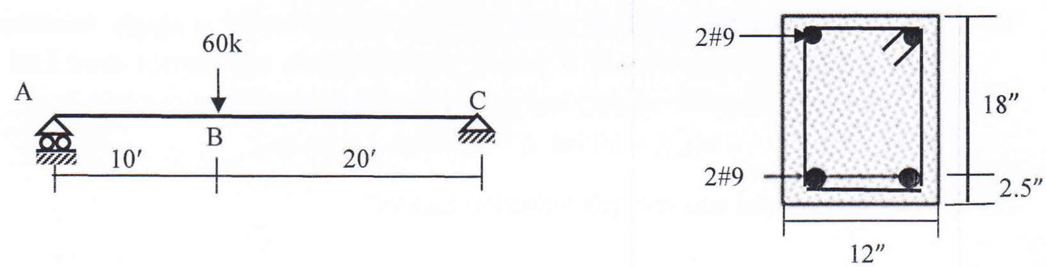
Part-B

[Answer any **four (04)** out of **Six** (06) questions]
Full Marks: 40 [=4*10]

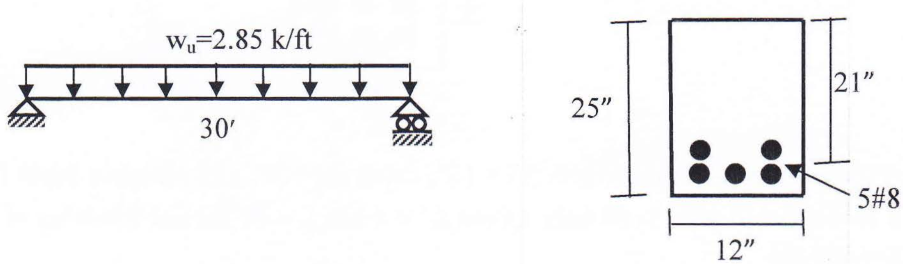
5. Use the USD Method to design the simply supported T-beam shown below to carry FF = 40 psf, PW = 60 psf and LL = 80 psf in addition to its self-weight. Distance between two adjacent beams is 15′ c/c [Given that f_y = 60 ksi and f_c' = 3 ksi]. [10]



6. Design the web reinforcement for the beam shown below using USD or WSD method. Neglect self weight of the beam [Given that f_c' = 3 ksi, f_y = 60 ksi, f_{call} = 1.35 ksi, f_{sall}= 24 ksi]. [10]



7. (a) A simply supported beam is designed (by USD method) for flexure only and steel requirement at mid-section is shown below. Do you think 2#8 bars can be cut off? If yes, determine the distance at which 2 #8 bars of top layer can be cut off . Given that, f_c' = 4 ksi, f_y = 60 ksi. Use ACI bar cut off specifications. [07]



(b) Mention the factors influencing development length of deformed bars in tension. [03]

8. A reinforced concrete one way 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 service floor finish load is 40 psf. Design the slab following the ACI provisions. Given that, $f_c' = 3$ ksi, $f_y = 60$ ksi. ACI moment coefficients are given as following: [10]

Exterior negative:	1/24
Mid-section Positive :	1/14
Interior Negative:	1/9

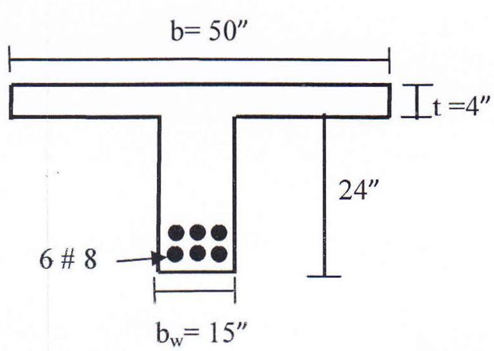
9. (a) Differentiate between development length in tension and development length in compression. [03]

(b) What are the conditions of a T-bean? Do you think that T-beam can be doubly reinforced? [04]

(c) Define one way slab. Mention the conditions required for a slab to be considered as one way slab. [03]

10. (a) Show location of critical section for shear design of different types of beams. [04]

(b) Determine the design positive moment capacity of the following T-beam. Given that, $f_c' = 4$ ksi, $f_y = 60$ ksi. [06]



List of Useful Formulae for CE 315

Fundamentals

* Tensile strength of concrete $f_t' = 7.5\sqrt{f_c'}$ $E_s = 29 \times 10^6$ psi Modular ratio, $n = E_s/E_c$

* Within elastic limit, Flexural stress $f_c = M\ \bar{y}/\ \bar{I}$

* Steel Ratio $\rho_s = A_s/bd$ Minimum Steel Ratio $\rho_{min} = 3\sqrt{f_c'}/f_y$, often taken as $= 200/f_y$

$Ec = 57000\sqrt{f'c}$(psi)

WSD

* 'Cracked' elastic section Analysis: $k = -n\rho_s + \sqrt{[2n\rho_s + (n\rho_s)^2]}$ $j = 1 - k/3$

Design: $k = n/(n + r)$ [where $r = f_{s(all)}/f_{c(all)}$] $j = 1 - k/3$

* Singly Reinforced Beam: $M_s = A_s f_s jd$ and $M_c = (f_c kj/2)\ bd^2 = R\ bd^2$

* Balanced Stress Steel Ratio $\rho_{sb} = k/2r$, when $M_s = M_c$

* Doubly Reinforced Beam: $M_1 = Rbd^2$, $A_{s1} = M_1/(f_s jd)$

$M_2 = M - M_1$, $A_{s2} = M_2/[f_s(d-d')]$ and $A_s' = M_2/[f_s'(d-d')]$, where $f_s' = 2f_s(k-d'/d)/(1-k)$

USD

* $\alpha = 0.72 - 0.04\ (f_c' - 4)$, and $0.56 \le \alpha \le 0.72$, while $\beta = 0.425 - 0.025\ (f_c' - 4)$, and $0.325 \le \beta \le 0.425$

$$\rho_{\max} = 0.85\beta_1 \frac{f_c'}{f_y} \frac{\epsilon_u}{\epsilon_u + 0.004} \qquad \rho_{\max} = 0.85\beta_1 \frac{f_c'}{f_y} \frac{\epsilon_u}{\epsilon_u + 0.005}$$

* Design conditions: $M_u < \phi M_n$, $V_u < \phi V_n$, $P_u < \phi P_n$ [$\phi = 0.483 + 83.3\varepsilon_t$]

* Singly Reinforced Analysis: $a = A_s f_y/(0.85 f_c'\ b)$ $M_n = A_s f_y (d - a/2) = \rho_s f_y (1 - 0.59\ \rho_s f_y / f_c')\ bd^2$

$c = a/\beta_1$

* Doubly Reinforced Analysis:

$a = A_{s1} f_y/(0.85 f_c'\ b)$ [where $A_{s1} = A_s - A_{s2}$, and can be taken as $= A_s - A_s'$ to begin with]

$A_{s2} = A_s'\ f_s'/f_y$, where $f_s' = E_s \times \varepsilon_t$

from which A_{s1} can be revised as $= A_s - A_{s2}$ and a can also be revised accordingly

$M_n = A_{s1} f_y (d - a/2) + A_{s2} f_y (d - d')$

* Design: Singly Reinforced if $M_n = \rho f_y (1 - 0.59\ \rho f_y/f_c')\ bd^2$

$a = d\ [1 - \sqrt{\{1 - 2M_n/(f_c bd^2)\}}]$, $A_s = (0.85 f_c'\ ab)/f_y$

Doubly Reinforced $M_1 = M_{max}$ $A_{s1} = \rho_{max}\ bd$,

$M_2 = M_n - M_1$ $A_{s2} = M_2 / f_y (d - d')$

$c = A_{s1} f_y/(\alpha f_c'\ b)$ $c/d' = \varepsilon_c/(\varepsilon_c + \varepsilon_t)$ $A_s' = M_2/\{f_s'(d - d')\}$

* T-beam b_{eff} is the minimum of L/4, $(16t + b_w)$, and (c/c distance between adjacent beams)

L-beam b_{eff} is the minimum of $(L/12 + b_w)$, $(6t + b_w)$, and (b_w + half the clear distance between adjacent beams)

* WSD Analysis: $k = \{n\rho_s + (t/d)^2/2\}/\{n\rho_s + (t/d)\}$ where $\rho_s (= A_s/b_{eff} d)$ $z = (3kd - 2t)/(2kd - t)\ t/3$

$M_s = A_s f_s (d - z)$ $M_c = f_c \{1 - t/(2kd)\}(b_{eff} t)(d - z)$

Design can start with $A_s \cong M_s/\{f_s(d - t/2)\}$ and follow the same equations

* USD Analysis: $A_{sf} = 0.85 f_c'\ (b_{eff} - b_w)t/f_y$ $M_{nf} = A_{sf} f_y (d - t/2)$

$A_{sw} = A_s - A_{sf}$ $a = A_{sw} f_y/(0.85 f_c'\ b_w)$ $M_{nw} = A_{sw} f_y (d - a/2)$ } $M_n = M_{nf} + M_{nw}$

Design: $A_{sf} = 0.85 f_c'\ (b_{eff} - b_w)t/f_y$, $M_{nf} = A_{sf} f_y (d - t/2)$; while A_{sw} can be obtained from $M_{nw} = M_n - M_{nf}$

: **Parameters of Development Length of Tension Bars**

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	$A_{tr}f_{tr}/(1.5Sn)$

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

where the term $(c + K_{tr})/d_b$ is ≤ 2.5.

Simplified Equations for Basic Development Length (Tension)

Condition	$(c + K_{tr})/d_b$	l_d
Avoid pullout failure (Experimentally derived limit)	2.5	$0.03\,(f_y/\sqrt{f_c'})d_b$
* Clear cover and Clear spacing ≥ d_b + Code required stirrups * Clear cover and Clear spacing ≥ $2d_b$	1.5	$0.05\,(f_y/\sqrt{f_c'})d_b$ (≥ #7 Bars) $0.04\,(f_y/\sqrt{f_c'})d_b$ (≤ #6 Bars and deformed wires) (?)

Bar Diameter and area

d (No.)	2	3	4	5	6	7	8	9	10
A_s (in^2)	0.05	0.11	0.20	0.31	0.44	0.60	0.79	1.00	1.27
d (mm)	8	10	12	16	19	22	25	28	31
A_s (in^2)	0.08	0.12	0.18	0.31	0.44	0.59	0.76	0.95	1.17

Shear Design

* $S = A_v f_v d/(V_{ext} - V_{cr}) = A_v f_v/\{(v_{ext} - v_c)\,b\}$ for vertical stirrups, and

$S = A_v f_v d\,(\sin\alpha + \cos\alpha)/(V_{ext} - V_c) = A_v f_v(\sin\alpha + \cos\alpha)/\{(v_{ext} - v_c)\,b\}$ for inclined stirrups

Summary of ACI Shear Design Provisions (Vertical Stirrups)

	WSD	USD	Additional Provisions
Design Shear Force	V_w	$V_n = V_u/\phi$ [$\phi = 0.75$]	Calculated at d from Support face
Min^m Section Depth	$V_w/5\sqrt{f_c'}b_w$	$V_n/8\sqrt{f_c'}b_w$	$f_y \le 60$ ksi
Concrete Shear Strength v_c	$1.1\sqrt{f_c'}$	$2\sqrt{f'c}$	$\sqrt{f_c'} \le 100$ psi $Vd/M \le 1.0$
No Stirrup	$V_w \le V_c/2$	$V_n \le V_c/2$	
Max^m Spacing	d/2, 24″ $S = A_v f_y/50b_w$	d/2, 24″ $S = A_v f_y/50b_w$	To be halved if $V_n \ge 4\sqrt{f_c'}b_w d$ OR $V_w \ge 2\sqrt{f_c'}b_w d$ in WSD

Temperature and shrinkage reinforcement

Slabs with f_y = 40 or 50 ksi	0.0020
Slabs with f_y ≥ 60 ksi	$0.0018 \times (60/f_y) \ge 0.0014$

Minimum Thickness of One way Slab

Simply Supported	One end continuous	Both ends continuous	Cantilever
$L/20$	$L/24$	$L/28$	$L/10$

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

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

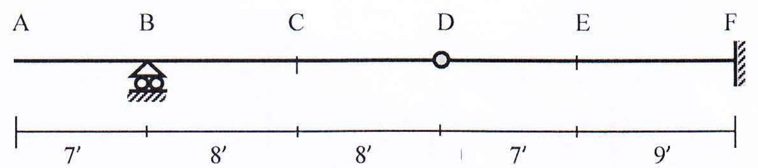
Part I

There are ***six (06)*** *questions in this part. Answer any* ***four (04)****.*
Assume any missing data reasonably.

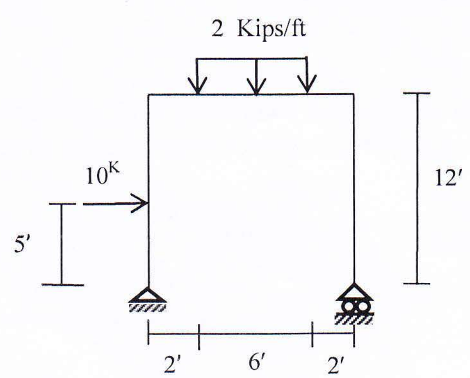
1. Draw influence lines for [10]

(a) Bending moment at C
(b) Bending moment at E
(c) Shear force at C
(d) Shear force at the left of B
(e) Vertical reaction at F

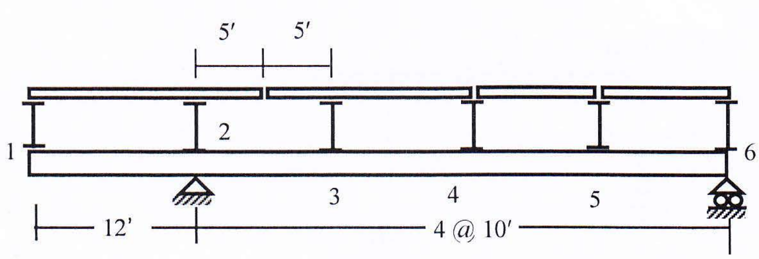
for the beam shown below



2. Draw the shear force and bending moment diagrams for the frame shown in figure below. [10]



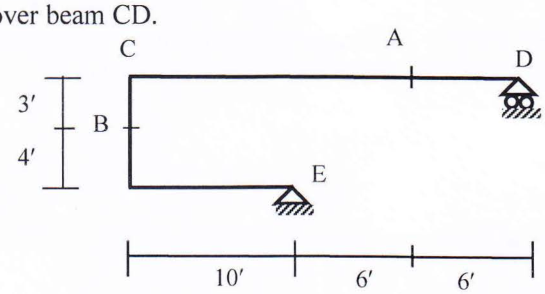
3. Draw influence lines for shear in panel 2-3, moment at panel point 3 of the girder with floor beam system shown in figure below. [10]



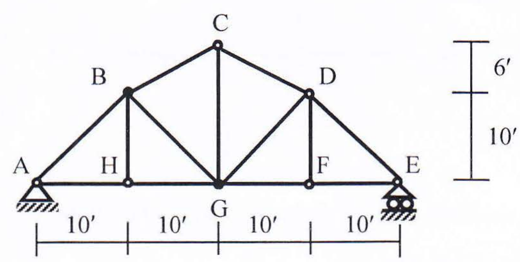
4. For the frame shown below draw influence lines for [10]

(a) Bending Moment at A
(b) Shear Force at B
(c) Vertical Reaction at E

Unit load moves over beam CD.

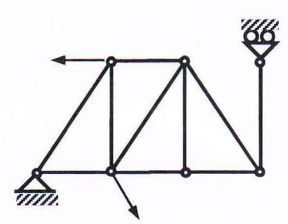


5. For the truss shown below, draw the influence lines for bar forces in member BG, BC and BH [10]
[Load moves over the bottom chord].



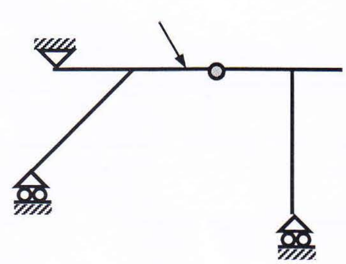
6. Determine whether the following structures are statically and geometrically stable or unstable and also calculate degree of static indeterminacy of each structure. [10]

(a)



(b)

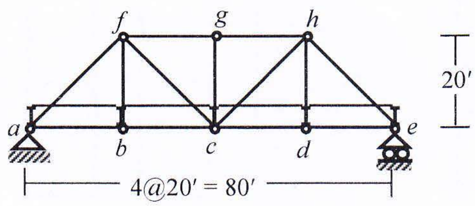
(c)



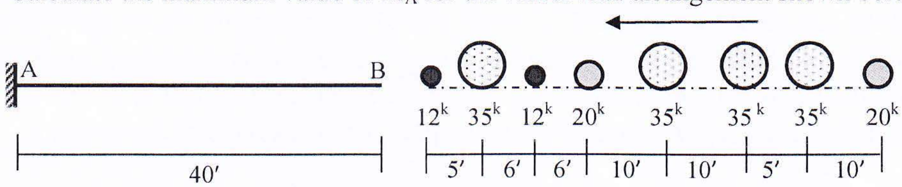
Part II

*There are **eight (08)** questions in this part. Answer any **six (06)**.*
Assume any missing data reasonably.

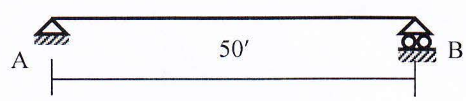
7. For the truss shown below, calculate the maximum tension and compression in members cf and dh due to a uniformly distributed dead load of 0.5 k/ft, a uniformly distributed live load of 1 k/ft and a concentrated live load of 10 k. [10]



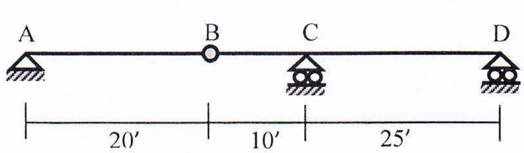
8. Calculate the maximum value of M_A for the wheel load arrangement shown below. [10]



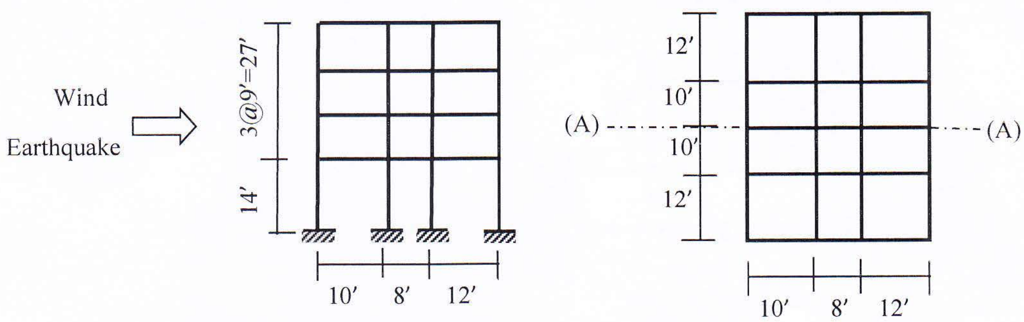
9. Calculate the maximum shear at 20′ right of support A for the following beam and the wheel load arrangement shown in Question 8. [10]



10. Calculate the maximum value of R_C for the wheel load arrangement shown in Question 8. [10]



11. Calculate the wind load at each storey of a four-storied concrete made office buildings (shown below) located at a flat terrain in Cox's Bazar (Basic wind speed = 260 kmph). Assume the structure to be subjected to Exposure C. [10]

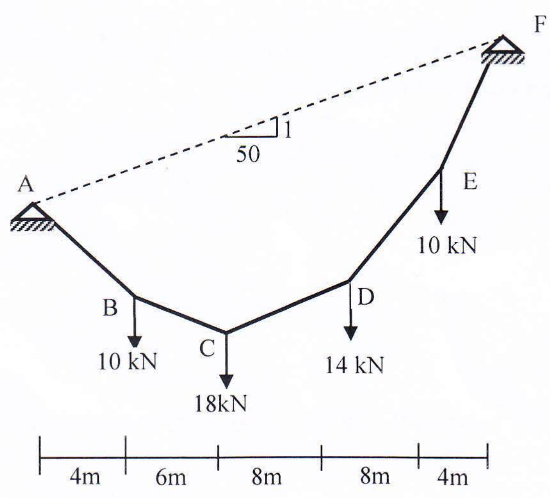


Side Elevation

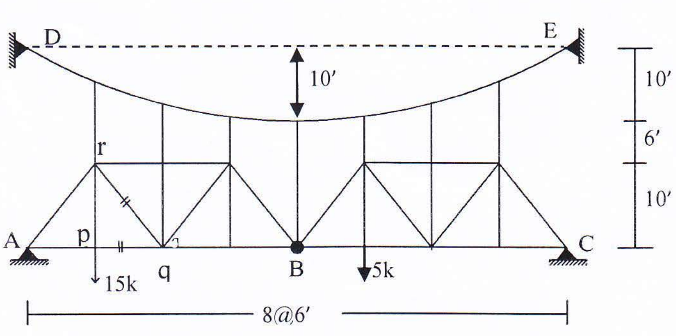
Plan

12. Calculate the seismic load at frame A of a four-storied concrete made industrial building located in Tangail (Zone 2). Assume the structure to be an Ordinary Moment Resisting Frame (OMRF) built on soil condition S_2, carrying a Dead Load of 170 lb/ft^2 and Live load of 60 lb/ft^2. Use the same figure for building plan and elevation as of *Question 11.* [10]

13. The cable shown below has supports at A and F. Maximum sag of the cable is 2m. Use the general cable theorem to calculate the sags at B and E. Also, calculate maximum cable tension. [10]



14. Calculate the force on each hanger and also determine the truss member force of *pq* and *rq* for the following cable suspension bridge. [10]



Annexure

Wind:

$q_z = 0.00256\ C_I\ C_z\ V_b^2$
$p_z = C_G\ C_t\ C_p\ q_z$

Category	C_I or 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_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

Overall **Pressure Co-efficient (C_P)**
for rectangular buildings with flat roof:

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

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:

$V = (ZIC/R)\ W$
$C = 1.25\ S/T^{2/3}$
$T = C_t\,(h_n)^{3/4}$
$F_j = (V - F_t)\ [w_j h_j / \sum w_i\, h_i]$

Soil Type	S
S_1	1
S_2	1.2
S_3	1.5
S_4	2

Response Modification Factor		R
Moment Resisting Frame System	SMRF (steel)	12
	SMRF (concrete)	12
	IMRF	8
	OMRF (steel)	6
	OMRF (concrete)	5

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

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

Wheel Load:

1. $\Delta R = \{(\sum P)\ d_1 + P'e\}/L - P_1$
2. $\Delta V = \{(\sum P)\ d_1 + P'e + P_0\, e_0\}/L - P_1$
3. $\Delta M = (P_2\, d_1 + P'e)\ (i/b) - (P_1\, d_1 + P_0\, e_0)\ (i/a)$
4. $M_{(Max)} = (\sum P/L)\ (L/2 - a/2)^2 - P\ b$

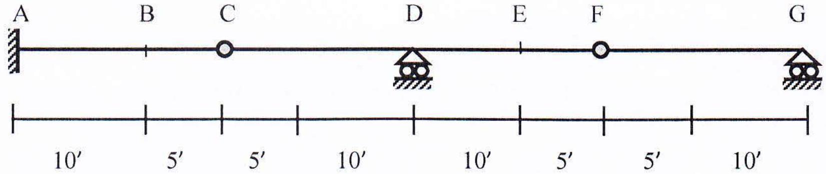
University of Asia Pacific
Department of Civil Engineering
Final Examination Spring 2016
Program: B. Sc. Engineering (Civil)

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

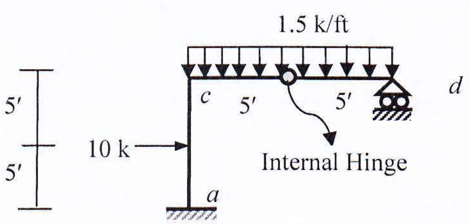
Part I

There are ***six (06)*** *questions in this part. Answer any* ***four (04)****.*
Assume any missing data reasonably.

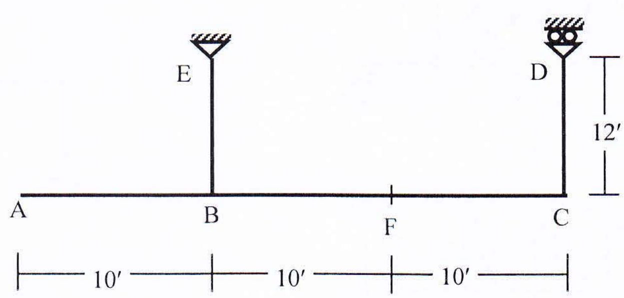
1. In the beam shown below (with internal hinge at C and F), draw the influence lines for (a) V_B, V_E (b) M_A, M_D (c) R_A, R_D [10]



2. Draw the AFD, SFD and BMD of the column ac shown below. [10]



3. Draw the influence lines of R_{EY}, V_F, and M_F for the frame shown below if unit load moves over beam AC. [10]



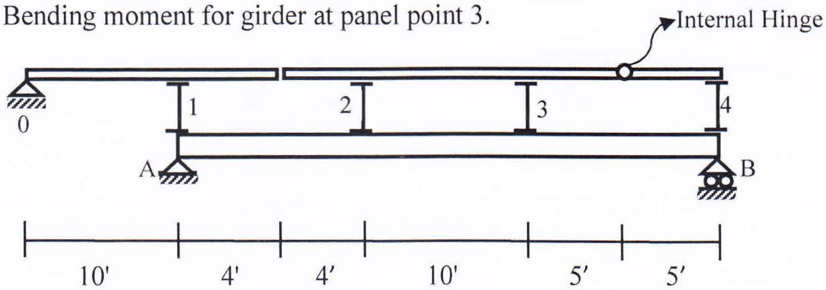
4. Girder AB supports a floor system as shown in the figure below. Draw the Influence line for [10]

(i) Floor beam reaction at panel point 1 and 2.

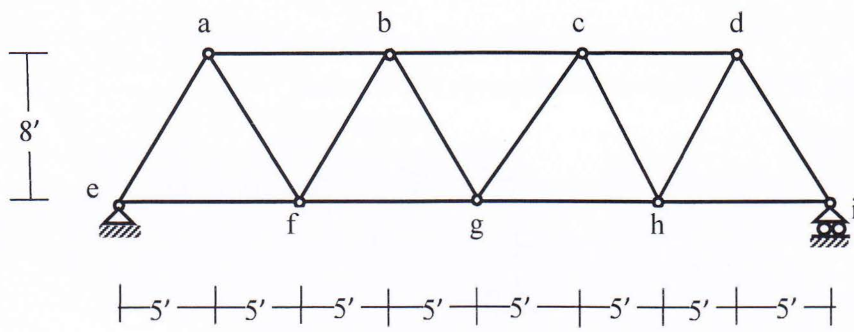
(ii) Support reaction at A.

(iii) Shear in panel 1-2.

(iv) Bending moment for girder at panel point 3.

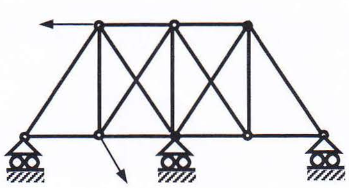


5. For the truss shown, draw influence lines for F_{ch}, F_{cd} and F_{gh}. Note, each bottom cord joint has a cross girder and unit load moves over the floor beam placed over the cross girders. [10]

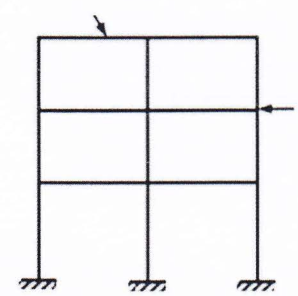


6. Determine the static/geometric stability and degree of statical indeterminacy of the following structures. [10]

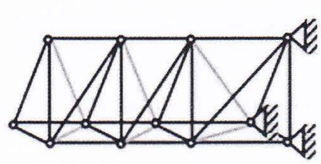
(a)



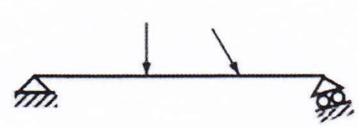
(b)



(c)



(d)

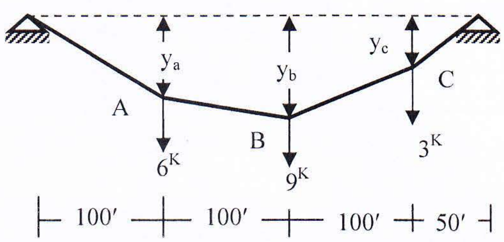


Part II

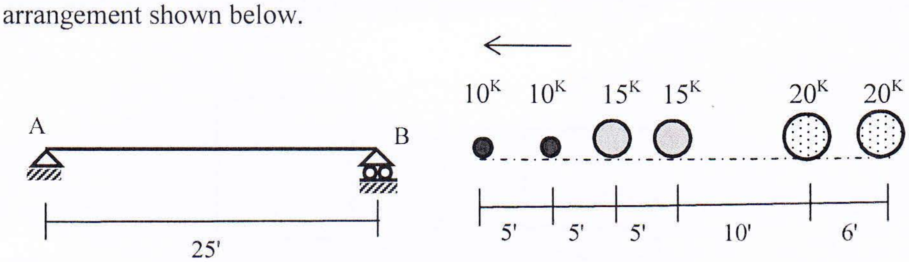
*There are **eight (08)** questions in this part. Answer any **six (06)**.*
Assume any missing data reasonably.

7. State and derive the General Cable Theorem. [10]

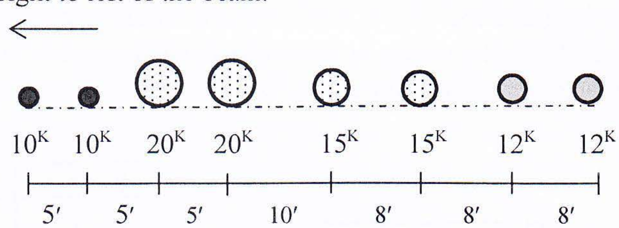
8. For the cable shown in figure below calculate cable sag at points A, B and C (i.e. y_a, y_b and y_c respectively). Given: Maximum Sag = 60′ [10]



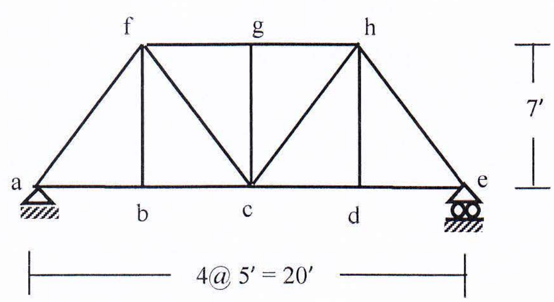
9. Calculate the maximum reaction at support A of a simply supported beam AB for the wheel loads arrangement shown below. [10]



10. Compute the maximum shear at a section 15′ from the left support of a simply supported beam of 55′ span due to series of moving loads as shown in figure below. Load moves on the span from right to left of the beam.

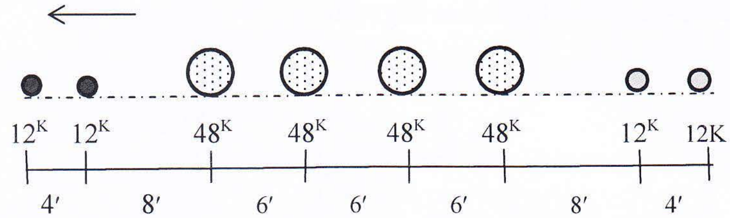


11. Compute the maximum tension and maximum compression of member fc in the parallel chord truss shown in figure below. [10]
Given: Moving uniform live load= 5 kips/ft
Roving concentrated live load = 50 kips.

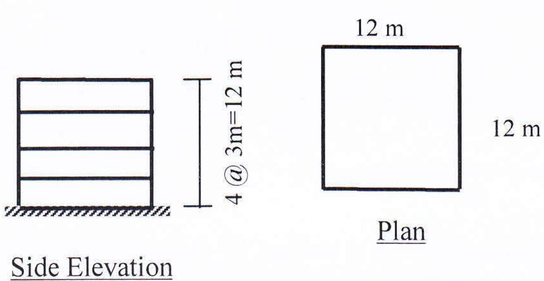


12. Using the loads shown in figure below calculate the maximum moment at the midpoint of a simply supported beam. [10]

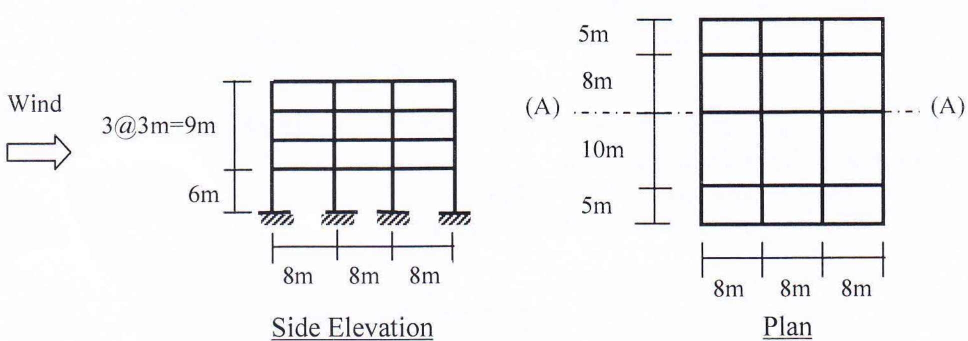
Given: Beam span= 50'



13. Calculate the seismic load using Equivalent Static Force Method at each story (i.e. at joints) of a four-storied concrete made Industrial building shown in figure below located in Noakhali (Zone 1). Assume the structure to be an Ordinary Moment Resisting Frame (OMRF), carrying a Dead Load including partition of 12 kN/m^2 and floor live load of 2 kN/m^2. [10]



14. Calculate the wind load at frame (A) of a four-storied concrete made residential building (shown below) located at a flat terrain in Savar (Basic wind speed = 210 Kmph). Assume the structure to be subjected to Exposure B. [10]



ANNEXURE

Earthquake

$$V = (ZIC/R)\ W$$
$$C = 1.25\ S/T^{2/3}$$
$$T = C_t\,(h_n)^{3/4}$$
$$F_x = (V - F_t)\ [w_x h_x / \sum w_i h_i]$$

Table: Site Coefficient for seismic Lateral forces

Soil Type	S
S_1	1
S_2	1.2
S_3	1.5
S_4	2

Table: Response Modification Coefficient for Structural Systems

Basic Structural System	Description of Lateral Force Resisting System	R
Moment Resisting Frame System	SMRF (steel)	12
	SMRF (concrete)	12
	IMRF	8
	OMRF (steel)	6
	OMRF (concrete)	5

C_t = 0.083 for steel moment resisting frames
= 0.073 for reinforced concrete moment resisting frames,
= 0.049 for all other structural systems

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

Seismic Dead Load

Seismic dead load W is the total dead load of a building or a structure including permanent partitions. A minimum of 25 percent of the floor live load should be considered.

Wind

$$q_z = C_C\ C_I\ C_z\ V_b^2$$
$$p_z = C_G\ C_p\ q_z$$

Table: Structure Importance Coefficient

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

Table: Combined height and Exposure Coefficient

Height, z (m)	Combined Height and Exposure Coefficient, C_z		
	Exp A	Exp B	Exp C
0~4.5	0.368	0.801	1.196
6.0	0.415	0.866	1.263
9.0	0.497	0.972	1.370
12.0	0.565	1.055	1.451
15.0	0.624	1.125	1.517
18.0	0.677	1.185	1.573
21.0	0.725	1.238	1.623
24.0	0.769	1.286	1.667
27.0	0.810	1.330	1.706
30.0	0.849	1.371	1.743

Table: Overall Pressure Co-efficient (C_P) for rectangular buildings with flat roof

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

Table: Gust Response Factors

Height z (m)	C_G (for non-slender structures)		
	Exp A	Exp B	Exp C
0~4.5	1.654	1.321	1.154
6.0	1.592	1.294	1.140
9.0	1.511	1.258	1.121
12.0	1.457	1.233	1.107
15.0	1.418	1.215	1.097
18.0	1.388	1.201	1.089
21.0	1.363	1.189	1.082
24.0	1.342	1.178	1.077
27.0	1.324	1.170	1.072
30.0	1.309	1.162	1.067

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

Course Title: Environmental Engineering I — Course Code: CE 331
Time: 3 hours — Full Marks: 100

There are Six (6) questions. Answer any Five (5).

1. (a) With neat diagrams explain the mechanisms of single and double acting reciprocating pumps. **[6]**
   (b) Enlist the advantages and disadvantages of centrifugal pumps. **[6]**
   (c) Design the transmission main and the pumping unit from the following data: **[8]**
   - Water supply rate = 50 gpcd
   - Estimated population = 75000
   - Ground R.L at the pump house = 102.50 ft
   - Treatment plant R.L = 196.00 ft
   - Velocity through pipe = 10 fps
   - Pumping time = 10 hrs. daily
   - Total length of pipe = 4000 ft
   - Friction factor = 0.01
   - Efficiency = 70%

2. (a) Write short notes on: (i) coarse screens; and (ii) fine screens that are often employed for water treatment. **[6]**
   (b) With appropriate diagrams explain DLVO coagulation theory. **[6]**
   (c) A clarifier is designed to have a surface overflow rate of 35.0 m^3/m^2.d. Compute the overall removal efficiencies with settling analyses data, illustrated in the following Table 1. The water temperature is 15°C, and particle specific gravity is 1.20. At 15°C the kinematic viscosity of water, μ is 0.00113kg/(s.m) and specific gravity of water ρ is 0.9990. **[8]**

Table 1. Results of settling test analyses.

Particle size mm	Weight fraction <size, %
0.10	12
0.08	25
0.07	40
0.06	75
0.05	85
0.04	94
0.02	99
0.01	100

Use the following equation:

$$F = (1 - y_0) + \frac{1}{V_s}\sum V \Delta y$$

3. (a) With necessary assumptions derive the following Stokes equation for the analyses of discrete particle settling in water column. **[10]**

$$v_t = \frac{g(\rho_p - \rho_\omega)d^2}{18\mu}$$

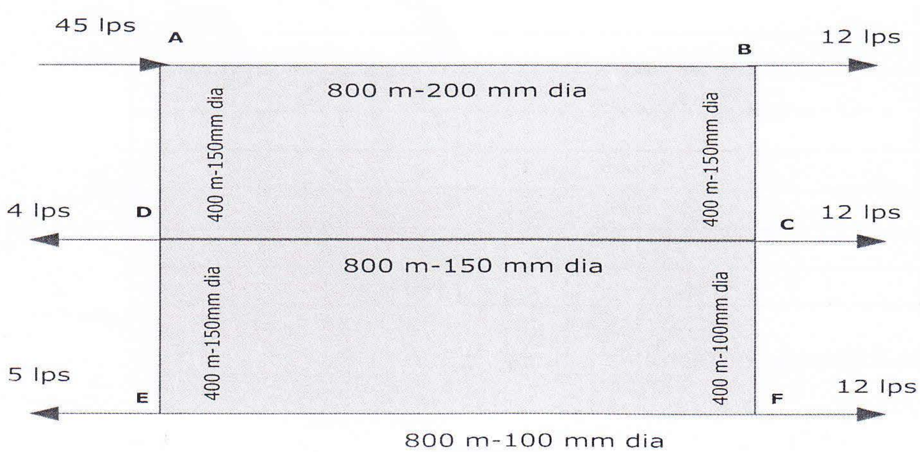
(b) Explain the following terms: (i) combined available residual chlorine; and (ii) free available residual chlorine. **[5]**

(c) What are the main differences between rapid and slow sand filters? **[5]**

4. Propose treatment flow diagrams for raw water sources (W_1, W_2) having characteristics shown in the following table; explain the steps of your proposed flow diagrams. The index in the parenthesis represents Bangladesh Standard (BS) value of a specific parameter. The following table also provides a comparison between the measured and BS values (of a specific parameter). Such comparison allows identification of the parameters that require treatment. '√' (in the Table) indicates that the parameter is within limit of BS, whereas 'X' represents that the parameter is beyond the limit of BS and requires treatment. **[20]**

Parameter	Unit	W_1		W_2	
		Value	Check with BS	Value	Check with BS
pH	---	6.3		7.4	
Turbidity (25)	NTU	1.5	√	105	X
Color (30)	TCU	1	√	34	X
CO_2 (15)	mg/L	75	X	4	√
Alkalinity, A	mg/L as $CaCO_3$	85	H<A, A is low	190	H<A
Hardness, H	mg/L as $CaCO_3$	70.83		50	
Fe (1)	mg/L	4.5	X	3	X
As (0.05)		0.3	X	0.02	√
BOD_5 (10)		2	√	15	X

5. (a) Calculate the flow in each of the pipe in the following looped pipe network by Hardy-Cross method. **[10]**



Use the following graph (Figure 1) if required.

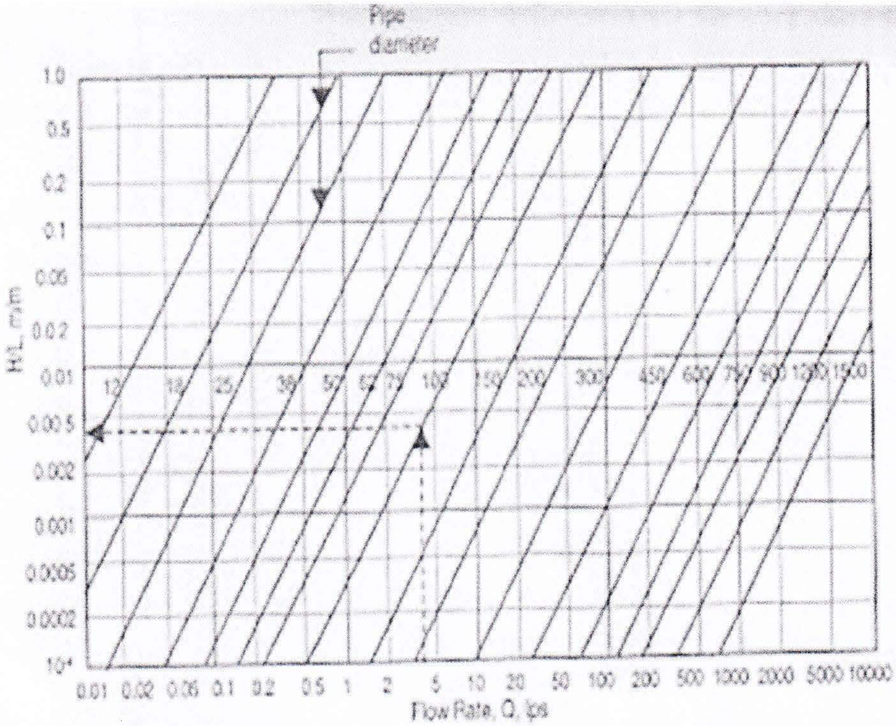


Figure 1. Determination of H/L.

Use the following equation.

$$\Delta = -\frac{\Sigma K Q_a^{\,x}}{x \Sigma K Q_a^{\,x-1}} = -\frac{\Sigma H}{x \Sigma \dfrac{H}{Q_a}}$$

(b) Enlist the advantages and disadvantages of: (i) gravity flow; and (ii) direct pumping systems. **[5]**

(c) Explain the causes and prevention methods of water hammer that might occur in the plumbing networks of a multi-storied building. **[5]**

6. (a) Explain the key steps to achieve water sustainability. **[5]**

(b) What are the physical factors that affect water loss rate and what are the steps to reduce such losses? **[5]**

(c) With engineering diagrams explain the mechanisms of: (i) infiltration well; and (ii) pond sand filters. **[10]**

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

Course Title: Open Channel Flow	Course Code: CE 361
Time- 3 hours	Full marks: 150

There are **FOUR** questions in each section. Answer any **THREE** from each section. *(25*6= 150)*

SECTION – A

1. (a) Obtain the relationship among Chezy's C, Darcy Weisbach friction factor C and Manning's n. (7)

(b) What are the assumptions in dealing with the compound cross sections when they are separated in subsections? Mention the considerations in the selection of a suitable channel reach for slope-area method. (6)

(c) Show that the best hydraulic triangular section is one-half of a square. (12)

2 (a) Define specific energy and total energy with expressions. (6)

(b) What do you mean by "Best Hydraulic Section"? Differentiate between "minimum permissible velocity" and non-erodible velocity". (2+4)

(c) A rectangular channel has a bottom width of 6m, α= 1.12 and n = 0.02. (13)

i) For h_n = 1m and Q = 11 m^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.

3. (a) Write down the momentum equation with all the expressions. (5)

(b) What are the factors affecting Manning's roughness factor n? (5)

(c) For a trapezoidal channel with b = 6 m and s = 2, compute the critical depth by either the method of bisection or Newton-Raphson method if Q = 14 m^3/s and α = 1. (15)

4. (a) Write down the classifications of open channel flow. (5)

(b) Derive an expression for the shear stress ratio (ratio between the shear on sloping sides and shear on the level bottom) in a trapezoidal channel. (7)

(c) By using Lacey's method, design a stable alluvial channel when d= 0.15 cm and the discharge is 25 m^3/s. (13)

SECTION – B

5 (a)	Derive Horton's formula to compute the equivalent roughness value for composite channel section.	(10)
(b)	An irrigation canal has to carry a discharge of 30 m^3/s through a coarse non-cohesive material having d_{50} = 2.5 cm, d_{75} = 3.0 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. Use Lane Method.	(15)
6 (a)	Draw the definition-sketch of hydraulic jump showing its features. Write down three applications of hydraulic jump.	(6)
(b)	Classify hydraulic jump based on Froude number.	(5)
(c)	Water flows at a velocity of 6.1 m/s and a depth of 1m 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	(14)
7 (a)	Draw the profiles for following channel conditions: (i) A mild slope followed by a steep slope, (ii) Mild slope followed by a free overfall, (iii) upstream and downstream of a sluice gate in a steep slope channel, (iv) A mild slope followed by a steeper mild slope	(8)
(b)	Which information are generally required for the computation of gradually varied flow profiles?	(3)
(c)	A 6 m wide rectangular channel has three reaches arranged serially. The bottom slope of the reaches are 0.016, 0.015 and 0.0064. The n values for the three reaches are 0.020, 0.015 and 0.025 respectively. For a discharge of 20 m^3/s, sketch the resulting flow profiles.	(14)
8 (a)	Mention practical occurrence (example) for each of the following profiles : i) M1 Profile, ii) M2 profile, iii) S2 profile, iv) M3Profile, v) S3 profile	(10)
(b)	A wide rectangular channel with C = 45 $m^{1/2}/s$ and S_0 = 0.0001 carries a discharge of 1.8 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 2.8 m by the Bresse method. (drawing required)	(15)

Given Formulae

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

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

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

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

Formula for Lacey's Method:

$$f_s = 1.76\sqrt{d}$$

$$s_0 = \frac{f^{5/3}}{3340 Q^{1/6}}$$

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

$$P = 4.75\sqrt{Q}$$

Lane Method: $\tau_b = 0.40\, d_{75}$

$$K = \frac{\tau_s}{\tau_b} = \sqrt{1 - \frac{sin^2\phi}{sin^2\Psi}}$$

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

For Hydraulic Jump:

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

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

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

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

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

$$F_2 = \frac{Q^2}{gA_2} + \bar{z}_2 A_2$$

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

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