L-3/T-1/CE

13/05/2024

Date : ~~25/04/2024~~

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B. Sc. Engineering Examinations 2021-2022

Sub : **CE 301** (Professional Practices 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. Answer any **THREE** questions.

1. (a) Define 'Civil Engineer' as per ASCE Body of Knowledge. **(5)**
   (b) Briefly discuss three measures of project activity. **(10)**
   (c) What are the attributes of an effective Brief? **(10)**
   (d) What are 'Thick Twice' contract clauses.? **(10)**

2. (a) Compare DBB and DB. **(5)**
   (b) What are different types of Project Delivery Systems, Procurement Methods and Contract Formats? **(10)**
   (c) What are the specific concerns of professional liability insurance? **(10)**
   (d) Briefly discuss 'General Liability Insurance' and 'Employment Practices Liability Insurance'. **(5)**
   (e) What do you understand by the term 'Fiduciary Risk'? **(5)**

3. (a) What do you understand by Scope-Schedule-Budget triangle relationship of a project? **(7)**
   (b) What are the ways of dealing with contract risk? **(8)**
   (c) Why AEC industry is infamous for its fragmentation? Explain. **(10)**
   (d) What are the common client concerns during predesign phase? **(5)**
   (e) Briefly discuss Bid Bond and Performance Bond. **(5)**

4. (a) Describe the tender process using a flow-chart. **(15)**
   (b) In a tabular format, show the GCC and PCC provisions for the following items for a construction contract. **(20)**
   (i) Liquidated Damage (ii) Completion Time (iii) Retention Money (iv) Price adjustment

SECTION - B

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

Assume any reasonable value of missing data.

5. (a) Briefly describe the three main elements of non-verbal communication. What is defined as problem and barrier to communication? List the major problems with sub-categories. Briefly explain denotation and abstraction. **(15)**

Contd P/2

CE 301

Contd...Q.No. 5

(b) In a standard format prepare a BoQ of the following work item:
Concreting work in the foundation of a multi-storied building having 50 m^3 of work volume. **(15)**

(c) List the documents that form the contract for procurement of works in order of priority. **(5)**

6. (a) What are the fundamental principles of code of ethics for engineers? Describe. **(12)**

(b) As per ASCE Code of Ethics lecture notes given to you, what is the responsibility of an engineer to a client or employer? **(20)**

(c) Provide an example of how a civil engineer can contribute to extending public knowledge in accordance with the code of ethics. **(3)**

7. (a) What leadership styles are followed in meetings? Briefly explain. In your opinion, which method is more effective and why? **(20)**

(b) List the seven C's of communication. **(9)**

(c) Outline the structure of a short report. **(6)**

8. (a) Name the different methods for procurement of services and describe the applicability of each. **(20)**

(b) Under the QCBS procurement, the following evaluation results are available: **(15)**

Proposal Submitted By	Technical Score (S_T) (100)	Financial Offer Value (million BDT)
Alpha Consulting	84	5.5
GBH	76	-
Omega Advisory	90	6.0
Peter IT Solutions	87	6.2
Giga Solutions	95	6.5

The technical qualifying mark is set at 80%, while the weightage for the technical score is also 80%.

Find the ranking of the proposals. What would be the next step after the ranking is established?

L-3/T-1/CE Date: 20/05/2024

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B.Sc. Engineering Examinations 2022-2023

Sub: **CE 311 (Structural Analysis)**

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 any **THREE** questions.

1. (a) Using Portal Method, analyze the multi-storied frame for the lateral loads shown in Fig. 1, Furthermore, draw shear force diagram, bending moment diagram and axial force diagram for columns and beams **(28)**

   (b) Compute the absolute maximum moment within a simply supported beam of 90 ft span for the series of wheel loads shown in Fig. 2. **(18 $\frac{2}{3}$)**

2. (a) Using Cantilever Method, analyze the indeterminate frame for the lateral loads as shown in Fig.3 and draw (i) axial force diagram, (ii) shear force diagram, and (iii) bending moment diagram of all beams and columns. Note: Numbers beside the columns indicate their cross-sectional area in inch^2 **(28)**

   (b) Analyze the frame as shown in Fig. 4 and draw shear force and bending moment diagram of the frame **(18 $\frac{2}{3}$)**

3. (a) Determine the member force of AB, AF, BF, BG, FG, FC and EF of the indeterminate truss as shown in Fig. 5, using appropriate assumptions. Assume, the diagonals are slender **(28)**

   (b) Calculate the maximum shear at one-fourth point from left support of a simply supported beam of 100 ft span, due to the wheel loads shown in Fig. 6. **(18$\frac{2}{3}$)**

4. (a) For the truss shown in Fig. 7, draw influence lines for axial force in member AF, AB, BF, CF, GF. Determine the maximum compressive force in CF if it is subjected to a moving concentrated load of 20 kips. **(28)**

   (b) Analyze the frame as show in Fig. 8 and draw shear force and bending moment diagram consider internal hinge at C. **(18$\frac{2}{3}$)**

Contd P/2

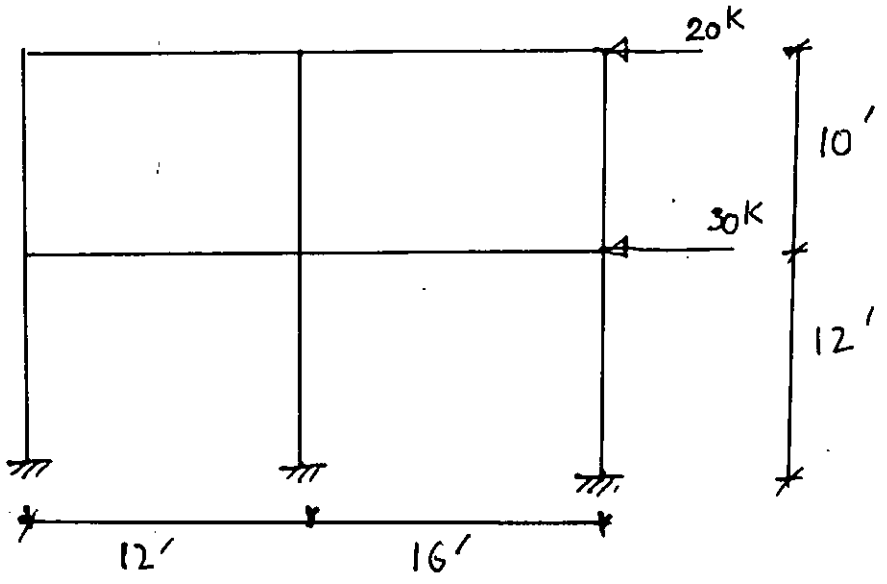


Fig-1

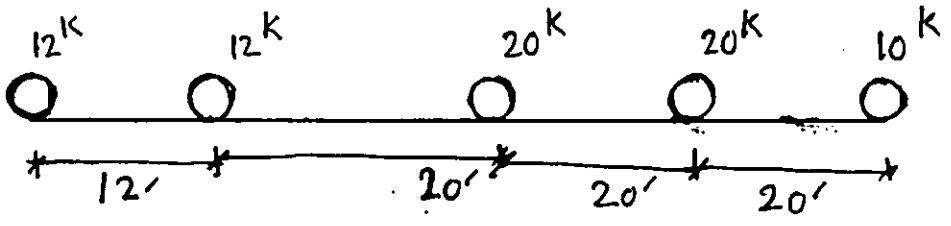


Fig-2

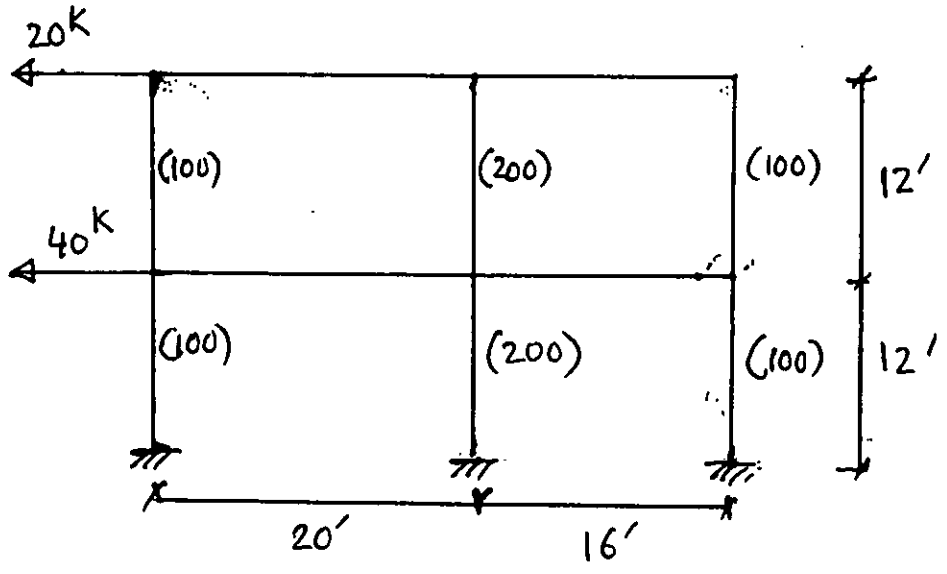


Fig-3

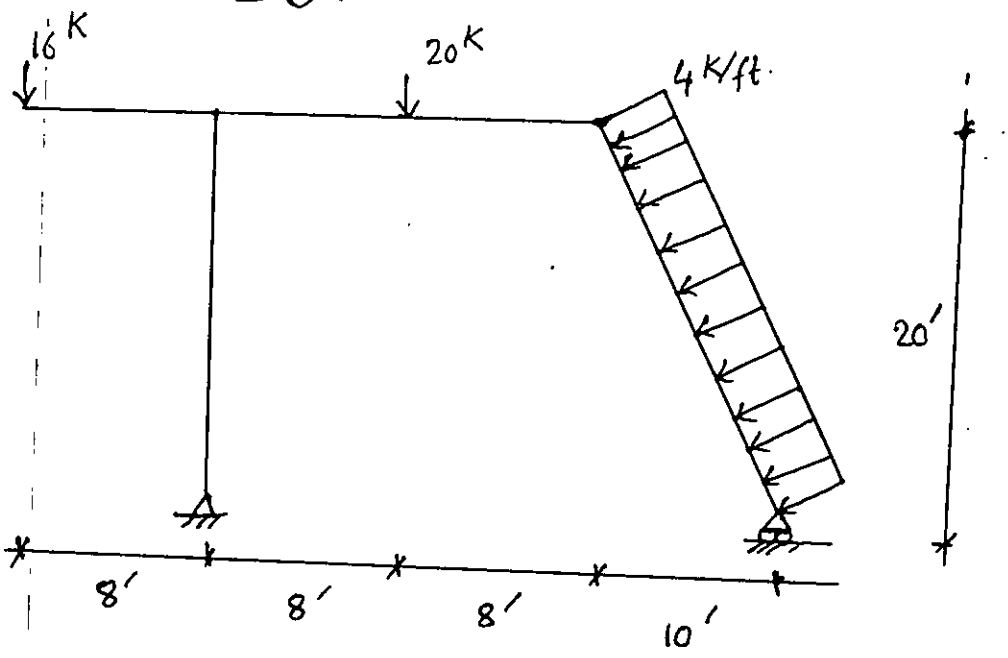


Fig-4

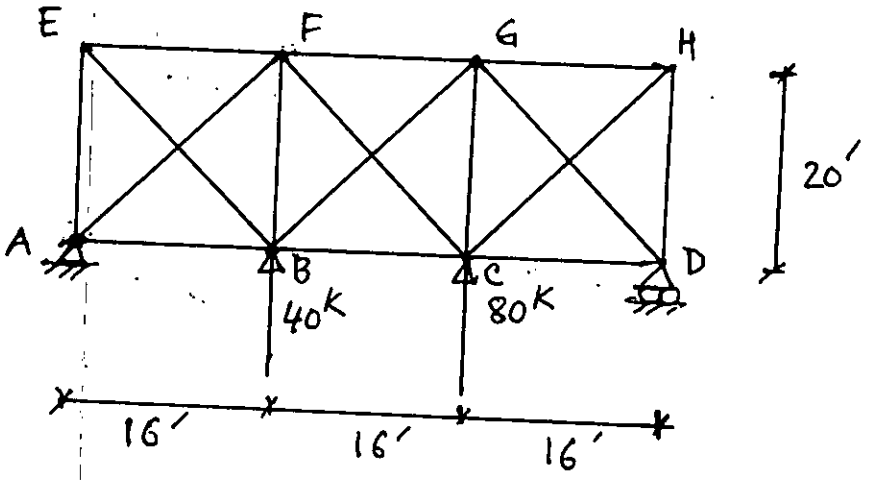


Fig-5

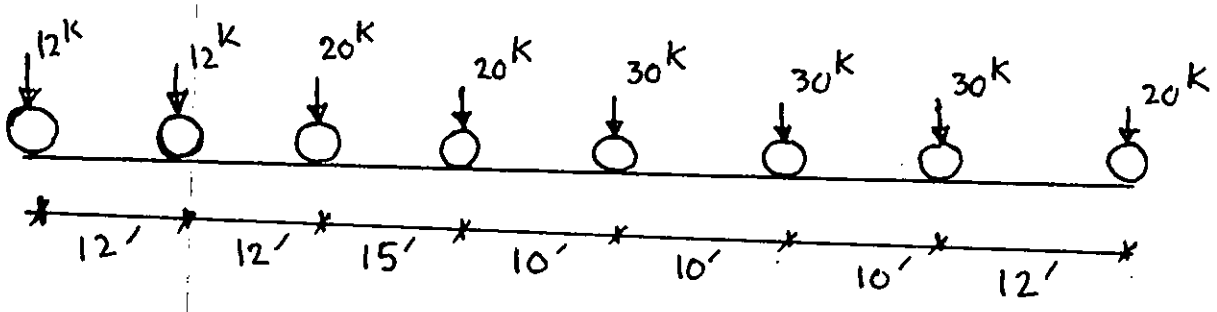


Fig-6

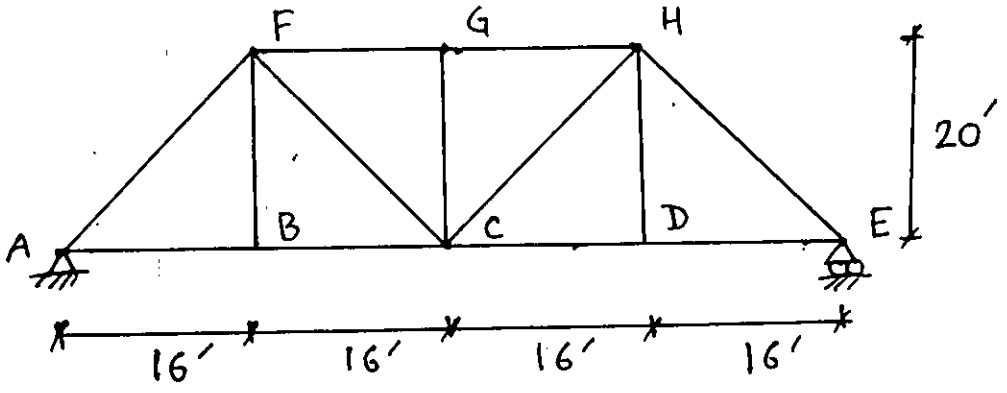


Fig-7

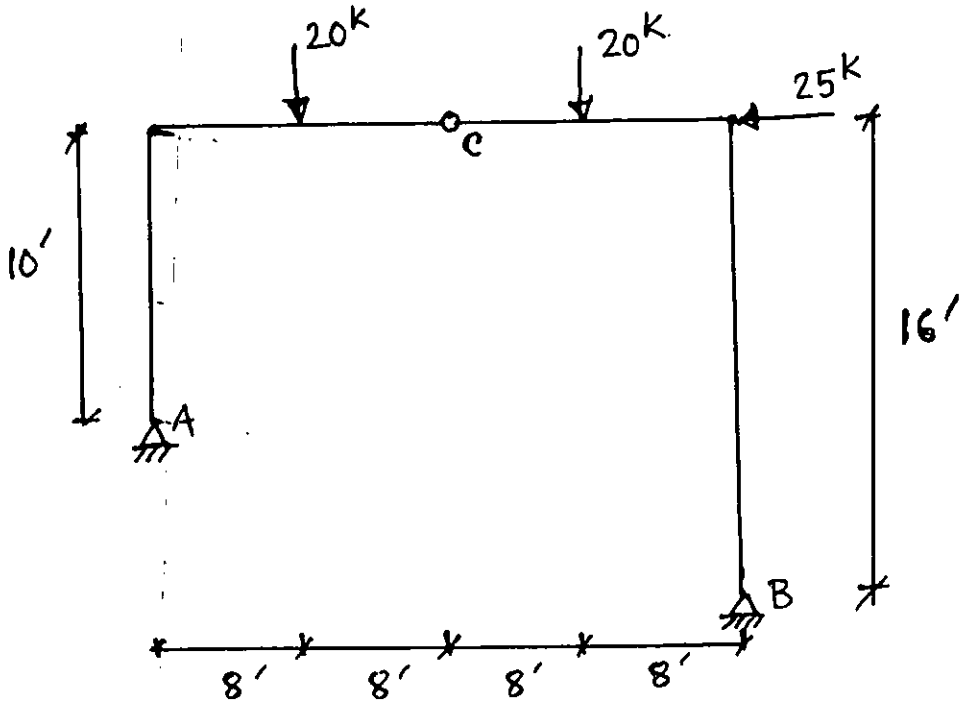


Fig-8

CE 311

SECTION – B

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

5. (a) Using the method of virtual work, find rotation of join b of the frame shown in Fig. 9. Consider the deflection of each member of the frame is caused by the bending strain energy. Given that E = 29000 ksi, $I_1 = 600$ in^4, $I_2 = 1.5I_1$. E is same for all sections. **(23 $\frac{2}{3}$)**

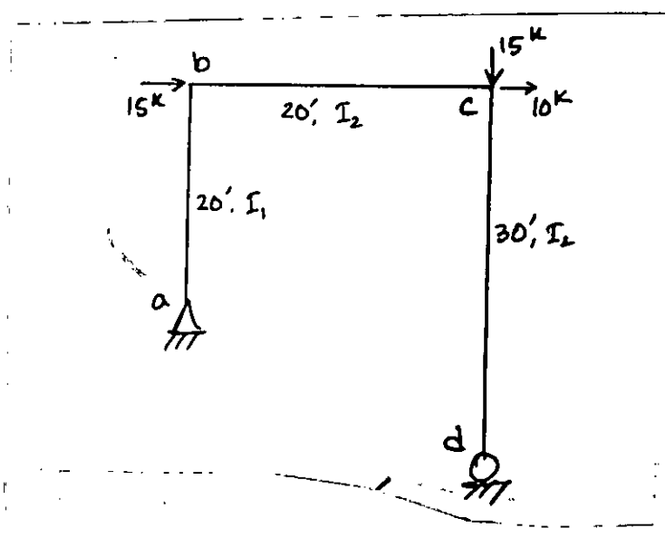


Fig. 9

(b) A girder shown in Fig. 10 is suspended from a parabolic cable of a suspension bridge. Draw bending moment diagram of the girder when the structure is subjected to the loading shown in figure. **(23)**

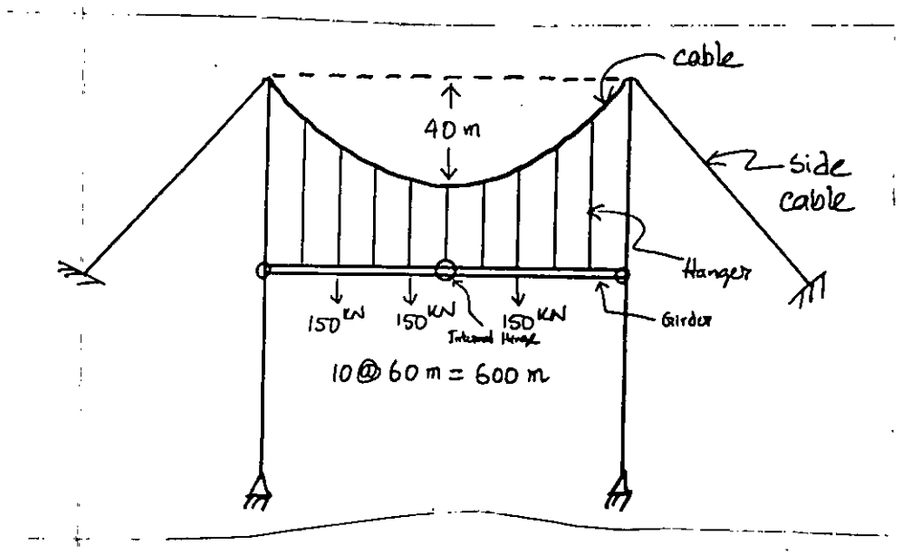


Fig. 10

CE 311

6. (a) Using the method of virtual work, determine vertical deflection of point **b** of the beam shown in Fig. 11. Consider that deflection of the beam is primarily caused by the bending strain energy. Given that E = 29000 ksi, I_1 = 750 in^4, $I_2 = 1.5I_1$. E is same for all sections. **(23)**

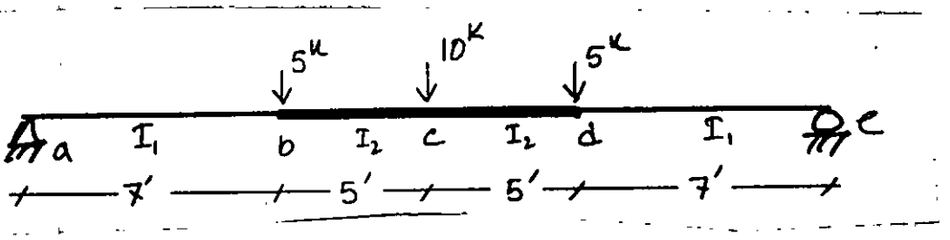


Fig. 11

(b) A truss member *ef* shown in Fig. 12 is fabricated 1.0 inch longer than the specification. Using the method of virtual work, determine the horizontal deflection of joint *f* of this loaded truss. Each member's cross-sectional area is shown in the figure in bracket (unit of Area is in^2). Given that E = 29000 ksi. **(23 $\frac{2}{3}$)**

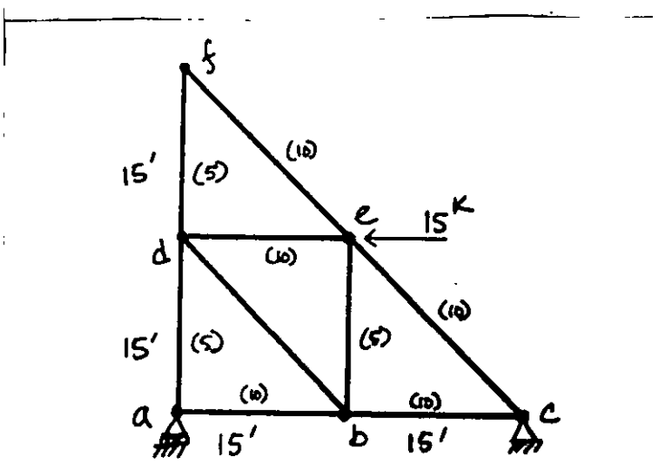


Fig. 12

7. (a) A 6 storied reinforced concrete residential building is located at Dhaka. Each story height of the building is 3 m, depth of the base is 2 m. Building plan dimension is 30 m X 30 m. Seismic zone coefficient (Z) = 0.20 and damping correction factor (η) = 1.2. Dead load including self-weight is 10 kN/m^2 and live load is 2 kN/m^2 for typical floors. Roof live load is 1 kN/m^2. Self-weight of all pedestals is 150 kN. Assume that GF having an RC floor will occupy typical floor loads. Determine earthquake base shear and story forces at Level 3 and 4. Follow BNBC 2020 for Earthquake Load Calculation. Use Tables 1 - 3 and following equations. Given that harmonic average value of SPT in the top 30 m soil of the building site is 13 (blows/30 cm). **(26 $\frac{2}{3}$)**

Contd P/7

CE 311

Contd... Q. No. 7(a)

$C_S = 2.5S\eta\left(\frac{T_C}{T}\right)$ for $T_C \le T \le T_D$ $\qquad$ $C_S = 2.5S\eta$ for $T_B \le T \le T_C$

$C_S = S\left(1+\frac{T}{T_B}(2.5\eta-1)\right)$ for $0 \le T \le T_B$ $\qquad$ $C_S = 2.5S\eta\left(\frac{T_C T_D}{T^2}\right)$ for $T_D \le T \le 4$ sec

(b) A single storied shed-building is located on a 2-D escarpment (shown in Fig. 13) of Tangail. The building- plan dimension is 20 m by 80 m. The total height of the building is 12 m including eave height of 10 m. Assume that building's site conditions and locations of the structure meet the first two conditions of wind speed up effect. Given that the building classification is enclosed and surface roughness B prevails in both upwind and downwind of the terrain. Basic wind speed of Tangail is 50.6 m/s. Determine the horizontal and vertical design wind pressures in the transverse direction of MWFRS of the building considering the maximum value of the topographic factor. Follow simplified procedure of BNBC 2020. Use Tables 4 to 6. **(20)**

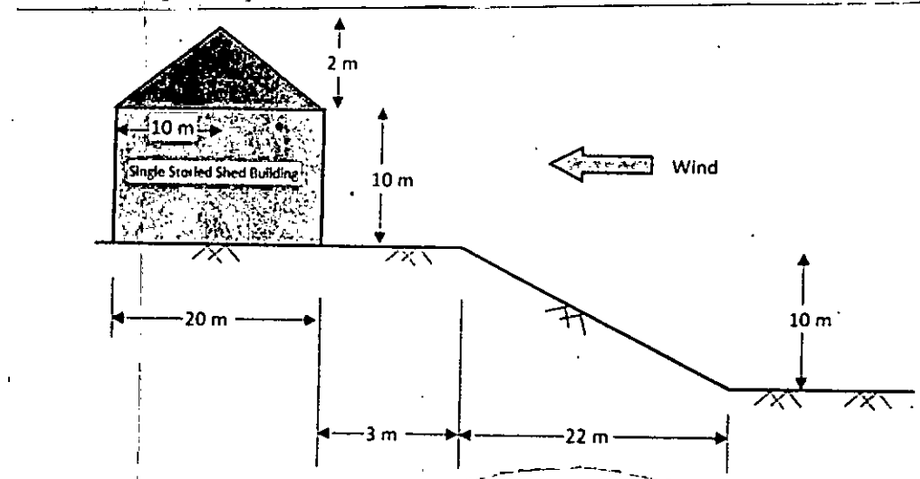


Fig. 13

8. (a) Briefly discuss the enclosure classification for determining internal wind pressure of building as per BNBC 2020. **(5)**

(b) Write down the conditions that must be satisfied for Simplified Procedure of wind load calculation (for MWFRS) following BNBC 2020. **(5)**

(c) A typical 4-storied RC office building is located on top of a 3-D axisymmetric hill of Mymensingh as shown in Fig. 14. Building plan dimension is 15 m × 15 m, each story height is 3 m and the height of parapet is 750 mm. Occupancy category is II and exposure category is B. Basic wind speed of Mymensingh is 67.4 m/s. **($36\frac{2}{3}$)**

Contd P/8

CE 311

Contd... Q. No. 8(c)

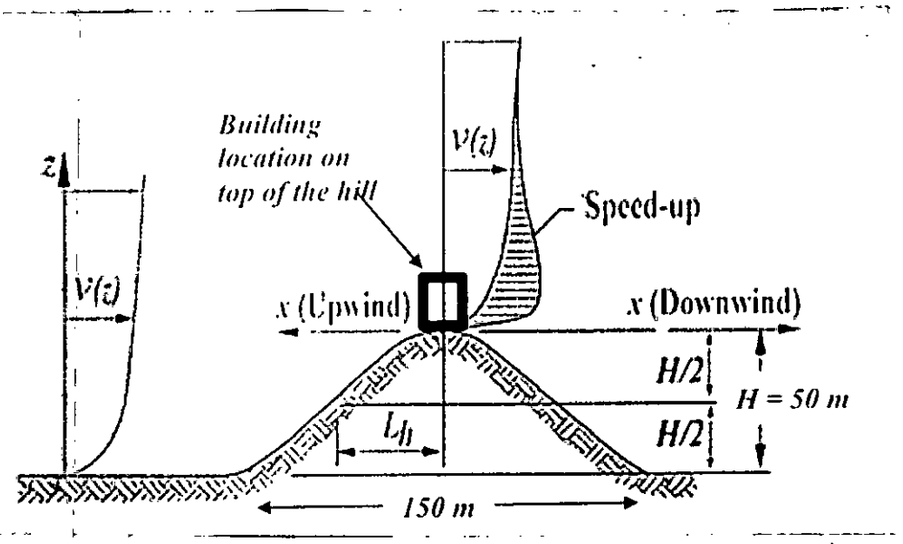


Fig. 14

Assume that the building is classified as enclosed. Equations of velocity pressure exposure coefficient are given below, where symbols have usual meanings.

$$K_z = 2.01\left(Z/Z_g\right)^{2/\alpha} \text{ for } 4.57 \text{ m} \le z \le z_g$$

$$K_z = 2.01\left(4.57/Z_g\right)^{2/\alpha} \text{ for } z < 4.57 \text{ m}$$

Approximate fundamental frequency of the building can be calculated from the following equation.

$n_1 = \dfrac{100}{H}$ where H is in *ft*.

Determine (i) topographic factor, (ii) the gust effect factor (G), (iii) the design wind pressure, (iv) horizontal base reaction due to the design wind pressure, (v) the design wind pressure in the windward and leeward parapet. Given that combined network pressure coefficient for windward parapet is 1.5 and for leeward parapet is -1.0.

See Tables 4, 7, 8 and Appendix A for solving this problem.

Chart 1: Integration Chart

Table for Evaluating $\int_0^L m\, m'\, dx$

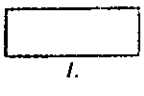
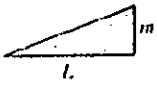
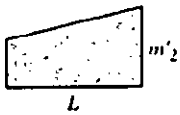
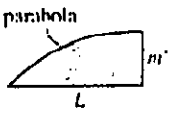
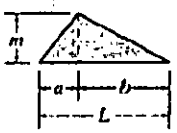
$\int_0^L m\, m'\, dx$				
	$mm'L$	$\frac{1}{2}mm'L$	$\frac{1}{2}m(m'_1 + m'_2)L$	$\frac{2}{3}mm'L$
	$\frac{1}{2}mm'L$	$\frac{1}{3}mm'L$	$\frac{1}{6}m(m'_1 + 2m'_2)L$	$\frac{5}{12}mm'L$
	$\frac{1}{2}m'(m_1 + m_2)L$	$\frac{1}{6}m'(m_1 + 2m_2)L$	$\frac{1}{6}[m'_1(2m_1 + m_2) + m'_2(m_1 + 2m_2)]L$	$\frac{1}{12}[m'(3m_1 + 5m_2)]L$
	$\frac{1}{2}mm'L$	$\frac{1}{6}mm'(L + a)$	$\frac{1}{6}m[m'_1(L + b) + m'_2(L + a)]$	$\frac{1}{12}mm'\left(3 + \frac{3a}{L} - \frac{a^2}{L^2}\right)L$
	$\frac{1}{2}mm'L$	$\frac{1}{6}mm'L$	$\frac{1}{6}m(2m'_1 + m'_2)L$	$\frac{1}{4}mm'L$

Table 1

Table 6.2.19: Response Reduction Factor, Deflection Amplification Factor and Height Limitations for Different Structural Systems

Seismic Force-Resisting System	Response Reduction Factor, R	System Overstrength Factor, Ω_o	Deflection Amplification Factor, C_d	Seismic Design Category B	Seismic Design Category C	Seismic Design Category D
				Height limit (m)		
C. MOMENT RESISTING FRAME SYSTEMS (no shear wall)						
1. Special steel moment frames	8	3	5.5	NL	NL	NL
2. Intermediate steel moment frames	4.5	3	4	NL	NL	35
3. Ordinary steel moment frames	3.5	3	3	NL	NL	NP
4. Special reinforced concrete moment frames	8	3	5.5	NL	NL	NL
5. Intermediate reinforced concrete moment frames	5	3	4.5	NL	NL	NP
6. Ordinary reinforced concrete moment frames	3	3	2.5	NL	NP	NP

10.7

Table 2

Site Class	Occupancy Category I, II and III				Occupancy Category IV			
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 1	Zone 2	Zone 3	Zone 4
SA	B	C	C	D	C	D	D	D
SB	B	C	D	D	C	D	D	D
SC	B	C	D	D	C	D	D	D
SD	C	D	D	D	D	D	D	D
SE, S_1, S_2	D	D	D	D	D	D	D	D

Table 3

Site Dependent Soil Factor and Other Parameters Defining Elastic Response Spectrum

Soil type	S	T_B(s)	T_C (s)	T_D (s)
SA	1.0	0.15	0.40	2.0
SB	1.2	0.15	0.50	2.0
SC	1.15	0.20	0.60	2.0
SD	1.35	0.20	0.80	2.0
SE	1.4	0.15	0.50	2.0

Table 4: Parameters for K_{zt}

Parameters for Speed-Up Over Hills and Escarpments						
Hill Shape	$K_1/(H/L_h)$			γ	μ	
	Exposure A	Exposure B	Exposure C		Upwind of crest	Downwind of Crest
2-dimensional ridges (or valleys with negative H in $K_1/(H/L_h)$	1.30	1.45	1.55	3	1.5	1.5
2-dimensional escarpments	0.75	0.85	0.95	2.5	1.5	4
3-dimensional axisym. Hill	0.95	1.05	1.15	4	1.5	1.5

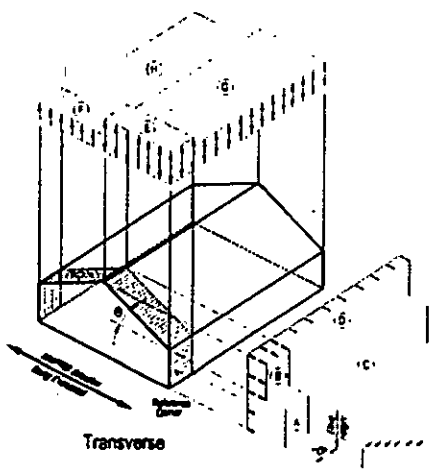


Fig. 7: Design pressure zones

Table 5: Adjustment factor

Adjustment Factor for Building Height and Exposure, λ			
Mean roof height (ft)	Exposure		
	A	B	C
15	1.00	1.21	1.47
20	1.00	1.29	1.55
25	1.00	1.35	1.61
30	1.00	1.40	1.66
35	1.05	1.45	1.70
40	1.09	1.49	1.74
45	1.12	1.53	1.78
50	1.16	1.56	1.81
55	1.19	1.59	1.84
60	1.22	1.62	1.87

Table 6 [*ps30* in *psf*]

Basic Wind Speed (mph)	Roof Angle (degrees)	Load Case	Zones									
			Horizontal Pressures				Vertical Pressures				Overhangs	
			A	B	C	D	E	F	G	H	EOH	GOH
110	0 to 5°	1	19.2	-10.0	12.7	-5.9	-23.1	-13.1	-16.0	-10.1	-32.3	-25.3
	10°	1	21.6	-9.0	14.4	-5.2	-23.1	-14.1	-16.0	-10.8	-32.3	-25.3
	15°	1	24.1	-8.0	16.0	-4.6	-23.1	-15.1	-16.0	-11.5	-32.3	-25.3
	20°	1	26.6	-7.0	17.7	-3.9	-23.1	-16.0	-16.0	-12.2	-32.3	-25.3
	25°	1	24.1	3.9	17.4	4.0	-10.7	-14.6	-7.7	-11.7	-19.9	-17.0
		2	------	------	------	------	-4.1	-7.9	-1.1	-5.1	------	------
	30 to 45	1	21.6	14.8	17.2	11.8	1.7	-13.1	0.6	-11.3	-7.6	-8.7
		2	21.6	14.8	17.2	11.8	8.3	-6.5	7.2	-4.6	-7.6	-8.7
120	0 to 5°	1	22.8	-11.9	15.1	-7.0	-27.4	-15.6	-19.1	-12.1	-38.4	-30.1
	10°	1	25.8	-10.7	17.1	-6.2	-27.4	-16.8	-19.1	-12.9	-38.4	-30.1
	15°	1	28.7	-9.5	19.1	-5.4	-27.4	-17.9	-19.1	-13.7	-38.4	-30.1
	20°	1	31.6	-8.3	21.1	-4.6	-27.4	-19.1	-19.1	-14.5	-38.4	-30.1
	25°	1	28.6	4.6	20.7	4.7	-12.7	-17.3	-9.2	-13.9	-23.7	-20.2
		2	------	------	------	------	-4.8	-9.4	-1.3	-6.0	------	------
	30 to 45	1	25.7	17.6	20.4	14.0	2.0	-15.6	0.7	-13.4	-9.0	-10.3
		2	25.7	17.6	20.4	14.0	9.9	-7.7	8.6	-5.5	-9.0	-10.3

Table 7: External Pressure Coefficient

Wall Pressure Coefficients, C_p			
Surface	L/B	C_p	Use With
Windward Wall	All values	0.8	q_z
Leeward Wall	0-1	-0.5	q_h
	2	-0.3	
	≥ 4	-0.2	
Side Wall	All values	-0.7	q_h

Table 8: Terrain Exposure Constants

Exposure	α	z_g (m)	$\hat{a}$	$\hat{b}$	$\bar{\alpha}$	$\bar{b}$	c	l (m)	$\bar{\varepsilon}$	z_{min} (m)*
A	7.0	365.76	1/7	0.84	1/4.0	0.45	0.30	97.54	1/3.0	9.14
B	9.5	274.32	1/9.5	1.00	1/6.5	0.65	0.20	152.4	1/5.0	4.57
C	11.5	213.36	1/11.5	1.07	1/9.0	0.80	0.15	198.12	1/8.0	2.13

*z_{min} = Minimum height used to ensure that the equivalent height z is greater of $0.6h$ or z_{min}.
For buildings with $h \leq z_{min}$, $\bar{z}$ shall be taken as z_{min}.

Appendix A: BNBC 2020 Provisions for Gust Effect Factor Calculations

2.4.8.1 Rigid structures

For rigid structures as defined in Sec 2.1.3, the gust-effect factor shall be taken as 0.85 or calculated by the formula:

$$G = 0.925\frac{1+1.7g_Q I_{\bar{z}} Q}{1+1.7g_v I_{\bar{z}}} \quad (6.2.6)$$

$$I_{\bar{z}} = c\left(\frac{10}{\bar{z}}\right)^{1/6} \quad (6.2.7)$$

Where, $I_{\bar{z}}$= the intensity of turbulence at height $\bar{z}$ where $\bar{z}$ = the equivalent height of the structure defined as $0.6h$, but not less than z_{min} for all building heights h. z_{min} and c are listed for each exposure in Table 6.2.10; g_Q and the value of g_v shall be taken as 3.4. The background response $Q$is given by

$$Q = \sqrt{\frac{1}{1+0.63\left(\frac{B+h}{L_{\bar{z}}}\right)^{0.63}}} \quad (6.2.8)$$

Where, B, h are defined in Sec 2.1.4; and $L_{\bar{z}}$ = the integral length scale of turbulence at the equivalent height given by

$$L_{\bar{z}} = l\left(\frac{\bar{z}}{10}\right)^{\bar{\epsilon}} \quad (6.2.9)$$

In which $l$and $\bar{\epsilon}$ are constants listed in Table 6.2.10.

2.4.8.2 Flexible or dynamically sensitive structures

For flexible or dynamically sensitive structures as defined in Sec 2.1.3 (natural period greater than 1.0 second), the gust-effect factor shall be calculated by

$$G_f = 0.925\left(\frac{1+1.7I_{\bar{z}}\sqrt{g_Q^2Q^2+g_R^2R^2}}{1+1.7g_v I_{\bar{z}}}\right) \quad (6.2.10)$$

The value of both g_Q and g_V shall be taken as 3.4 and g_R is given by

$$g_R = \sqrt{2\ln(3600n_1)} + \frac{0.577}{\sqrt{2\ln(3600n_1)}} \quad (6.2.11)$$

R, the resonant response factor, is given by

$$R = \sqrt{\frac{1}{\beta}R_n R_h R_B(0.53 + 0.47R_L)} \quad (6.2.12)$$

$$R_n = \frac{7.47N_1}{(1+10.3N_1)^{5/3}} \quad (6.2.13)$$

$$N_1 = \frac{n_1 L_{\bar{z}}}{\bar{V}_{\bar{z}}} \quad (6.2.14)$$

$$R_l = \frac{1}{\eta} - \frac{1}{2\eta^2}(1 - e^{-2\eta}) \text{ for } \eta > 0 \quad (6.2.15a)$$

$$R_l = 1 \text{ for } \eta = 0 \quad (6.2.15b)$$

Where, the subscript l in Eq. 6.2.15 shall be taken as h, B, and L, respectively, where h, B, and L are defined in Sec 2.1.4.

n_1 = building natural frequency

$R_l = R_h$ setting $\eta = 4.6n_1h/\bar{V}_{\bar{z}}$

$R_l = R_B$ setting $\eta = 4.6n_1B/\bar{V}_{\bar{z}}$

$R_l = R_L$ setting $\eta = 15.4n_1L/\bar{V}_{\bar{z}}$

β = damping ratio, percent of critical

$\bar{V}_{\bar{z}}$ = mean hourly wind speed at height $\bar{z}$ determined from Eq. 6.2.16.

$$\bar{V}_{\bar{z}} = \bar{b}\left(\frac{\bar{z}}{10}\right)^{\bar{\alpha}} V \quad (6.2.16)$$

Where, $\bar{b}$ and $\bar{\alpha}$ are constants listed in Table 6.2.10.

L-3/T-1/CE Date: ~~05/05/2024~~ 26/5/24

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B. Sc. Engineering Examinations 2022-2023

Sub: **CE 331** (Environmental Engineering 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**.

1. (a) What is the role of an Environmental Engineering? Describe with examples. Explain the Energy-Environment Nexus with examples. What are the challenges of using Renewable Energy in Bangladesh? **(18)**

   (b) Determine the capacity of a pump to supply water from a treatment plant to an elevated water tank using the following data. **(10)**

   Volume of water to be pumped in a day: 8000 m^3

   Pumping Hours: 8 hr. daily.

   RL of Treatment Plant: 200 m

   RL of Pump Station: 195 m

   RL of elevated water Tank: 250 m

   Total Length of Pipe: 500 m

   Friction Factor: 0.01

   Velocity of water: 8 ft/sec

   Pump Efficiency: 75%

   (c) Describe the three major activities in a Water Safety Plan (WSP)? **(7)**

2. (a) State the SDG 6 and Target 6.1. What are the challenges to achieve this target and what measures are undertaken to overcome those? Describe. **(17)**

   Determine the volume of a Storage Tank to collect rainwater from the roof catchment of the concrete building as shown in Figure 1. The average annual rainfall is 1100 mm. Assume any reasonable value of missing data if necessary.

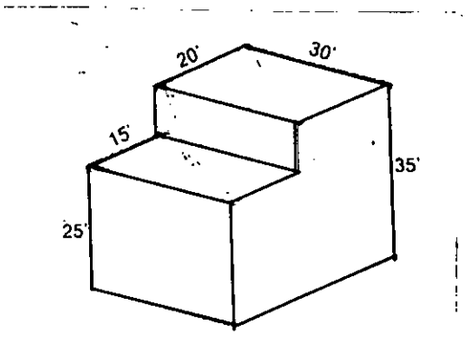


Figure 1 for Question No. 2 (a)

Contd P/2

CE 331

Contd... Q. No. 2

(b) How is activated carbon prepared? What are the advantages and disadvantages of using Granular Activated Carbon (GAC) and Powdered Activated Carbon (PAC)? **(8)**

(c) A home water softener has 0.2 m^3 of ion exchange resin with exchange capacity of 82 kg/m^3. The occupants use 3000 L of water per day. If the water contains 320 mg/L of hardness as $CaCO_3$ and it is desired to soften it to 75 mg/L as $CaCO_3$ how much should be bypassed? What is the time between regeneration cycles? **(10)**

3. (a) A settling column analysis is run on a type-I suspension. The settling column is 3 m tall and initial suspended solids concentration of the well-mixed sample is 600 mg/L. Results of the analysis are shown below: **(17)**

Time (min)	0	58	77	91	114	154	250
Concentration remaining (mg/L)	600	540	405	305	200	120	45

What is the theoretical efficiency of the settling basin that receive this suspension if the loading rate is 2.1×10^{-2} m/min?

(b) When is filter backwashing done? Explain how dual and mixed-media filters can increase the effectiveness of filtration. Differentiate between physical adsorption and chemisorption. **(18)**

4. (a) Determine the chemical dosage to soften the water having the following composition to meet the criteria of maximum Mg-hardness of 30 mg/L as $CaCO_3$ and Total hardness of 80-120 mg/L as $CaCO_3$: **(15)**

CO_2	5.5 mg/L
Ca^{2+}	87 mg/L
Mg^{2+}	18 mg/L
Na^{+}	24 mg/L
Alk.	182 mg/L (as $CaCO_3$)
Cl^{-}	65 mg/L
SO_4^{2-}	68 mg/L

(b) Write short notes on: **(20)**

(i) Water stabilization and recarbonation

(ii) Roughing filtration

(iii) Double-layer compression

(iv) Difference among Fe, Mn, and As oxidation.

Contd P/3

CE 331

SECTION – B

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

Assume reasonable values for any missing data.

5. (a) Derive an expression for the steady radial flow (Q) of water in a well installed in a confined aquifer. State the assumptions considered in the derivation of the expression. **(10+8)**

A 6-inch (0.15 m) diameter well pumping from a 35 m thick confined aquifer produces water at a rate of 950 L/min, when the drawdown is 7.5 m and the radius of influence is 950 m. If the static water level is 65 m (from the bottom of the aquifer), estimate the hydraulic conductivity of the aquifer.

(b) Define the following parameters for aquifers: (i) Storativity, (ii) Specific yield. **(7)**

An unconfined aquifer with a specific yield of 0.14 has an area of 23 sq. km. If the water table drops by 2.6 m during a dry season, how much water is lost from the storage of the aquifer?

(c) List the tubewell technologies commonly used in Bangladesh. What is the maximum static water level from which a No. 6 handpump tubewell can abstract water? Explain. What type of handpump tubewell can be used if the water level drops below this level (e.g., during the dry season)? What is the abstraction limit of such handpump technologies? **(10)**

6. (a) Explain how the following factors affect per capita consumption of water: (i) pressure of water, (ii) quality of water, (iii) sewerage facilities. **(8)**

What do you understand by non-revenue water (NRW)? Explain.

(b) How many fire streams should be available for a protected area of a city?

The population of a city is 65,000. Determine the total streamflow required for firefighting for the city, considering the flow from each stream to be 950 L/min. Also, determine the storage required for a five-hour availability of water for firefighting. **(9)**

(c) The following information is available from a test boring carried out for the installation of a deep tubewell: **(18)**

- Static water level: 150 ft. (from the ground surface)
- Suitable water-bearing strata: 180 – 350 ft.
- Groundwater quality: Suitable for drinking purposes
- Grain size distribution of the finest sand layer within the water-bearing strata is shown in Figure 2.
- Consider a 6-inch diameter strainer and a 14-inch diameter housing pipe

Design a deep tubewell based on the above information, including the position and length of the housing pipe, position and length of the strainer (consider maximum allowable length), gravel pack details, slot size/number of the strainer, and estimated yield of the well. Draw a section through the designed well showing all details, including the position and lengths of the housing pipe and strainer, blind pipe, and gravel pack.

Contd P/4

CE 331

Contd... Q. No. 6(c)

Notes: (i) Assume reasonable values for missing data; (ii) Percentage openings of 40-slot, 30-slot and 20-slot size strainers are 20%, 15% and 10%, respectively; (iii) Consider openings of sieves: #8: 2.36 mm, #16: 1.18 mm, #30: 0.60 mm, #40: 0.425 mm; (iv) Attach the worked out version of the attached Figure 2 with Answer Script.

7. (a) The following data is available on the population of a city. Based on this data, estimate the population of the city for the yers 2030 and 2040 using the "least square parabola method." **(11)**

Year	Population (Thousands)
1980	73
1990	80
2000	90
2010	102
2020	116

(b) Write short notes on: **(12)**

(i) Aquitard,

(ii) Perched aquifer, and

(iii) Flowing artesian well.

(c) Figure 3 shows a Branched Distribution Network for supplying water in a residential area. The average demand is 0.15 cusec at point C and 0.10 cusec at point D. The peak factor is 1.8, and loss and wastage is 10%. The pressure at point B is 40 psi, and the terminal pressure required is 30 psi. Lengths of BC and CD are 450 ft and 375 ft, respectively. Design the branch lines BC and CD. **(12)**

[Assume reasonable values for missing data, if needed; $h_f = (4fLv^2)/2gD$, symbols have their usual meanings]

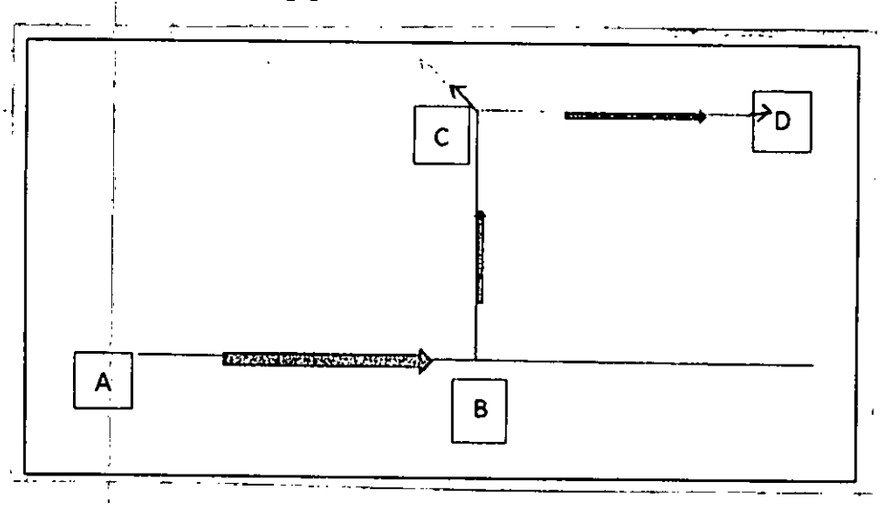


Figure 3 for Question No. 7 (c)

Contd P/5

CE 331

8. (a) (i) Explain the role of water vapor in global warming.

(ii) State the impacts of climate change on agricultural and human health. **(3+6+6)**

(iii) Write short notes on: (I) Wet intake, and (II) Water hammer.

(b) (i) Describe a water treatment technology for removing iron and arsenic in iron-arsenic problem areas in Bangladesh.

(ii) Draw qualitative pump performance curves. **(6+4+10)**

(iii) Describe the various water distribution network methods with their advantages and disadvantages.

Contd P/6

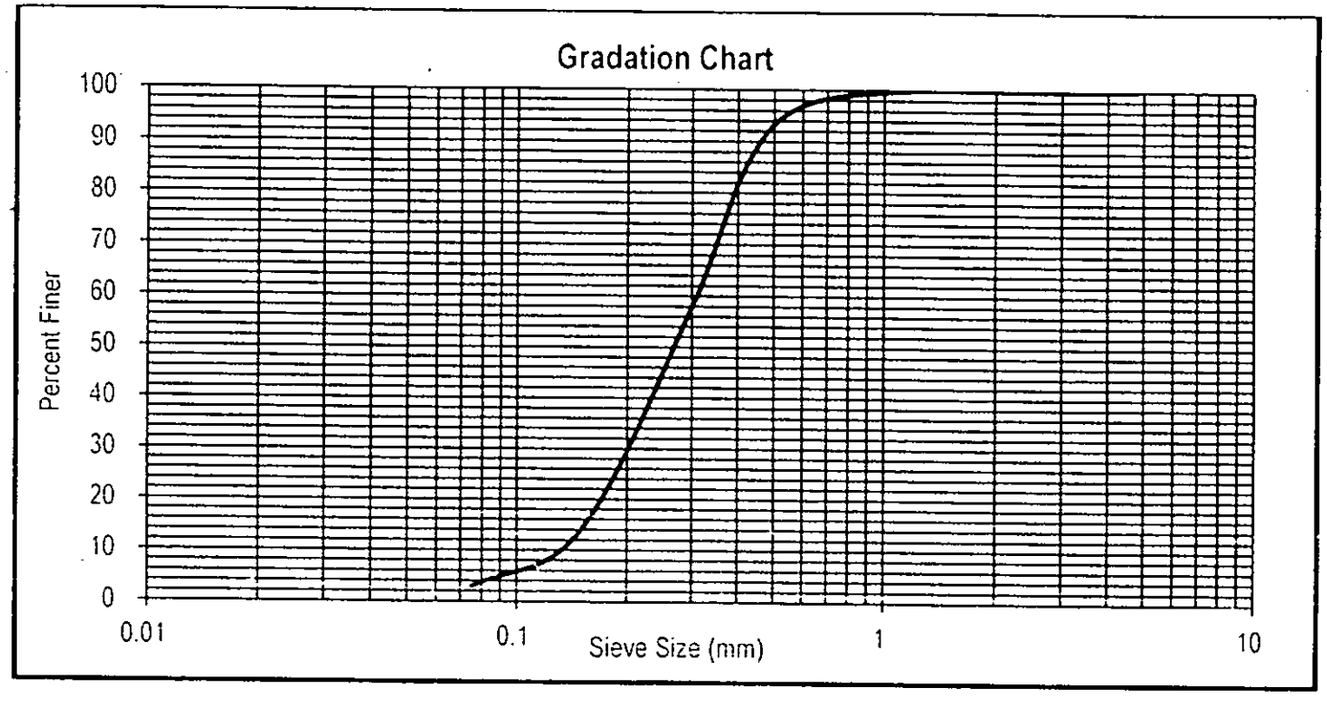


Figure 2 for Question Number 6(c)
[Attach the worked-out version of this figure with your Answer Script]