L-3/T-1/CE **Date : 02/11/2019**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B. Sc. Engineering Examinations 2018-2019

Sub : **CE 301** (Professional Practice and Communication)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Question No. 4 is **Compulsory**. Answer Any **TWO** from Question 1 to 3.

1\. (a) What are the various methods available for procurement of intellectual services? Describe the suitability of each method. **(25)**

(b) A consultant is to be selected using QCBS method for design of Airport Infrastructures. The qualifying marks is 75% for technical proposal. The weightage for technical and financial proposals are 90% and 10% respectively.

After evaluation of technical proposals received following results are known:

Technical Scores:

Firm	A	B	C	D
Technical Score (T) %	80	70	90	76

After opening of financial proposals, the following figures are obtained:

Firm	A	B	C	D
Financial Offer Value (Tk) In lakh	100	-	140	110

Prepare the ranking of the firms. **(10)**

2\. (a) For the procurement of twenty storied building construction work with an estimated cost of 80 crore taka, the project duration is four years. It is planned to have a minimum billing amount is 10%. Prepare the Tender Data Sheet (TDS) for this project for the following items: **(25)**

(i) Tender Security (ii) Specific Experiences in terms of project size and work value (iii) Annual Construction Turnover (iv) Liquid Asset.

(b) What contract provision will apply, if the Contractor delays the work without a reasonable ground? Explain how this provision is applied? **(10)**

3\. (a) Write the specification of brick work considering all aspects of material quality, workmanship, measurement and payment. **(20)**

(b) Prepare a BoQ, in a standard format, for brick work of 250 mm thick and 50 m^3 of work volume. **(15)**

Contd P/2

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4. (a) Show diagrammatically the preparation for a career in Civil engineering by ASCE. **(17)**

   (b) Discuss briefly the five basic characteristics of a profession. **(18)**

SECTION – B

There are **FOUR** questions in this section.

Answer either **5(a)** or **5(b)**. Question **6**, **7** and **8** are **Compulsory**.

5. Explain in your own words what is the Engineer supposed to do in the following cases (as per ASCE code of ethics lecture-note given to you): **(15)**

   5(a) (i) conflict of interest

   (ii) confidential information

   (iii) undertaking engineering assignments

   (iv) regarding public health, safety and welfare

   (v) in all professional relations or professional matters.

   OR

   5(b) (i) competing with other engineers

   (ii) accepting compensation

   (iii) interchanging information and experience

   (iv) express opinion on engineering subject

   (v) avoiding type of conduct or practice.

6. (a) Define communication and briefly describe the process of human communication. Name (without describing) the basic communication skills and the traits of an effective communicator. **(17)**

   (b) Name three broad categories of formal communication channels. Describe three types of internal operational. **(18)**

7. (a) Show diagrammatically the following: **(10)**

   (i) Scope-schedule-budget relationship

   (ii) Various stages of a project.

   (b) Briefly describe the various project characteristics. **(10)**

8. (a) Define contracts. Briefly describe the terms used to categorize contracts. For a contract to be binding what are six elements that must be present. **(17)**

   (b) Briefly describe the various types of project delivery systems. **(18)**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B. Sc. Engineering Examinations 2018-2019

Sub : **CE 311** (Structural Analysis and Design I)

Full Marks : 280 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **SEVEN** questions in this section. Answer Q. No. 7 and any **FOUR** from the rest.

1. For the beam shown in Fig. 1, develop influence line diagram for (i) Reaction at C (ii) Moment at B (iii) Shear just right of C (iv) Shear just left of E. **(28)**

2. Compute maximum shear at quarter point of a simply supported beam of 60 ft due to the wheel loads shown in Fig. 2. **(28)**

3. Determine maximum moment at one-third point of a simply supported beam of 60 ft due to the wheel loads shown in Fig. 2. **(28)**

4. The member AC of the truss shown in Fig. 3 is fabricated 1 inch longer than specified. After fabrication of the truss, the temperature drops by 40° F on a cold day of the winter. Calculate vertical deflection at joint C of the truss due to misfit and drop of temperature. Given: AE is constant. Thermal expansion coefficient, $\alpha = \dfrac{1}{150{,}000}$ per °F. Use virtual work method. **(28)**

5. Using method of virtual work, calculate vertical deflection of point C of the beam shown in Fig. 4. Given: E = 29000 ksi, I = 500 in^4. **(28)**

6. Calculate rotation of joint A of the frame shown in Fig. 5. Given: E = 29000 ksi and I = 800 in^4. Consider bending strain energy only. **(28)**

7. **(Q. No. 7 is COMPULSORY)**

   Estimate the earthquake base shear and storey shear forces at each level of a 21 m high 7 storied office building located in Sylhet. The structural system is SMRF and each storey height is 3 m with a plan dimension 30×20 m. The soil type is S4. Given: Dead load = 5 kN/m^2, partition wall load = 5 kN/m^2, Z = 0.25, I = 1.0, R = 12, S = 2.0 and C_t = 0.083. Notations convey usual meaning. Use equivalent static force method of BNBC. **(28)**

Contd P/2

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SECTION – B

There are **SEVEN** questions in this Section. Answer any **FIVE**.

8. Draw shear force diagram, bending moment diagram and axial force diagram of the beams and columns of the multi-storied building frames loaded as shown in Figure 6 (Use Portal Method). **(28)**

9. (a) Using Cantilever Method draw shear force diagram and bending moment diagrams for the column ADGJ and girder GHI of the multi-storied building frame loaded as shown in Figure 7. Relative column cross-sectional areas are given beside the columns. **(28)**

10. Draw shear force diagram and bending moment diagram of the column ABC of the Mill Bent shown in Figure 8. Also find the bar force in the knee bracing BG and EK. **(28)**

11. Analyze the suspension bridge as shown in Figure-9. Draw shear force and bending moment diagram for the stiffening girder of the suspension bridge. Also compute maximum tension in the cable. **(28)**

12. Check the static determinacy of the frame shown in Figure-10. Draw the shear force and bending moment diagrams for the frame. Given shear at E = – 16 kips. **(28)**

13. Check the static determinacy of the arch structure shown in Figure-11. Determine the reactions at A & D and the tension in the rod AD for the loading condition as shown, Also calculate the internal moments at point F & G. **(28)**

14. Check the static determinacy of the frame as shown in Figure-12. Draw the axial force diagram, shear force diagram and bending moment diagram of the beam BCD of the frame. C is an internal hinge. **(28)**

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contd..... P/3

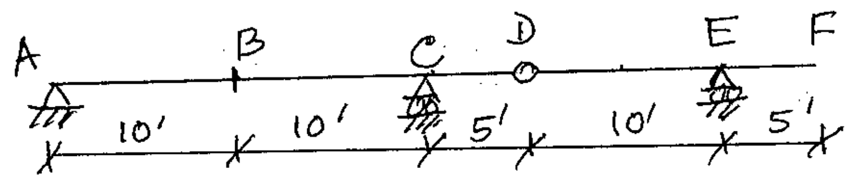

Fig. 1

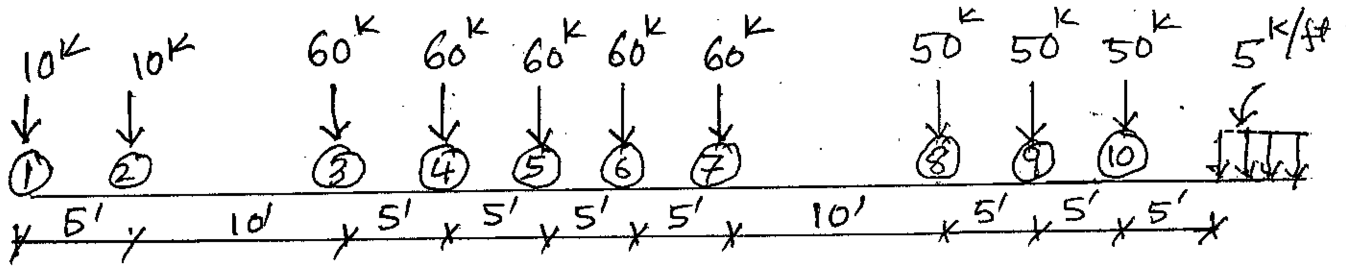

Fig. 2

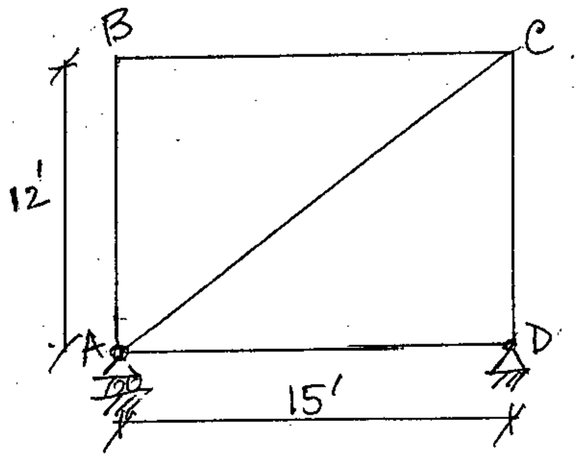

Fig. 3

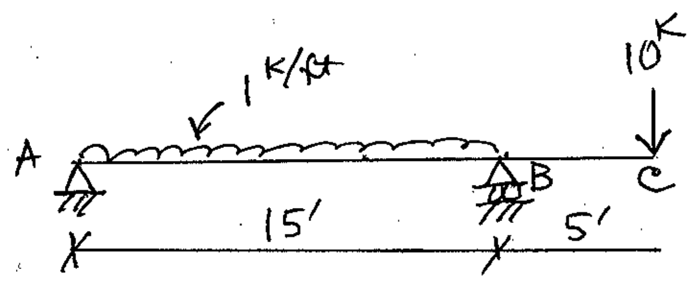

Fig. 4

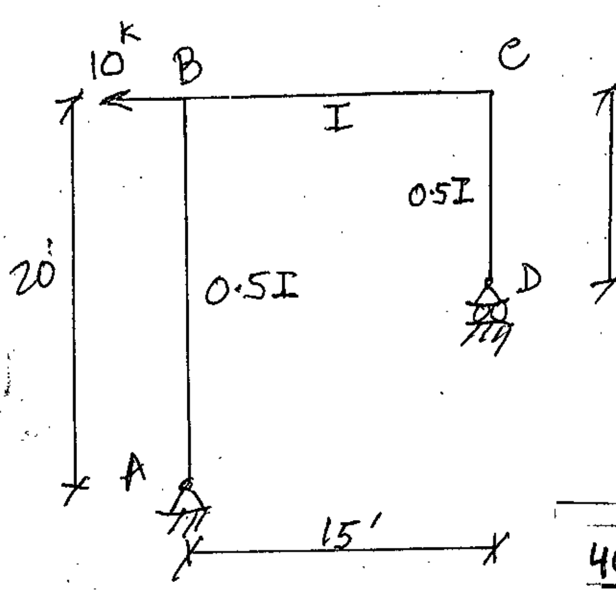

Fig. 5

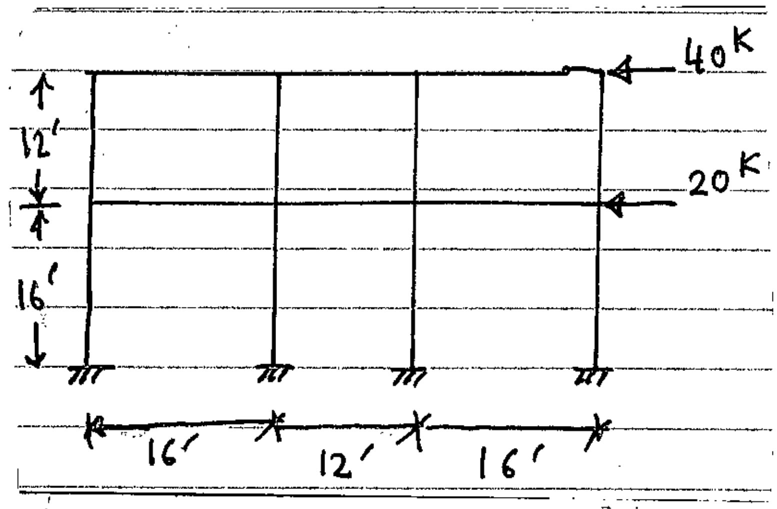

Fig. 6

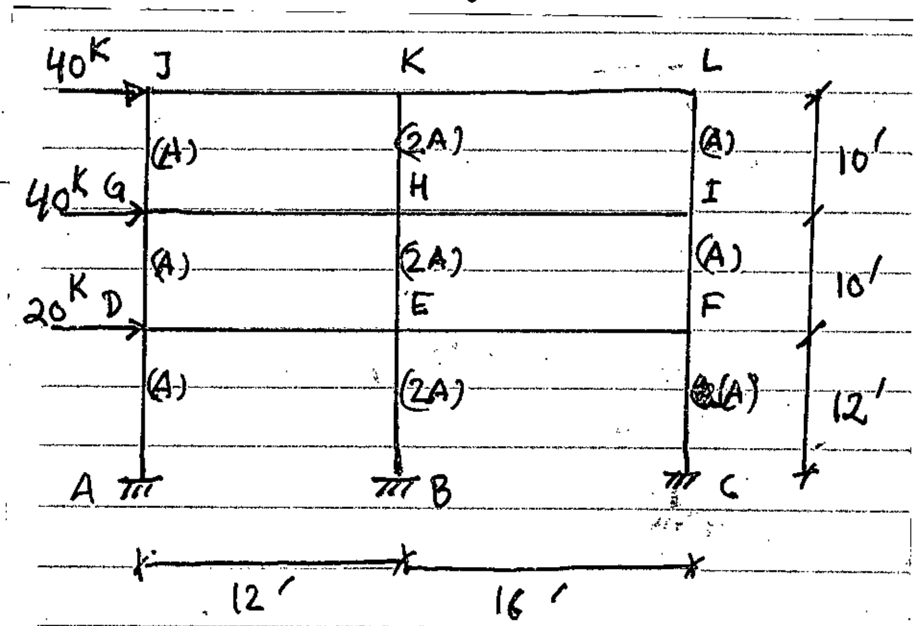

Fig. 7

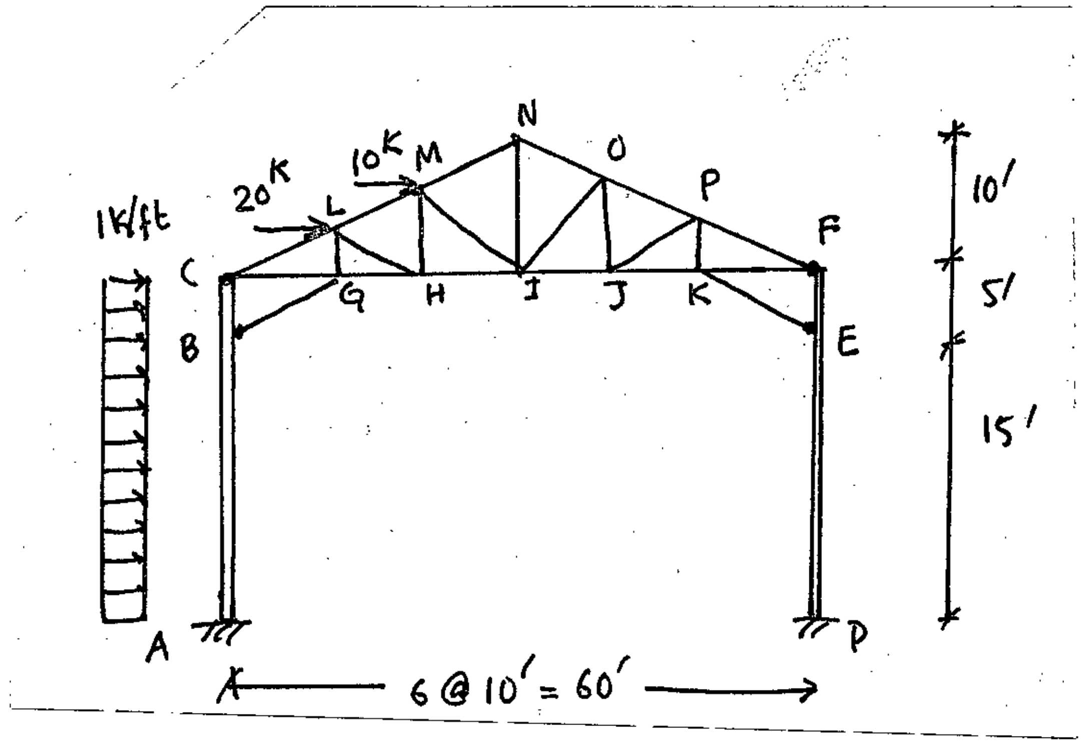

Fig. 8

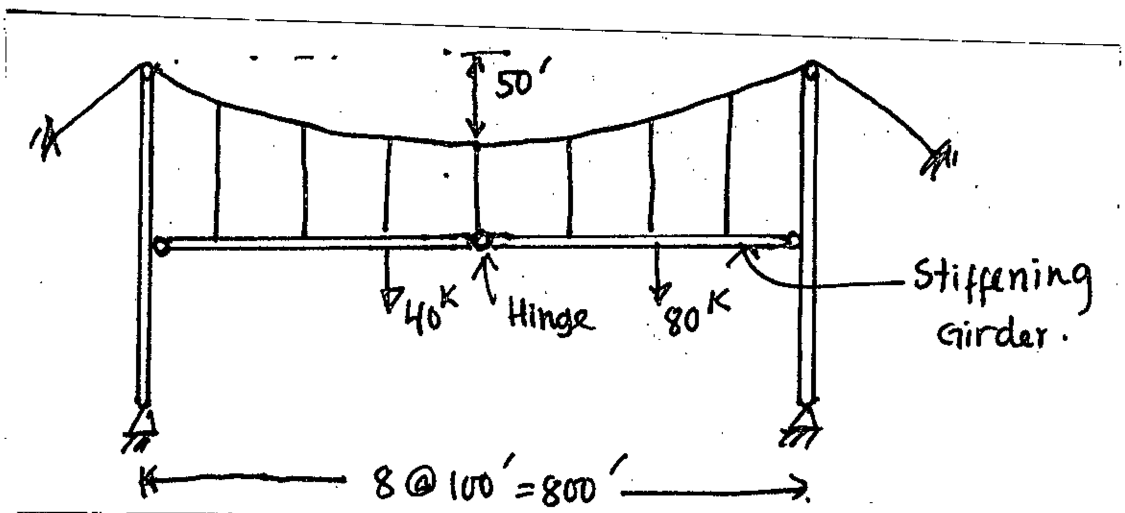

Fig. 9

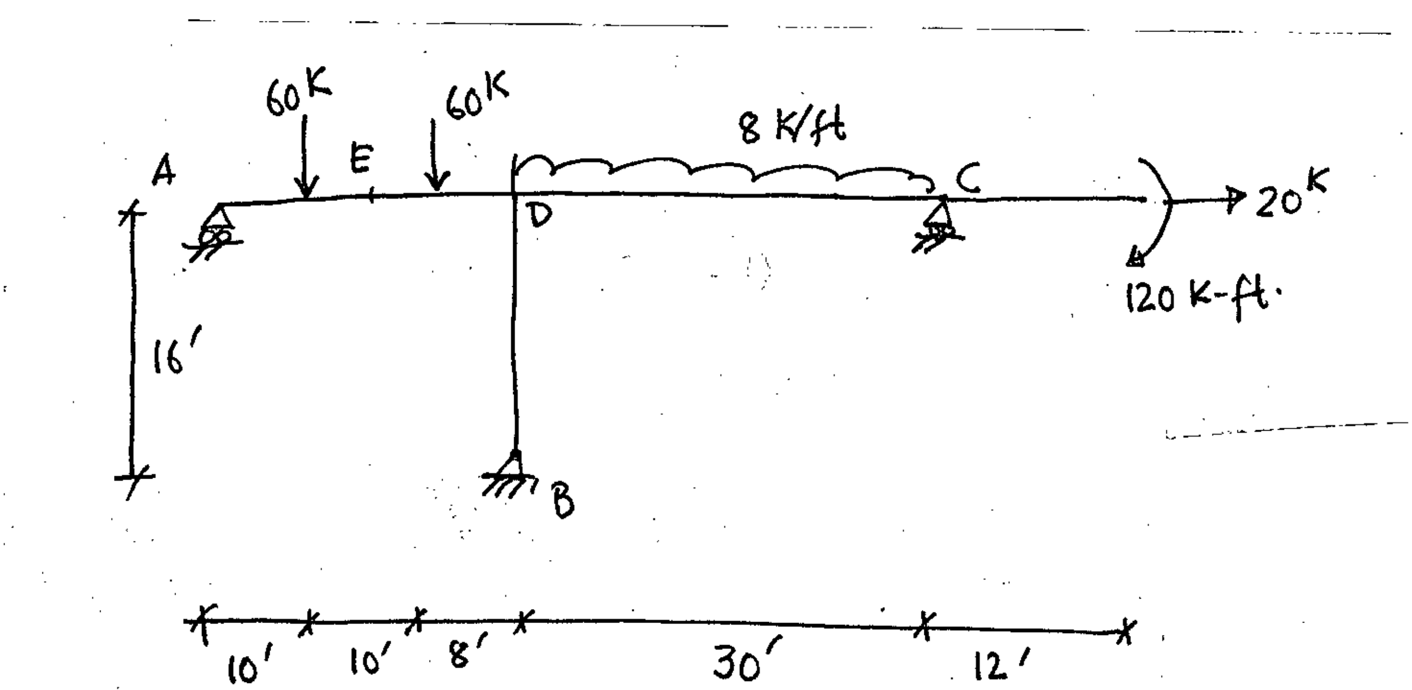

Fig. 10

Contd.... P/5

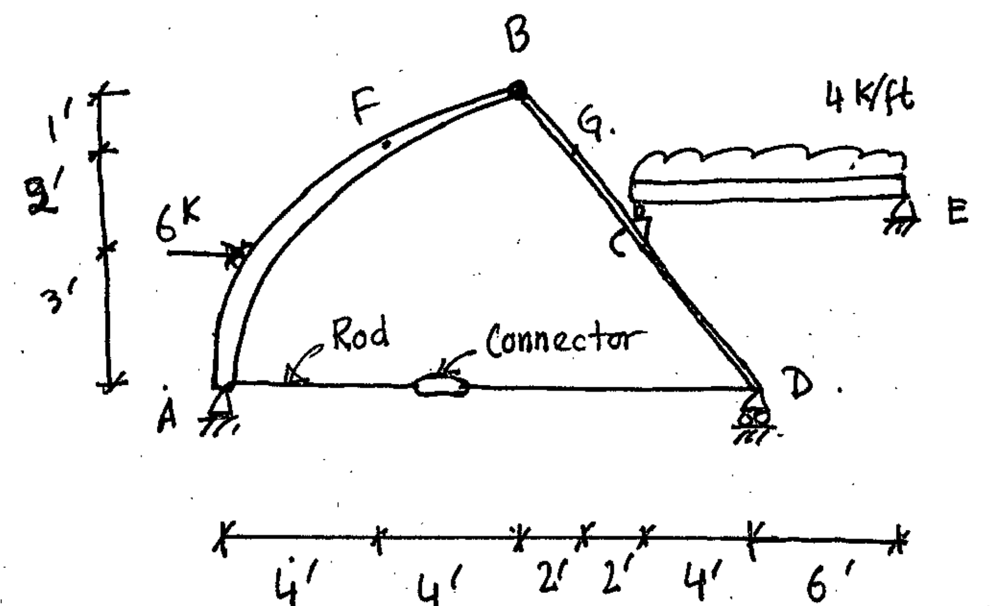
B
F
G.
4 k/ft
1'
2'
3'
6k
C
E
Rod
Connector
A
D
4'
4'
2'
2'
4'
6'

Fig. 11

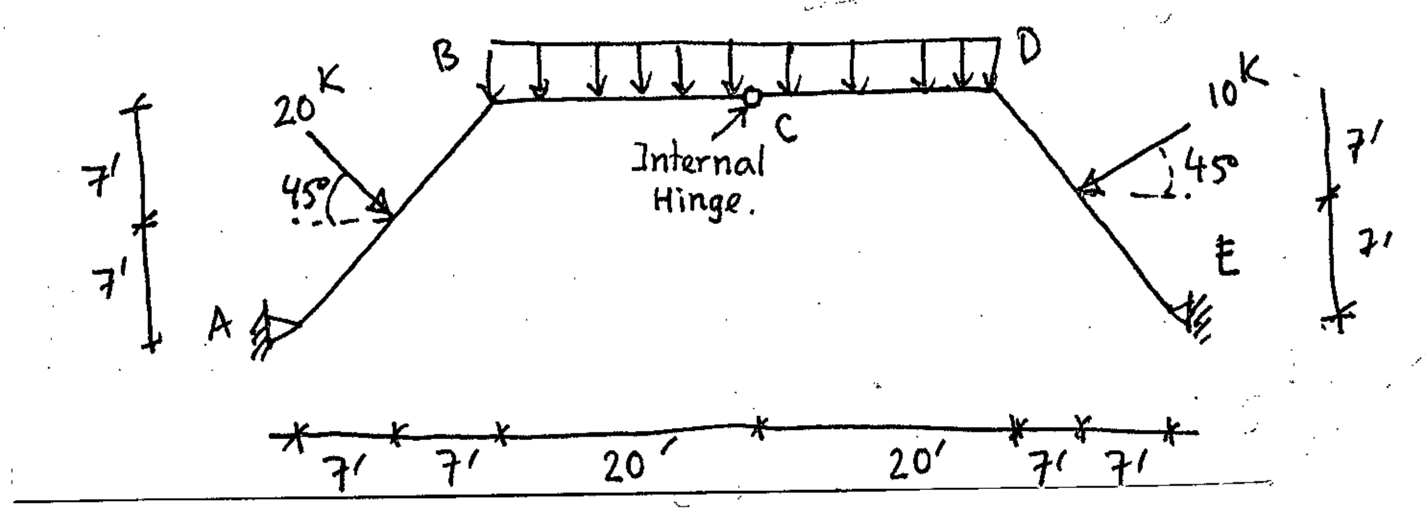
B
D
20k
10k
45°
45°
C
Internal Hinge.
7'
7'
7'
7'
A
E
7'
7'
20'
20'
7'
7'

Fig. 12

L-3/T-1/CE **Date : 06/11/2019**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B. Sc. Engineering Examinations 2018-2019

Sub : **CE 315** (Design of Concrete Structures - I)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

Use USD method of Design if not mentioned otherwise.

Assume reasonable value for any missing data.

1. (a) Explain the differences between USD and WSD methods of design with particular emphasis on how safety is ensured in both the design methods. **(7)**

   (b) Discuss the behavior of RC rectangular beam in flexure under increasing load by drawing neat sketches for strain and stress distribution of uncracked, cracked and ultimate conditions. **(8)**

   (c) A rectangular beam made using concrete with $f_c' = 6.0$ ksi and steel with $f_y = 60$ ksi has a width b = 20 in, an effective depth of d = 17.5 in., and a total depth of h = 20 in. The concrete modulus of rupture $f_r = 530$ psi. The elastic moduli of the concrete and steel are respectively, $E_c = 4030$ ksi and $E_s = 29000$ ksi. The tensile steel consists of four No. 10 bars.

   (i) Determine the cracking moment M_{cr}. **(10)**

   (ii) Find the maximum service load moment that can be resisted without stressing the concrete above 0.45 f_c' or the steel above $0.4f_y$. **(10)**

2. (a) What are the sources of uncertainties in analysis, design and construction of RC structure? **(5)**

   (b) Derive equation for finding ρ_{max} and discuss how a minimum tensile strain (ε_f = 0.004) at failure is ensured by not exceeding maximum reinforcement ratio. Also discuss the variation of φ with ε_t as given in ACI/BNBC code. **(10)**

   (c) A beam section is limited to width b = 14 in. and total depth h = 28 in. Calculate the required reinforcement if the beam has to resist a factored moment M_u = 725 kip-ft. Assume two layer tensile reinforcement with d = 24 in. and d_t = 25.5 in. Also , assume d' = 2.5 in. if compression steel is required.

   Given: $f_c' = 3$ ksi, $f_y = 60$ ksi. **(20)**

3. (a) A floor system consists of a 6 in. slab supported by continuous T-beams with 30 ft span and centre to centre spacing of 12 ft. 6 in. as shown in Fig. 1. Web dimensions as determined by negative moment requirements at support are b_w = 12, And d = 21 in. What tensile reinforcement is required at midspan to resist a factored moment M_u = 600 kip-ft? Also, check minimum reinforcement and ε_t. **(15)**

   Given: $f_c' = 3$ ksi, $f_y = 60$ ksi.

Contd P/2

CE 315

Contd..... Q. No. 3

(b) A rectangular RC beam as shown in Fig 2 measures 14 in. wide and has an effective depth of 23 in. Tension steel consists of eight No. 8 bars in two layers (d = 23 in., d_t = 24.5 in.) and compression steel consists of four No. 8 bars is located 2.5 in. from the compression face. What is the design moment capacity of the beam according to ACI/BNBC code? Check for yielding of compression steel and ε_t. **(20)**

Given: f_c' = 3.5 ksi, f_y = 60 ksi.

4. (a) A rectangular beam is 16 in. wide and has an effective depth of 26.5 in. For f_c' = 4.0 ksi, f_y = 60 ksi, determine the required spacing of No. 3 stirrups for factored shear of

   (i) V_u = 30 kip **(14)**

   (ii) V_u = 100 kip

   (b) A rectangular beam has width 14 in. and effective depth 24.5 in. as shown in Fig. 3. It is reinforced with eight No 9 bars in two rows (d = 24.5″, d_t = 26.0″). What is the nominal flexural strength M_n and what is the maximum moment φM_n that can be utilized in the design? **(15)**

   Given: f_c' = 5.0 ksi, f_y = 60 ksi.

   (c) Why is a minimum amount of reinforcement provided in RC beams? Write the ACI/BNBC provisions for minimum reinforcement. **(6)**

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

Use USD method of Design. Assume reasonable value for any missing data.

5. (a) Figure 4 shows the one-way reinforced concrete floor system of a commercial Building. Design the one-way slab supported by beams cast monolithically with the slab. The slab is to carry a service live load (LL) of 60 psf in addition to its self-weight. Assume floor finish (FF) load of 40 psf and partition wall (pw) load of 60 psf.

   Given: f_c' =3.5 ksi and f_y = 60 ksi. Use supplied ACI moment co-efficients. Show the reinforcements in plan and section. **(20)**

   (b) Why are temperature and shrinkage reinforcements required in one-way slab? **(9)**

   (c) What is the minimum length of lap for column splices as per ACI/BNBC code? **(6)**

6. (a) Design the slab as two-way floor slab system, when there are no secondary beams B2 in the floor system of Fig. 4. The two-way slab panels are 25′×30′ in plan, supported by column line beams only. Given : LL = 60 psf in addition to self-weight of slab; FF = 40 psf; PW = 60 psf; f_c' =3.5 ksi and f_y = 60 ksi. Use supplied moment-co-efficient tables. Show the reinforcements in plan with neat sketches. **(20)**

Contd P/3

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Contd..... Q. No. 6

(b) Calculate the development length of 16 mm and 25 mm uncoated top bars. Repeat the calculation for bottom bars also. Use f_c' =3.5 ksi and f_y = 60 ksi. **(8)**

(c) What do you understand by the term "serviceability" in RC design? **(7)**

7. (a) Determine both positive and negative reinforcements for the beam B1 supported on three columns as shown in Fig. 4. The beam B1 is to carry load from one-way slab given in Question 5(a) above. Consider self-weight of the beam. The size of the beam is 12″× 30″. Consider material strength f_c' =3.5 ksi and f_y = 60 ksi. Show the reinforcements in long and cross-sections. Use supplied moment coefficient table. **(20)**

(b) What are the BNBC/ACI code provisions for beam stirrups (hoops) for moderate seismic risk region e.g. Dhaka? **(8)**

(c) Discuss in short about equilibrium and compatibility torsion. **(7)**

8. (a) Design the stirrups for the beam shown in Fig. 5. All loads are factored. Calculate the stirrups with 3 sets of spacings. Width of beam b = 12″ and effective depth d = 21″. Given: f_c' =3.0 ksi and f_y = 60 ksi. **(20)**

(b) Why does ACI/BNBC code recommend increased development lengths for bars in a bundled group of reinforcements? Mention the recommended increased lengths for such bars. **(8)**

(c) What are the factors that influence development length of rebar? **(7)**

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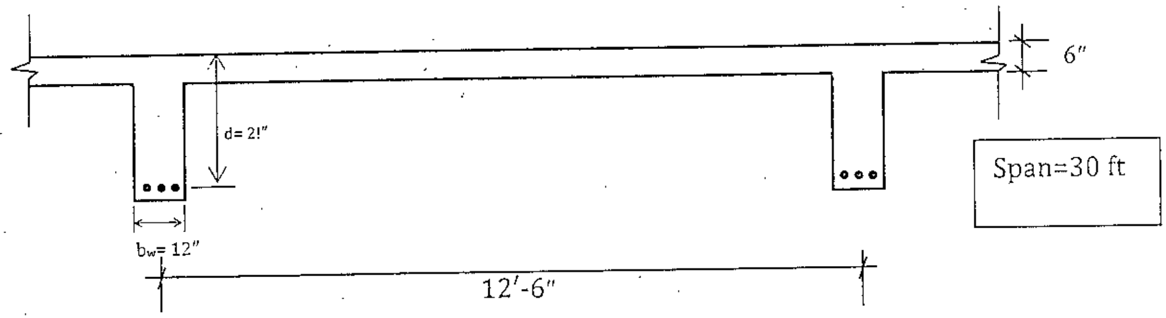
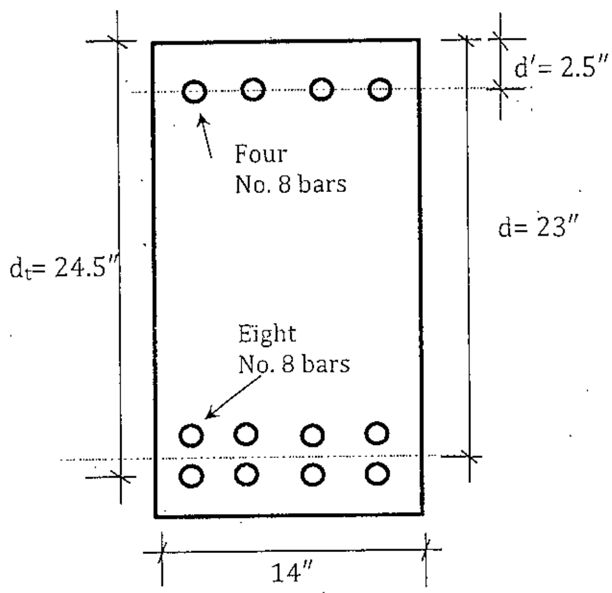


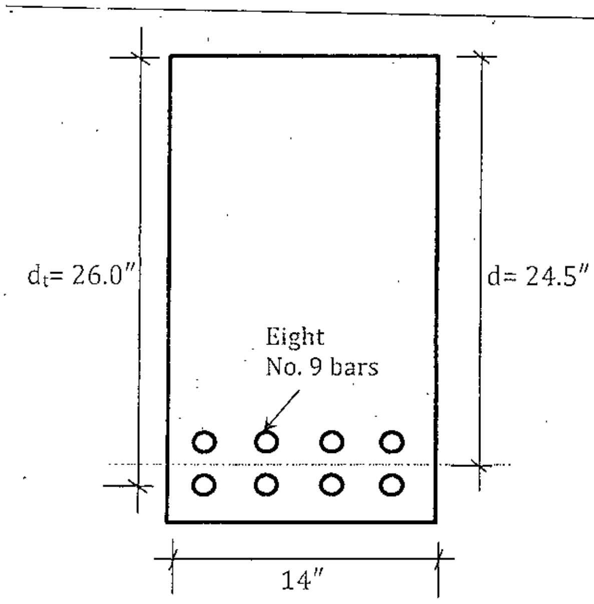
Given:
f_c'= 3 ksi
f_y= 60 ksi

Fig. 1



Given:
f_c'= 3.5 ksi
f_y = 60 ksi

Fig. 2



Given:
f_c'= 5.0 ksi
f_y = 60 ksi

Fig. 3

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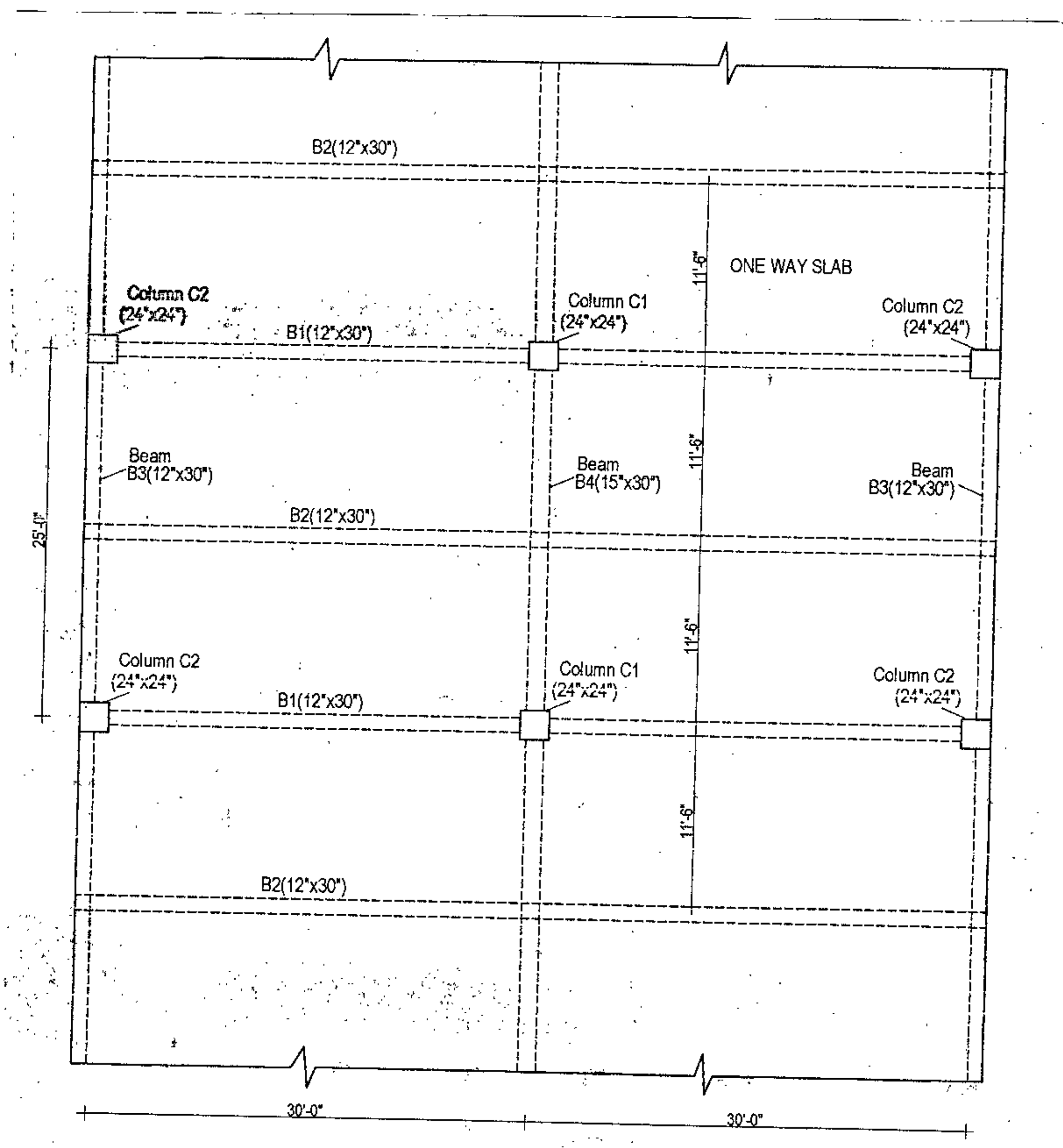

Fig- 4

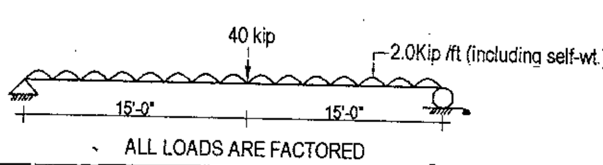

Fig. 5

Contd.... P/6

CE 315
L-3/T-1

(*) Design of Concrete Structures : A. H. Nilson
12th Edition, Pages 408–411

TABLE 12.3

Coefficients for negative moments in slabs[a]

$M_{a,neg} = C_{a,neg}\, w l_a^2$
$M_{b,neg} = C_{b,neg}\, w l_b^2$ where w = total uniform dead plus live load

Ratio $m = \frac{l_a}{l_b}$		Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9
1.00	$C_{a,neg}$		0.045		0.050	0.075	0.071		0.033	0.061
	$C_{b,neg}$		0.045	0.076	0.050			0.071	0.061	0.033
0.95	$C_{a,neg}$		0.050		0.055	0.079	0.075		0.038	0.065
	$C_{b,neg}$		0.041	0.072	0.045			0.067	0.056	0.029
0.90	$C_{a,neg}$		0.055		0.060	0.080	0.079		0.043	0.068
	$C_{b,neg}$		0.037	0.070	0.040			0.062	0.052	0.025
0.85	$C_{a,neg}$		0.060		0.066	0.082	0.083		0.049	0.072
	$C_{b,neg}$		0.031	0.065	0.034			0.057	0.046	0.021
0.80	$C_{a,neg}$		0.065		0.071	0.083	0.086		0.055	0.075
	$C_{b,neg}$		0.027	0.061	0.029			0.051	0.041	0.017
0.75	$C_{a,neg}$		0.069		0.076	0.085	0.088		0.061	0.078
	$C_{b,neg}$		0.022	0.056	0.024			0.044	0.036	0.014
0.70	$C_{a,neg}$		0.074		0.081	0.086	0.091		0.068	0.081
	$C_{b,neg}$		0.017	0.050	0.019			0.038	0.029	0.011
0.65	$C_{a,neg}$		0.077		0.085	0.087	0.093		0.074	0.083
	$C_{b,neg}$		0.014	0.043	0.015			0.031	0.024	0.008
0.60	$C_{a,neg}$		0.081		0.089	0.088	0.095		0.080	0.085
	$C_{b,neg}$		0.010	0.035	0.011			0.024	0.018	0.006
0.55	$C_{a,neg}$		0.084		0.092	0.089	0.096		0.085	0.086
	$C_{b,neg}$		0.007	0.028	0.008			0.019	0.014	0.005
0.50	$C_{a,neg}$		0.086		0.094	0.090	0.097		0.089	0.088
	$C_{b,neg}$		0.006	0.022	0.006			0.014	0.010	0.003

[a] A crosshatched edge indicates that the slab continues across, or is fixed at, the support; an unmarked edge indicates a support at which torsional resistance is negligible.

TABLE 12.4

Coefficients for dead load positive moments in slabs[a]

$M_{a,pos,dl} = C_{a,dl}\, w l_a^2$
$M_{b,pos,dl} = C_{b,dl}\, w l_b^2$ where w = total uniform dead load

Ratio $m = \frac{l_a}{l_b}$		Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9
1.00	$C_{a,dl}$	0.036	0.018	0.018	0.027	0.027	0.033	0.027	0.020	0.023
	$C_{b,dl}$	0.036	0.018	0.027	0.027	0.018	0.027	0.033	0.023	0.020
0.95	$C_{a,dl}$	0.040	0.020	0.021	0.030	0.028	0.036	0.031	0.022	0.024
	$C_{b,dl}$	0.033	0.016	0.025	0.024	0.015	0.024	0.031	0.021	0.017
0.90	$C_{a,dl}$	0.045	0.022	0.025	0.033	0.029	0.039	0.035	0.025	0.026
	$C_{b,dl}$	0.029	0.014	0.024	0.022	0.013	0.021	0.028	0.019	0.015
0.85	$C_{a,dl}$	0.050	0.024	0.029	0.036	0.031	0.042	0.040	0.029	0.028
	$C_{b,dl}$	0.026	0.012	0.022	0.019	0.011	0.017	0.025	0.017	0.013
0.80	$C_{a,dl}$	0.056	0.026	0.034	0.039	0.032	0.045	0.045	0.032	0.029
	$C_{b,dl}$	0.023	0.011	0.020	0.016	0.009	0.015	0.022	0.015	0.010
0.75	$C_{a,dl}$	0.061	0.028	0.040	0.043	0.033	0.048	0.051	0.036	0.031
	$C_{b,dl}$	0.019	0.009	0.018	0.013	0.007	0.012	0.020	0.013	0.007
0.70	$C_{a,dl}$	0.068	0.030	0.046	0.046	0.035	0.051	0.058	0.040	0.033
	$C_{b,dl}$	0.016	0.007	0.016	0.011	0.005	0.009	0.017	0.011	0.006
0.65	$C_{a,dl}$	0.074	0.032	0.054	0.050	0.036	0.054	0.065	0.044	0.034
	$C_{b,dl}$	0.013	0.006	0.014	0.009	0.004	0.007	0.014	0.009	0.005
0.60	$C_{a,dl}$	0.081	0.034	0.062	0.053	0.037	0.056	0.073	0.048	0.036
	$C_{b,dl}$	0.010	0.004	0.011	0.007	0.003	0.006	0.012	0.007	0.004
0.55	$C_{a,dl}$	0.088	0.035	0.071	0.056	0.038	0.058	0.081	0.052	0.037
	$C_{b,dl}$	0.008	0.003	0.009	0.005	0.002	0.004	0.009	0.005	0.003
0.50	$C_{a,dl}$	0.095	0.037	0.080	0.059	0.039	0.061	0.089	0.056	0.038
	$C_{b,dl}$	0.006	0.002	0.007	0.004	0.001	0.003	0.007	0.004	0.002

[a] A crosshatched edge indicates that the slab continues across, or is fixed at, the support; an unmarked edge indicates a support at which torsional resistance is negligible.

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Contd.... P/7

CE 315
L-3/T-1

TABLE 12.5

Coefficients for live load positive moments in slabs[a]

$M_{a,pos,ll} = C_{a,ll} w l_a^2$
$M_{b,pos,ll} = C_{b,ll} w l_b^2$ where w = total uniform live load

Ratio $m = \frac{l_a}{l_b}$		Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9
1.00	$C_{a,ll}$	0.036	0.027	0.027	0.032	0.032	0.035	0.032	0.028	0.030
	$C_{b,ll}$	0.036	0.027	0.032	0.032	0.027	0.032	0.035	0.030	0.028
0.95	$C_{a,ll}$	0.040	0.030	0.031	0.035	0.034	0.038	0.036	0.031	0.032
	$C_{b,ll}$	0.033	0.025	0.029	0.029	0.024	0.029	0.032	0.027	0.025
0.90	$C_{a,ll}$	0.045	0.034	0.035	0.039	0.037	0.042	0.040	0.035	0.036
	$C_{b,ll}$	0.029	0.022	0.027	0.026	0.021	0.025	0.029	0.024	0.022
0.85	$C_{a,ll}$	0.050	0.037	0.040	0.043	0.041	0.046	0.045	0.040	0.039
	$C_{b,ll}$	0.026	0.019	0.024	0.023	0.019	0.022	0.026	0.022	0.020
0.80	$C_{a,ll}$	0.056	0.041	0.045	0.048	0.044	0.051	0.051	0.044	0.042
	$C_{b,ll}$	0.023	0.017	0.022	0.020	0.016	0.019	0.023	0.019	0.017
0.75	$C_{a,ll}$	0.061	0.045	0.051	0.052	0.047	0.055	0.056	0.049	0.046
	$C_{b,ll}$	0.019	0.014	0.019	0.016	0.013	0.016	0.020	0.016	0.013
0.70	$C_{a,ll}$	0.068	0.049	0.057	0.057	0.051	0.060	0.063	0.054	0.050
	$C_{b,ll}$	0.016	0.012	0.016	0.014	0.011	0.013	0.017	0.014	0.011
0.65	$C_{a,ll}$	0.074	0.053	0.064	0.062	0.055	0.064	0.070	0.059	0.054
	$C_{b,ll}$	0.013	0.010	0.014	0.011	0.009	0.010	0.014	0.011	0.009
0.60	$C_{a,ll}$	0.081	0.058	0.071	0.067	0.059	0.068	0.077	0.065	0.059
	$C_{b,ll}$	0.010	0.007	0.011	0.009	0.007	0.008	0.011	0.009	0.007
0.55	$C_{a,ll}$	0.088	0.062	0.080	0.072	0.063	0.073	0.085	0.070	0.063
	$C_{b,ll}$	0.008	0.006	0.009	0.007	0.005	0.006	0.009	0.007	0.006
0.50	$C_{a,ll}$	0.095	0.066	0.088	0.077	0.067	0.078	0.092	0.076	0.067
	$C_{b,ll}$	0.006	0.004	0.007	0.005	0.004	0.005	0.007	0.005	0.004

[a] A crosshatched edge indicates that the slab continues across, or is fixed at, the support; an unmarked edge indicates a support at which torsional resistance is negligible.

TABLE 12.6

Ratio of load W in l_a and l_b directions for shear in slab and load on supports[a]

Ratio $m = \frac{l_a}{l_b}$		Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9
1.00	W_a	0.50	0.50	0.17	0.50	0.83	0.71	0.29	0.33	0.67
	W_b	0.50	0.50	0.83	0.50	0.17	0.29	0.71	0.67	0.33
0.95	W_a	0.55	0.55	0.20	0.55	0.86	0.75	0.33	0.38	0.71
	W_b	0.45	0.45	0.80	0.45	0.14	0.25	0.67	0.62	0.29
0.90	W_a	0.60	0.60	0.23	0.60	0.88	0.79	0.38	0.43	0.75
	W_b	0.40	0.40	0.77	0.40	0.12	0.21	0.62	0.57	0.25
0.85	W_a	0.66	0.66	0.28	0.66	0.90	0.83	0.43	0.49	0.79
	W_b	0.34	0.34	0.72	0.34	0.10	0.17	0.57	0.51	0.21
0.80	W_a	0.71	0.71	0.33	0.71	0.92	0.86	0.49	0.55	0.83
	W_b	0.29	0.29	0.67	0.29	0.08	0.14	0.51	0.45	0.17
0.75	W_a	0.76	0.76	0.39	0.76	0.94	0.88	0.56	0.61	0.86
	W_b	0.24	0.24	0.61	0.24	0.06	0.12	0.44	0.39	0.14
0.70	W_a	0.81	0.81	0.45	0.81	0.95	0.91	0.62	0.68	0.89
	W_b	0.19	0.19	0.55	0.19	0.05	0.09	0.38	0.32	0.11
0.65	W_a	0.85	0.85	0.53	0.85	0.96	0.93	0.69	0.74	0.92
	W_b	0.15	0.15	0.47	0.15	0.04	0.07	0.31	0.26	0.08
0.60	W_a	0.89	0.89	0.61	0.89	0.97	0.95	0.76	0.80	0.94
	W_b	0.11	0.11	0.39	0.11	0.03	0.05	0.24	0.20	0.06
0.55	W_a	0.92	0.92	0.69	0.92	0.98	0.96	0.81	0.85	0.95
	W_b	0.08	0.08	0.31	0.08	0.02	0.04	0.19	0.15	0.05
0.50	W_a	0.94	0.94	0.76	0.94	0.99	0.97	0.86	0.89	0.97
	W_b	0.06	0.06	0.24	0.06	0.01	0.03	0.14	0.11	0.03

[a] A crosshatched edge indicates that the slab continues across, or is fixed at, the support; an unmarked edge indicates a support at which torsional resistance is negligible.

Contd.... P/8

CE 315
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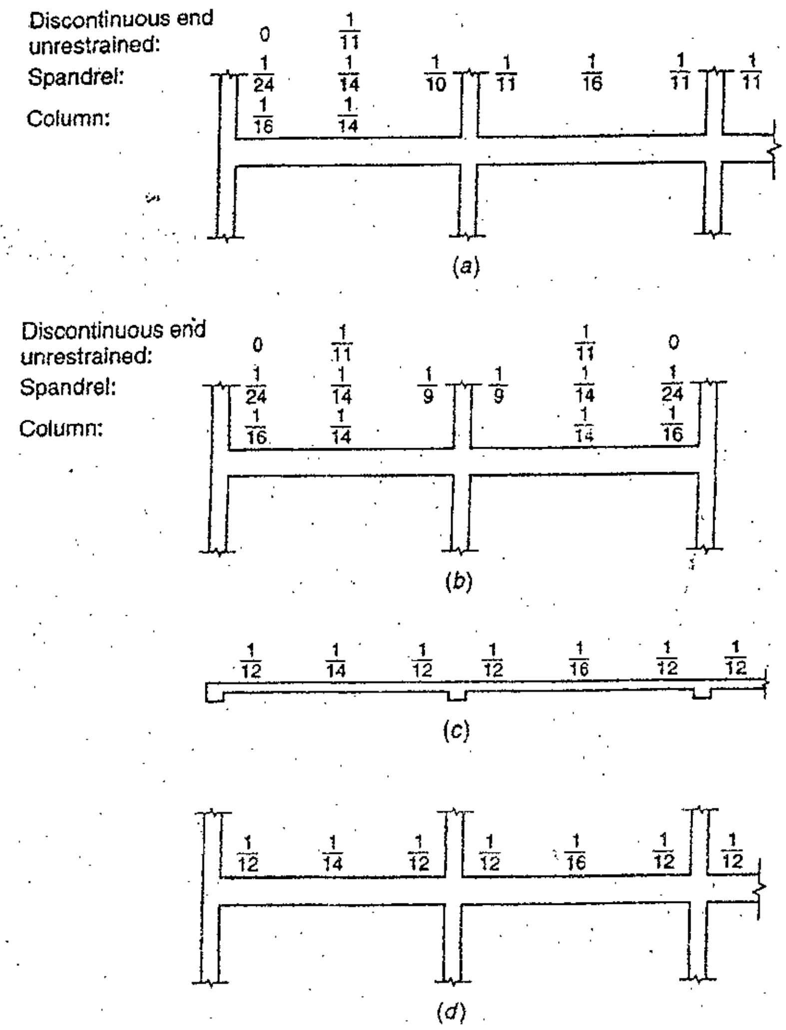
Summary of ACI moment coefficients: (*a*) beams with more than two spans; (*b*) beams with two spans only; (*c*) slabs with spans not exceeding 10 ft; (*d*) beams in which the sum of column stiffnesses exceeds 8 times the sum of beam stiffnesses at each end of the span.



Date : 20/01/2020

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

B. Sc. Engineering Examinations

Sub : **CE 317** (Design of Concrete Structures-II)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

Assume reasonable value for any missing data.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1.	(a) Design a square tied column with about 2.5% reinforcement to support working unfactored loads: P_{DL}=900 kip and P_{LL}=600 kip. Given: f_c'=5.0 ksi and f_y=72.5 ksi. Also, design the ties required.	9
	(b) A 16 X 28 inch column is reinforced with Ten No. 9 bars as shown in Fig.1. Construct the nominal strength interaction diagram for the column with five points corresponding to pure axial load, pure bending, balance condition, ε_s= 0.001 (tensile) and ε_s=0.005 (tensile). Also find corresponding ϕ for the above points. Assume bending about Y-Y axis. Given: f_c'=4 ksi and f_y=60 ksi.	26
2.	(a) A 60"x60" square pier of a bridge is reinforced with seventy-two No-9 bars arranged uniformly around the perimeter. Material strengths are f_c'=4.0 ksi and f_y=60 ksi. Check adequacy of the short column using Load Contour Method for: P_u=4000 kip, M_{ux}=4000 kip-ft, M_{uy}=5000 kip-ft. Use supplied column strength interaction diagram chart assuming γ=0.9	20
	(b) Why is φ value for compression lower than those for flexure or shear? What does the horizontal cut-off in the ACI/BNBC design strength interaction diagram signify?	7
	(c) What is a slender column? Write ACI/BNBC kl_u/r limits below which the effects of slenderness may be neglected for sway and non-sway frames.	8
3.	(a) A circular spirally reinforced column carries unfactored working loads: P_{DL}=700 kip and P_{LL}=500 kip. Design the column with about 2.5% reinforcement. Also design the ACI spiral. Given: f_c'=4.5 ksi and f_y=72.5 ksi.	11
	(b) A ground floor column of a 12-storied building is to be designed for the following load combinations (axial force and uniaxial bending)- Gravity load combination P_u=3000 kip, M_u=100 kip-ft Lateral load combination P_u=2000 kip, M_u=1000 kip-ft Architectural considerations require that a circular tied column of 40 in. diameter is to be used. Material strengths are f_c'=4ksi and f_y=60ksi. Find the required column reinforcement and show in sketch. Use supplied column strength interaction design chart assuming reinforcement distributed along the perimeter and γ=0.9.	17
	(c) Explain the Seismic design philosophy under different levels of earthquakes.	7
4.	(a) Write the seismic detailing provisions of a two-way slab without beam, which is part of an IMRF system, as per BNBC.	10
	(b) Discuss different modes of failure of a high-rise shear wall.	8
	(c) A shear wall of a 18-storey building is subjected to following factored loads: P_u=650 kip V_u=500 kip M_u=6000 kip-ft The wall is 20 ft long, 180 ft high and 12 inch thick. Design the shear wall with f'_c=4ksi and f_y= 60 ksi. Ignore axial force as it is less than balanced load of the section.	17

SECTION – B

There are **FOUR** questions in this Section. Answer any **THREE**.

Assume reasonable values for any missing data

5. A commercial building is to be designed using a flat plate floor system. The interior columns are 20" x 20" and they are spaced 21 ft c/c in both directions. Specified live load 100 psf and superimposed dead load 160 psf including self weight of slab. Material strengths are $f'_c = 3.5$ ksi and $f_y = 60$ ksi.

   (a) ~~Find the slab thickness for adequacy against punching shear failure, when no shear reinforcement~~ is used. (15)

   (b) Design a typical interior panel of the above building and show the reinforcements with neat sketches. (20)

6. (a) If the flat plate floor of the building stated in Q.5 has thickness $h = 7.5"$, design the shear reinforcement for the slab. Loads and material strengths are same as in Q.5. (17)

   (b) The plan of a pile cap with 12 nos. 20" diameter cast-in-situ piles with the column (24" x 24") is shown in Fig. 2. The column carries a DL = 900 kip and LL = 500 kip (working). The individual pile capacity is adequate. Design the pile cap and show the reinforcements with neat sketches. Given: $f'_c = 3.0$ ksi and $f_y = 60$ ksi. (18)

7. (a) A post-tensioned bonded concrete beam as shown in Fig. 3 has a prestress of 1700 kN in the steel immediately after prestressing and reduces to 1500 kN due to losses. In addition to a self weight of 4.5 kN/m, there is a live load of 11.0 kN/m. Compute the extreme fibre stresses at midspan i) Under the initial condition with full prestress and no live load. (20)

ii) at final condition with live loads and considering losses. (iii) Compute also the live load that can be carried by the beam for zero tensile stress in the bottom fibre.

(b) The interior column is 20" x 20" in cross section. It carries total service loads DL = 500 kip and LL = 300 kip. Design a square footing with the bottom at 5 ft below grade. The allowable soil bearing pressure is 4500 psf. Use $f'_c = 3000$ psi and $f_y = 60,000$ psi. Show the reinforcements in plan and sections. (15)

8. (a) Discuss the advantages of Prestressed concrete over Reinforced concrete. (10)

(b) Explain, why prestressed concrete beams are either I, T or box section? (10)

(c) Make a preliminary design for a section of prestressed beam to resist a total moment of 450 KN-m. The overall depth of the section is given as 900 mm. The effective prestress force for steel is 850 MPa and allowable stress for concrete under working load is −12.0 MPa. (15)

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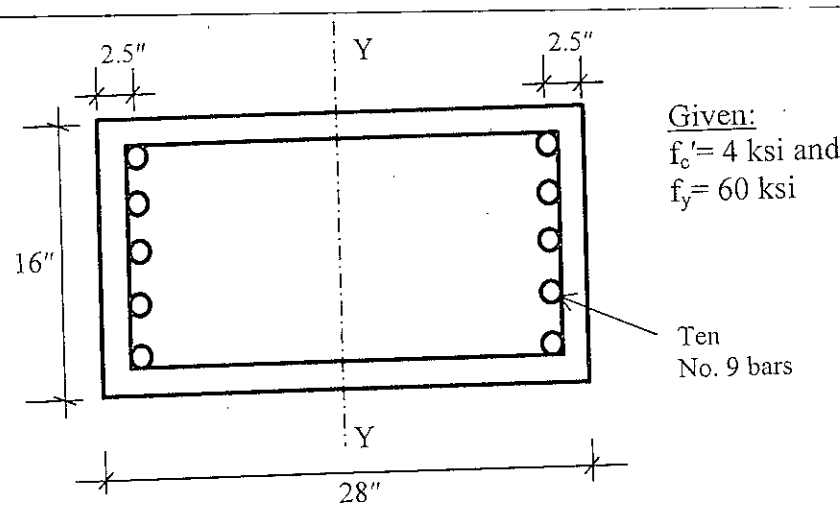

Fig. 1

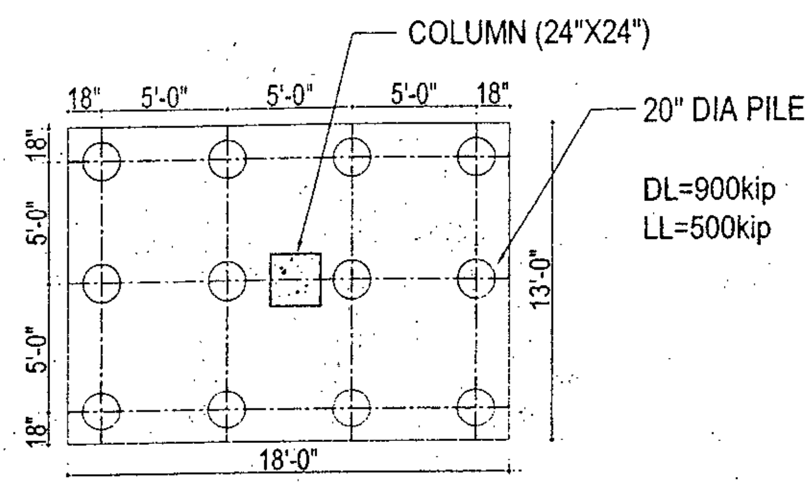

Fig- 2

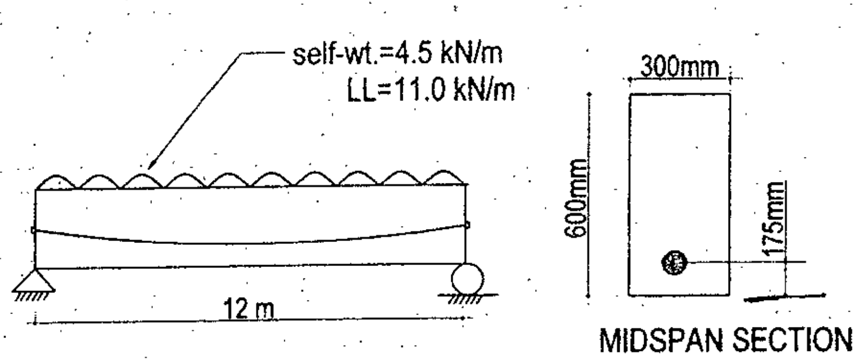

Fig- 3

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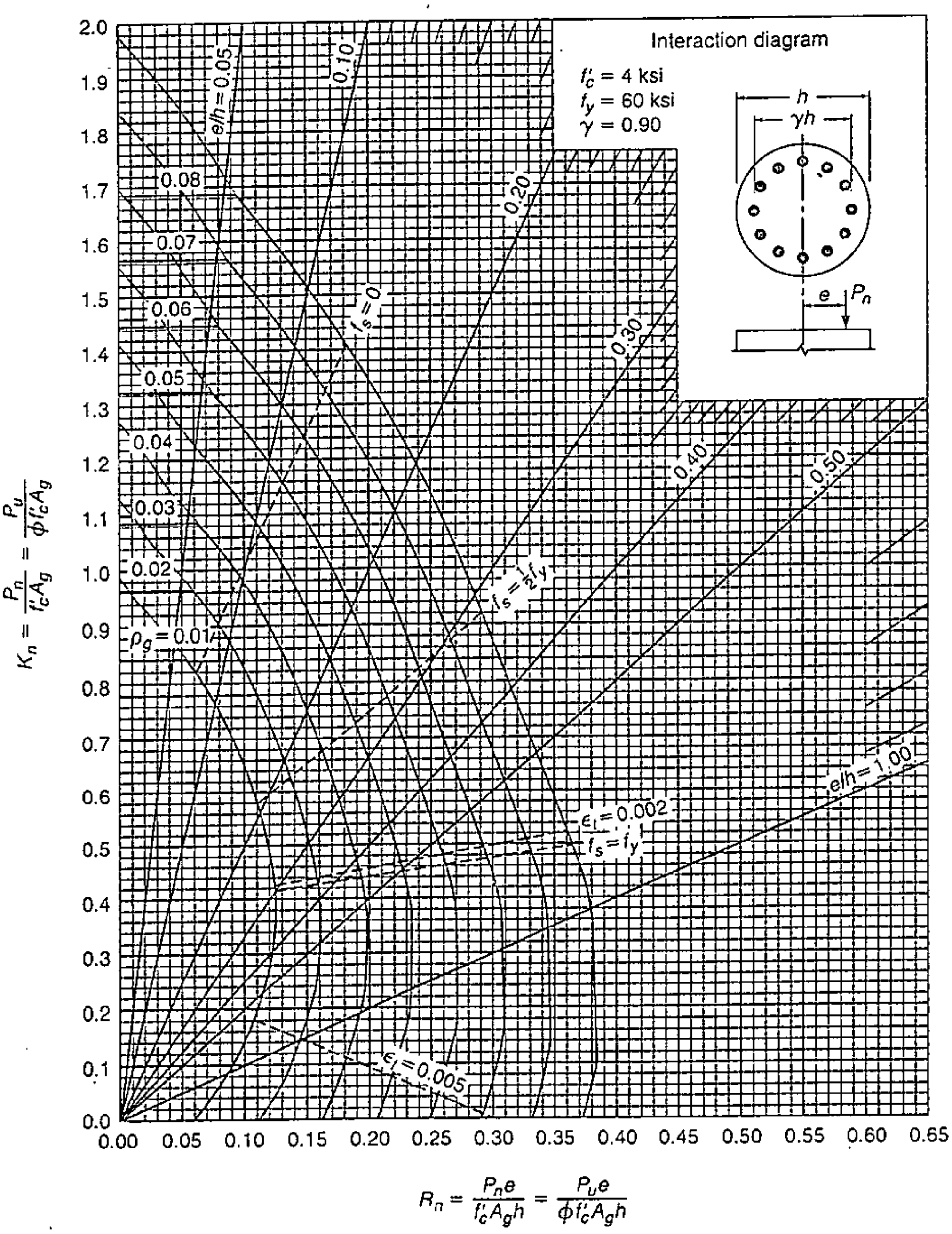
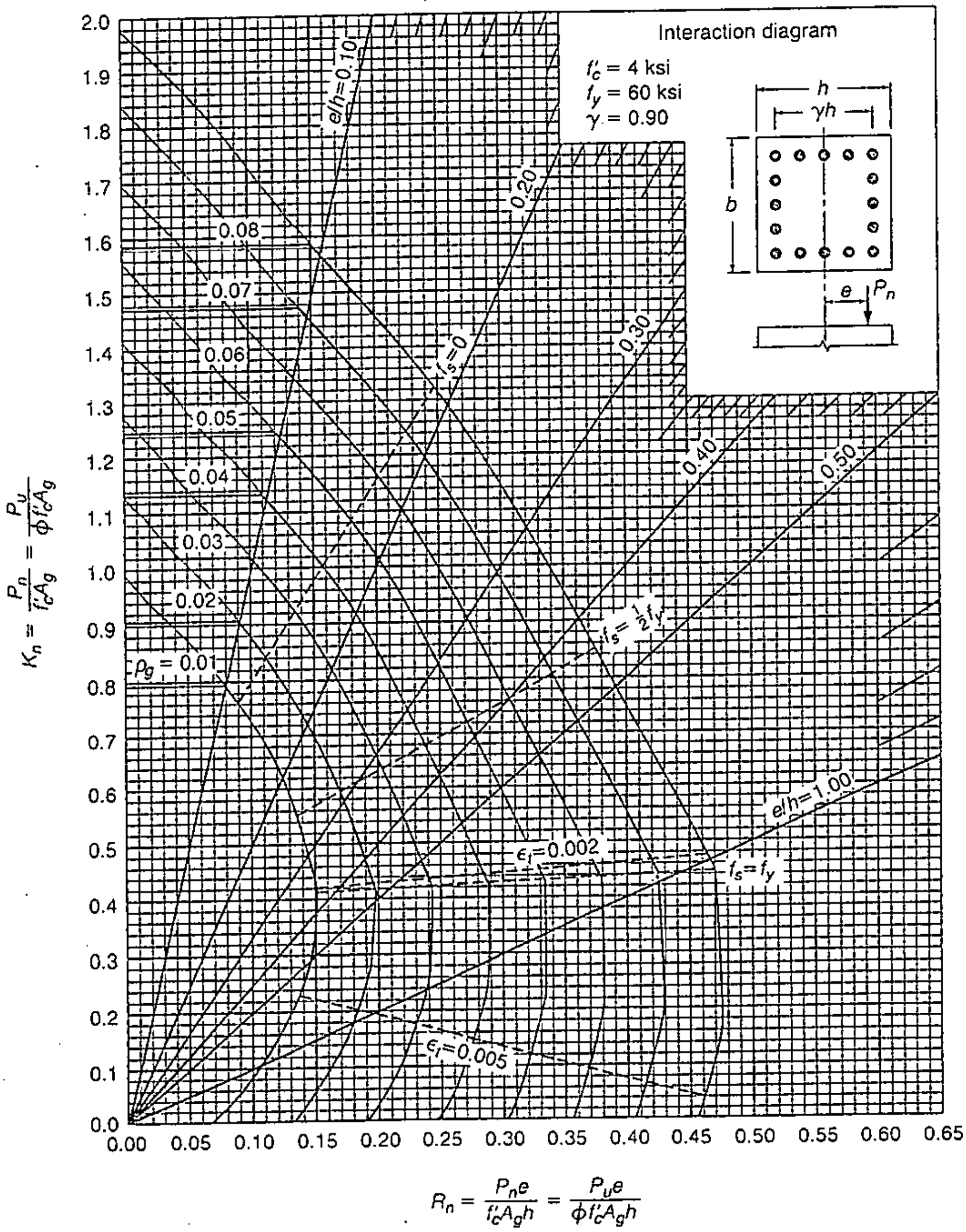


GRAPH A.16

Column strength interaction diagram for circular section with $\gamma = 0.90$.



GRAPH A.8
Column strength interaction diagram for rectangular section with bars on four faces and $\gamma = 0.90$.

From Design of Concrete Structures, 15th Ed
by: Darwin, Dolan, Nilson

L-3/T-1/CE **Date : 29/10/2019**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B. Sc. Engineering Examinations 2018-2019

Sub : **CE 331** (Environmental Engineering- I)

Full Marks: 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

There are **FOUR** questions in this section. Answer **ALL**.

1. (a) What are the Sustainable Development Goals? What is hydrologic cycle and why is it important? Identify the pathway for transmission of diarrhoeal and other faecal-oral diseases from faeces. **(12)**

(b) What are the major greenhouse gases? What are the principal impacts of climate change in Bangladesh? Illustrate the natural services that a healthy biodiversity commonly provide to minimize overall environmental degradation. **(12)**

2. (a) Draw a diagram to demonstrate the "Essential Elements of Water Supply System". Briefly describe "Pond Sand Filter", "Shallow Shrouded Tube Well" and "Unaccounted-for Water". **(16)**

OR

Draw a flow diagram of public water supply chain. Explain briefly "Tara Pump", "Rainwater Harvesting" and "Non Revenue Water".

(b) State the hydraulics of groundwater flow towards a well and deduce the mathematical expression for the yield of a well in an unconfined aquifer. **(10)**

OR

State the hydraulics of groundwater flow towards a well and deduce the mathematical expression for the yield of a well in a confined aquifer.

3. (a) What are the purposes and methods of well development? Draw a flow diagram for the reverse recirculation rotary drilling method for a well boring. **(13)**

OR

What are the differences between "Screen Well" and "Gravel Pack Well"? Draw a flow diagram for the direct rotary drilling for a well boring.

(b) The population of a town as per the census records are given below (table 1) for the year 1955 to 2015. Estimate the population for the years 2035 and 2050 using Logistic method. **(13)**

Contd P/2

CE 331

Contd... Q. No. 3(b)

Table -1	
Year	Population
1955	40,200
1965	44,500
1975	60,400
1985	75,600
1995	99,000
2005	1,24,300
2015	1,58,900

OR

With the populations given above in Table-1, estimate the population for the years 2035 and 2050 using Incremental Increase method.

4. (a) Describe the sources and significance of the following water quality parameters: **(10)**

   (i) Nitrogen and (ii) Phosphorus.

   (b) Explain the process of ion exchange for demineralization with necessary diagram and equations. How can dual and mixed media filters achieve the gradation necessary for longer filter runs? **(19)**

SECTION - B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) What are the typical differences between water quality of surface and ground water? What are the different water treatment applications of gas transfer? What is the purpose of filter backwashing? **(8+8+4)**

   (b) Describe the mechanism of reduction of surface potential by double layer compression in alum coagulation. **(15)**

6. (a) What are the properties of an ideal disinfectant? What is the difference between Reverse Osmosis and Electro-dialysis? **(8+4)**

   (b) What is water hammer? Explain the phenomenon of water hammer by suitable sketches. How can you reduce the water hammer effect in water works practices? **(2+8+3)**

   (c) Describe briefly the steps of laying underground water pipes. **(10)**

Contd P/3

CE 331

7. (a) Discuss briefly the steps of the water safety plan processes with flow diagram. **(15)**

(b) Drinking water is supplied to a pourashava from ground water having both dissolved iron (10 mg/L) and Arsenic (1.0 mg/L). The water supply is intermittent. It is expected risk of ingress of contamination when there is low or no pressure in the system. Calculate the risk score and category for these three hazardous events (i) High iron concentration, (ii) High *As* concentration, and (iii) ingress of the contaminations to the distribution system. **(20)**

8. (a) What are the basic assumptions made in the Hardy-Cross method? Deduce the expression for determining flow correction in Hardy-Cross Method. **(2+10)**

(b) Discuss briefly the layout of water distribution system. **(12)**

(c) An elevated cylindrical water tank of 80000 gallons capacity has to be designed. If concrete work per sft in the floor and wall of shell costs Tk. 120.00 and Tk. 180.00 respectively, what would be the most economic dimensions for the tank? **(11)**

L-3/T-1/CE **Date : 19/10/2019**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B. Sc. Engineering Examinations 2018-2019

Sub : **CE 341** (Principles of Soil Mechanics)

Full Marks : 280 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer **Q. No. 1** and any **TWO** from the rest.

Question No. 1 is COMPULSORY

Assume reasonable value of missing data, if any. Use attached chart where necessary.

1. (a) Define the following soil types:
   (i) Verved day (ii) Boulder clay (iii) Loess **(6)**
   (b) Derive an expression for shrinkage limit of soil having known specific gravity. **($5\frac{2}{3}$)**
   (c) Classify different types of soils based on particle size according to ASTM D422. **(5)**
   (d) Define principal types of secondary structures in soils. **(6)**
   (e) A clay sample (liquid limit = 65%, plastic limit = 32% and natural moisture content = 49%) was collected from a depth of 6 m below the existing ground level. Water table is at the ground level and saturated unit weight of the sample is 18 kN/m^3. If the sample is normally consolidated, estimate the undrained shear strength (Su) of the sample at that depth. **(6)**
   (f) Deduce an expression for Rankine's passive earth pressure due to a cohesive frictional (c-ϕ) backfill. **(6)**
   (g) Draw neatly Casagrande's Plasticity Chart according to Unified Soil Classification System (USCS) showing the classifications of different soil deposits. **(7)**
   (h) Draw typical results for consolidated drained (CD) direct shear tests conducted on loose and dense sands. **(5)**

2. (a) Liquid limit test was carried out on a soil sample using Casagrande's apparatus and the following data were obtained: **($13\frac{2}{3}$)**

No. of blows (N)	16	20	24	30	35
Water content (%)	57.1	55.2	53.8	51.9	50.6

   Plot the flow curve and determine the liquid limit of the soil. Also calculate the value of toughness index if the plastic limit of the soil is 24%.

   (b) Classify the following two inorganic soils according to USCS: **(11)**

   Soil A: Percent finer No. 200 sieve (0.075 mm) = 93
   Liquid limit = 52%
   Plastic limit = 31%

   Soil B: Percent finer No. 4 sieve (4.75 mm) = 92
   Percent finer No. 200 sieve (0.075 mm) = 8
   D_{60} = 1.7 mm, D_{30} = 0.43 mm, D_{10} = 0.08 mm
   <u>Consistency limit of fraction passing No. 200 sieve</u>
   Liquid limit = 43%
   Plastic limit = 21%

Contd P/2

CE 341

Contd..... Q. No. 2

(c) What are the merits and demerits of direct shear test? Briefly describe the behaviour of saturated samples of clay in consolidated drained (CD) triaxial compression test and also show with neat sketches two examples of consolidated undrained (CU) analyses in clays. **(11)**

(d) A smooth vertical wall of height 10 m retains a soft clay backfill of unit weight 16.5 kN/m^3. Undrained shear strength of the clay backfill is 35 kN/m^2. For undrained condition of the backfill, calculate the following. **(11)**

(i) Depth of tension crack and unsupported height of wall

(ii) Active earth force before tension crack forms.

(iii) Active earth force after the formation of tension cracks.

3. (a) The following results were obtained at failure in consolidated undrained (CU) triaxial compression tests conducted on three specimens of a clay sample: **(14)**

Specimen No.	Cell pressure (kN/m^2)	Deviator stress kN/m^2	Pore water pressure kN/m^2
1	75	150	300
2	199	272	418
3	25	50	100

Draw the Modified Failure Envelope in a plain graph paper and hence estimate the values of effective shear strength parameters C' and ϕ'. Also write down the Mohr-Coulomb equation for the effective stress failure envelope.

(b) Explain the concepts of Rankine's active earth pressure, passive earth pressure and at-rest earth pressure. **($10\frac{2}{3}$)**

(c) For a soil, the following results were obtained from grain size distribution and Alterberg limit tests: **(8)**

% finer No. 200 sieve (0.075mm) = 91

Liquid limit = 56

Plastic limit = 30

Classify the soil based on AASHTO Classification system.

(d) The following results were obtained in a consolidated drained (CD) direct shear test conducted on a clay sample. **(14)**

Specimen No.	Effective Normal Stress (kN/m^2)	Peak Shear Stress (kN/m^2)	Residual Shear Stress (kN/m^2)
1	75	80	14
2	150	105	27
3	250	145	44

Determine the effective peak friction angle (ϕ'_p) and effective residual friction angle (ϕ'_r). Also comment on the stress history of the sample.

4. (a) A specimen of a saturated normally consolidated clay sample was fully consolidated in the triaxial cell under a cell pressure of 200 kN/m^2. Pore pressure within the specimen at the end of consolidation was zero. Deviator stress was then applied under undrained condition and increased until failure took place. The values of deviator stress and pore pressure at failure were found to be 150 kN/m^2 and 50 kN/m^2, respectively. A second specimen of the same clay was fully consolidated in the triaxial cell under a cell pressure of 300 kN/m^2. Pore pressure within this specimen at the end of consolidation was zero. Deviator stress was then applied under undrained condition until failure took place. Calculate the following analytically: **(13)**

(i) The values of effective angle of internal friction (ϕ') and undrained angle of internal friction (ϕ_u) of the sample.

(ii) The values of pore pressure at failure (u_f) and pore pressure parameter A at failure (A_f) of the second specimen.

(b) Liquid limit of a soil in air-dry state and over-dry state were found to be 85% and 56%, respectively. Plastic limit of the soil in air-dry state was found to be 31%. What is the group symbol of the soil? Also mention the group name of the soil. **(8)**

(c) For the retaining wall shown in Fig. 1, the backfill supports a uniformly distributed load of 30 kN/m^2. Draw Rankine's active earth pressure distribution on the wall and determine the total active force (thrust) per unit length of the wall. Also state the assumptions in Coulomb's theory of earth pressure.

(d) Draw the following qualitative curves: **($11\frac{2}{3}$)**

(i) Pore water pressure versus axial strain for saturated samples of normally consolidated and overconsolidated clays in consolidated undrained (CU) triaxial compression tests.

(ii) Skempton's pore pressure parameter B versus degree of saturation.

(iii) Skempton's pore pressure parameter A at failure (A_f) versus overconsolidation (OCR) ratio.

Also mention the major factors affecting shear strength of soils.

SECTION – B

There are **FOUR** questions in this section. Answer all **FOUR** questions.
Assume reasonable value (values) for missing data only

5. (a) Why compaction test is done in the laboratory? Write down the salient features of the Standard Proctor and Modified Proctor test method. Discuss the factors affecting compaction of soils. **(10)**

(b) Two sites are being considered as "borrow" sites. The in-place unit weight of the soil of the first site is 101 lb/ft^3; the water content was found to be 10%. On the 2nd site, the unit weight of the soil was found to be 96 lb/ft^3, at a water content of 14%. The construction site required 315,00 ft^3 of soil in a compacted state, at a unit weight of 126 lb/ft^3, at a water content of 14%. The unit (per ft^3) price from each "borrow" site was Tk. 9.00 for the material and Tk. 10.00 for transportation. In addition, for the material that required the additional water, Tk 1.50 was estimated to be the additional cost for unit volume (ft^3) of soil. Calculate the cost of material from each site. Assume Gs is equal to 2.65 for both the sites. **(15)**

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(c) Derive an expression of buoyant unit weight of soil as a function of void ratio, specific gravity and unit weight of soil. **(10)**

OR

5. (d) A saturated clay has a water content of 39.3% and its mass density of 1.84 gm/cm^3. Determine the porosity of soil and specific gravity of soil skeleton. **(15)**

(e) Describe the effects compacting clay on dry or wet of optimum moisture content. "There are two ways of specifying compaction of earthworks", Explain. Also give your opinion with justifications, with one you will adopt? **(10)**

(f) How do you estimate the void ratio of soil in the field? Describe the importance of the term Density Index and how it can be used to describe the state of compaction of soil. Also state for what type of soil this term is usually used. **(10)**

6. (a) Determine the total stress (vertical) 8.0 m below the point "A" due to line loads shown in Fig. 2. **(25)**

(b) How do you construct field e-log(p) curve using Schmertmann's procedure for Over Consolidated (OC) clay. **(10)**

OR

6. (c) What is time factor? How it is related to the average degree of consolidation? Also, state how it can be used in calculating settlement rate of a foundation? **(10)**

(d) A "T" shaped foundation is loaded with a uniform load of 100 kN/m^2 as shown in Fig. 3. Estimate the vertical pressure at a point which is 6.0 m below the point "G". **(25)**

7. (a) A footing is placed on silty clay stratum, with properties shown in Fig. 4. Then a 4 feet fill layer is added as shown. Calculate: **(30)**

   (i) Settlement of The clay layer, and

   (ii) Time require to attain 8.5 inch of settlement.

(b) How do you mitigate piping in hydraulic structures? **(5)**

8. (a) Draw the uplift pressure diagram on the bottom face of the concrete spillway, Fig. 5 (at Points: A, B, C, E, I and K). Also calculate the safety factor with respect to piping, assuming saturated unit weight of the base material is 20 kNm^3. **(20)**

(b) Calculate the coefficient of permeability (k) of a soil sample 6 cm in height and 50 cm^2 in cross sectional area, if a quantity of water equal to 430 cm^3 percolates in 10 minutes under a constant head of 40 cm. Comment on the value of k. Also, calculate seepage velocity if the dry weight of the sample is 500 gm and Gs of the sample is 2.65. **(15)**

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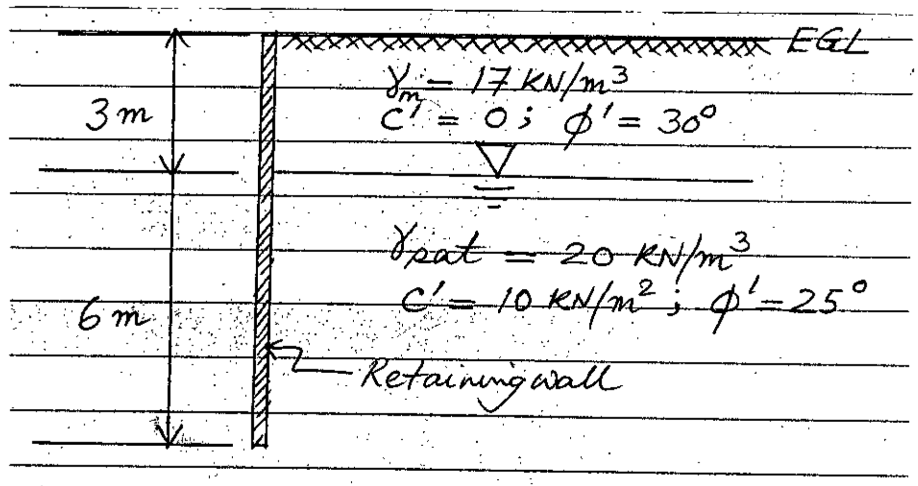

Fig. 1

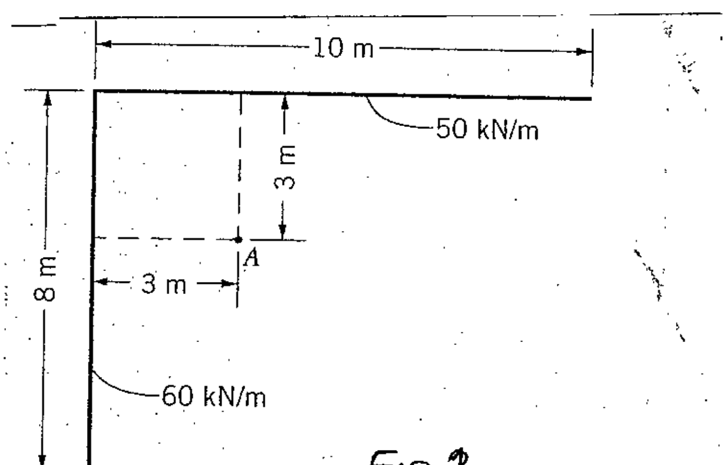

Fig 2

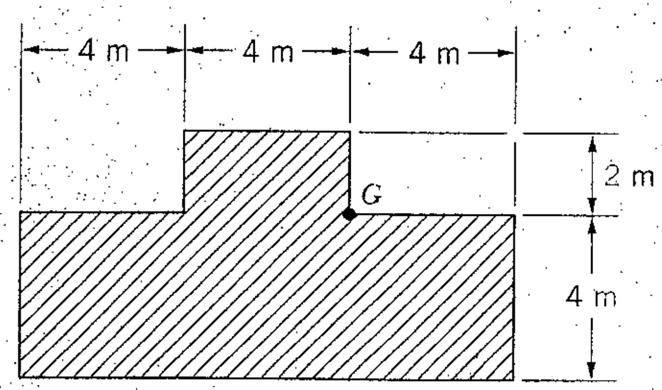

Fig. 3

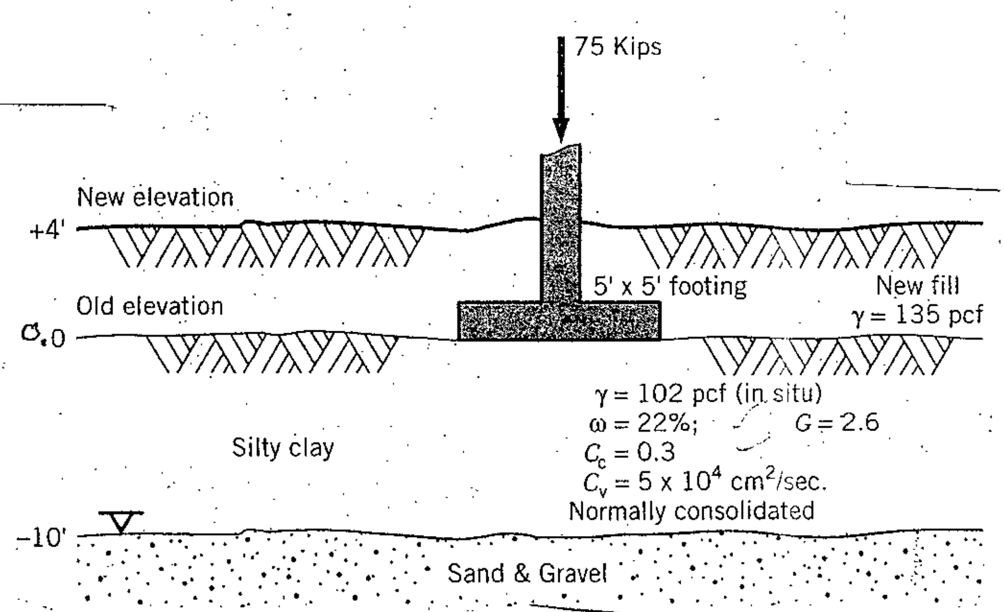

Fig 4

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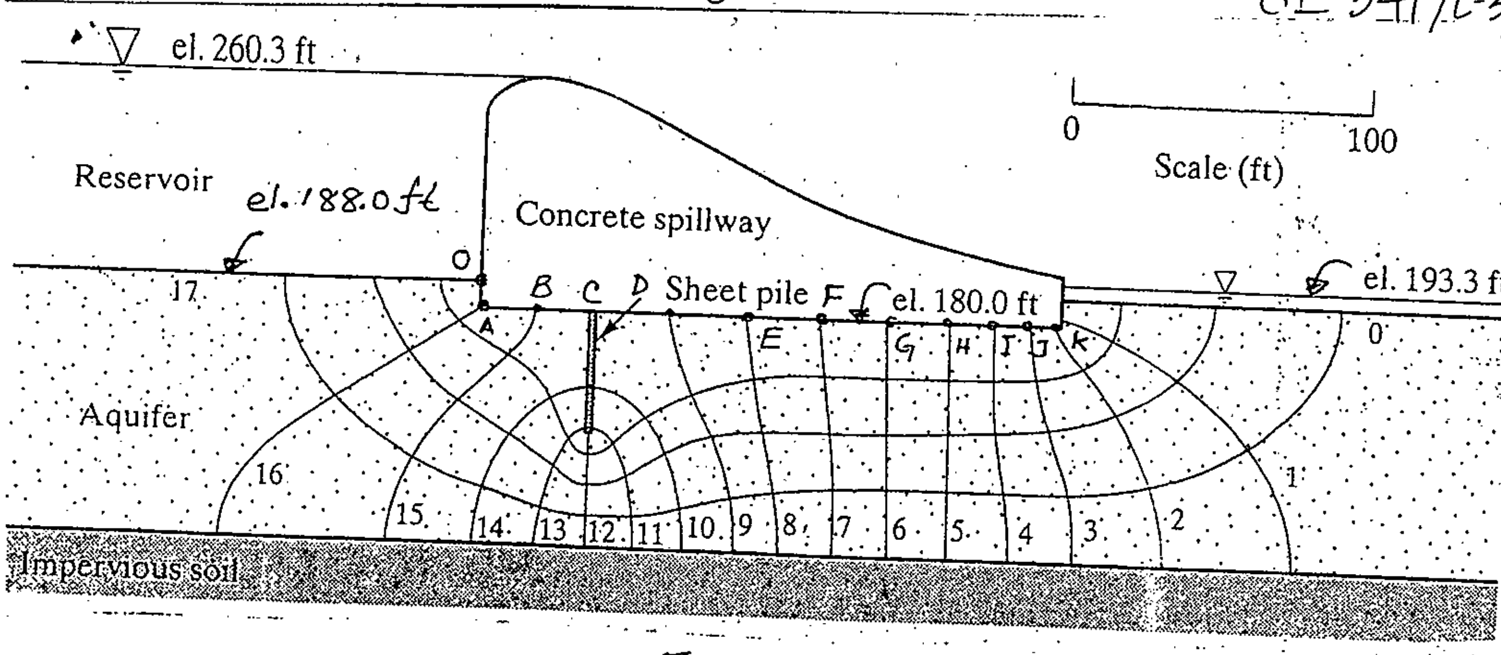

Fig. 5

General Classification	Granular Material (35% or less passing No. 200 sieve)							Silt Clay Materials (More than 35% passing No. 200 Sieve)			
Group Classification	A-1		A-3	A-2				A-4	A-5	A-6	A-7
	A-1-a	A-1-b		A-2-4	A-2-5	A-2-6	A-2-7				A-7-5 A-7-6
Sieve Analysis; Percent Passing											
No. 10	50 max	—	—	—	—	—	—	—	—	—	—
No. 40	30 max	50 max	51 min	—	—	—	—	—	—	—	—
No. 200	15 max	25 max	10 max	35 max	35 max	35 max	35 max	36 min	36 min	36 min	36 min
Characteristics of fraction passing No. 40											
Liquid Limit	—		—	40 max	41 min	40 max	41 min	40 max	41 min	40 max	41 min*
Plasticity Index	6 max		N.P.	10 max	10 max	11 min	11 min	10 max	10 max	11 min	11 min*
Usual types of significant constituent materials	Stone Fragments; gravel and sand		Fine sand	Silty or clayey gravel and sand				Silty soils		Clayey soils	
General Rating as Subgrade	Excellent to good							Fair to poor			

- * Plasticity index of A-7-5 subgroup is equal to or less than L.L. minus 30.
- * Plasticity index of A-7-6 subgroup is greater than L.L. minus 30.

Chart 1 AASHTO soil classification system (after Atkins, 1997)