BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B.Sc. Engineering Examinations: January 2020 Term

Sub: **CE 271** (Building Services 1: Plumbing)

Full Marks: 120 Time: 2 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

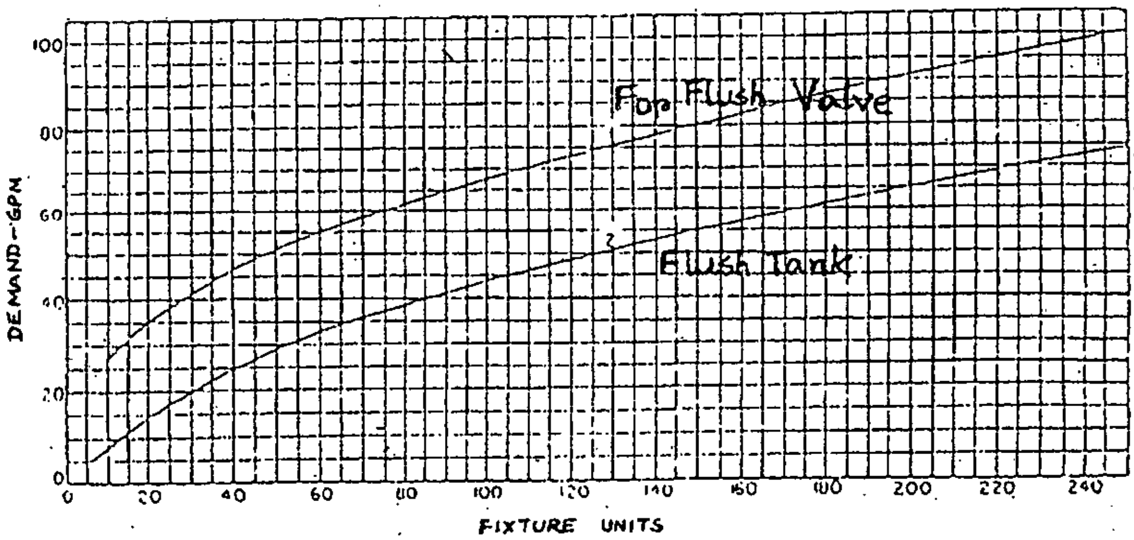
SECTION – A

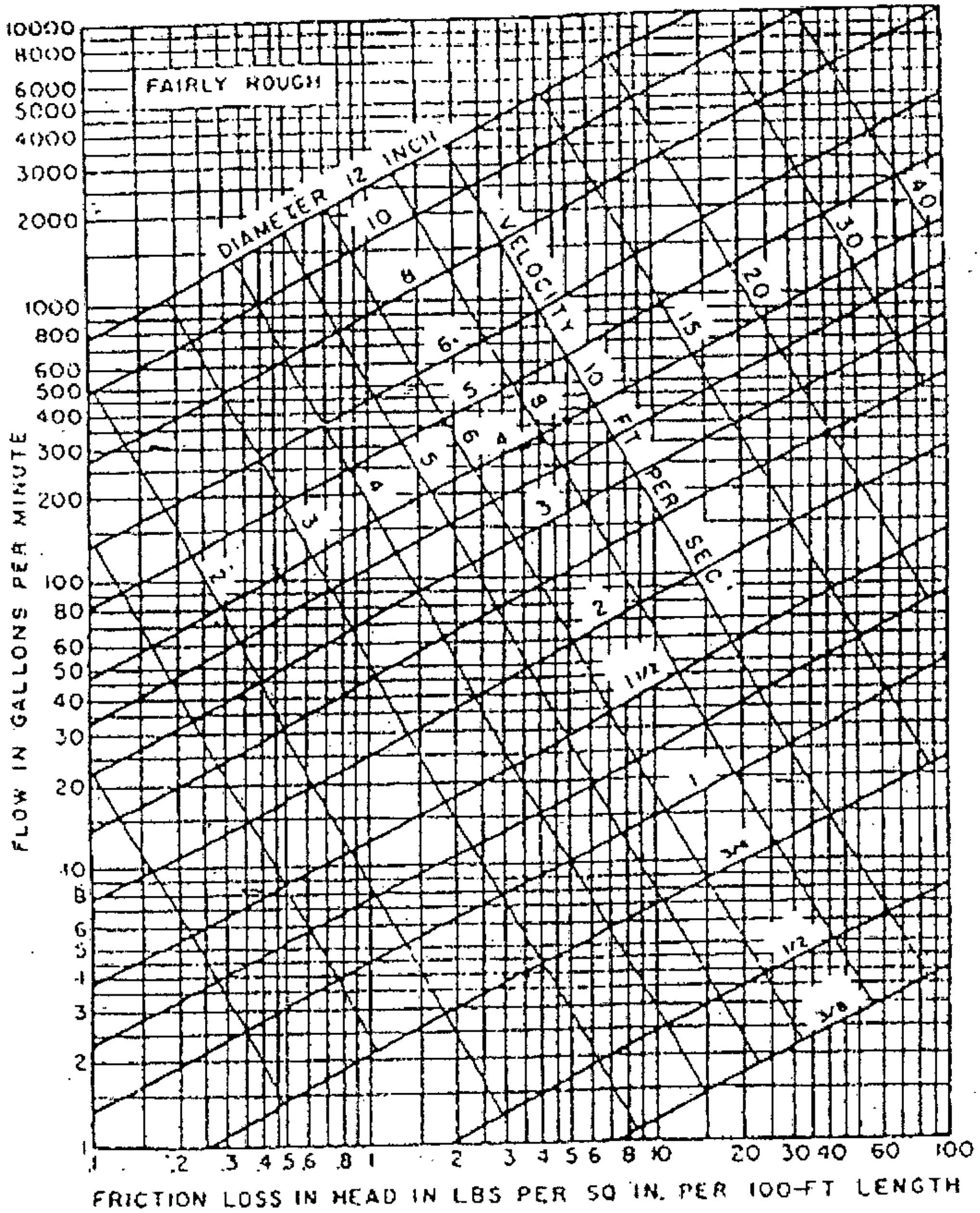
There are **FOUR** questions in this Section. Answer any **THREE.**

No.	Questions	Marks
1.	(a) List and explain the factors determining the per capita water consumption. With a diagram, describe the water cycle of a plumbing system.	8
	(b) You need to design the water distribution system of a 4-storied Apartment building by downfeed system. The main pressure is 40 psi and the minimum fixture pressure is 5 psi. Each storey has the following fixtures: Bathtub 1, Water Closet 3, Shower 2, Tap 4, Kitchen Sink 1 (i) Determine the minimum height of the Roof Tank of the building. (ii) Determine the water distribution pipe sizes of the building. (Table, Graph, Nomographs are attached).	12
2.	(a) What are the main requirements of supplying water to a building? With a neat sketch, describe the various components of a House Water Connection.	12
	(b) What rules should be followed in connecting the vertical stacks with building sewer for different drainage systems? What are the purposes and proper locations of Manholes?	8
3.	(a) What are the available sanitation technologies in rural areas of Bangladesh? Describe the design consideration of a Pour-flush latrine. Show a schematic diagram of twin pit pour flush latrine.	12
	(b) What are the causes of loss of trap seal? Describe with sketches.	8
4.	(a) Define DFU. Differentiate between (i) black water and grey water (ii) upfeed system and downfeed system	8
	(b) Write down the minimum sizes for the followings: (i) soil pipe (ii) waste pipe (horizontal) (iii) waste pipe (vertical) (iv) anti-siphonage pipe connecting soil pipe (v) vent pipe.	12

Table: Fixture Unit values

Type of Fixture	Fixture Unit Value	
	Private	Public
Lavatory	1	2
Bath tub	2	4
Water Closet (Flush tank)	3	5
Water Closet (Flush valve)	6	10
Urinal	----	5
Shower	2	4
Kitchen Sink	2	4
Hand wash basin	2	4
Ablution Tank	1	1




FAIRLY ROUGH
DIAMETER 12 INCH
VELOCITY 10 FT PER SEC.
FLOW IN GALLONS PER MINUTE
FRICTION LOSS IN HEAD IN LBS PER SQ IN. PER 100-FT LENGTH
10000
8000
6000
5000
4000
3000
2000
1000
800
600
500
400
300
200
100
80
60
50
40
30
20
10
8
6
5
4
3
2
1
.1
.2
.3
.4
.5
.6
.8
1
2
3
4
5
6
8
10
20
30
40
60
100

SECTION-B: CE 271

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

5	In a six storied apartment building at Dhaka, the ground floor is designed for parking vehicles while the other five floors are used for residential purpose. Each floor area is 1000sft and there is only one toilet per floor. Design the Underground reservoir, roof tank and the pump for the building. Clearly mention the assumptions. Provide necessary drawings of the piping systems.	20
6	Show the following plumbing systems of drainage with diagram: i)Single stack, ii) One-pipe system, iii) Two-pipe system, iv) Partially ventilated one pipe system. Mention the advantages and disadvantages of each of the systems.	20
7(a)	What is anti-siphonage pipe? Why anti-siphonage pipe is required? What sort of situation might arise in a building due to the absence of anti siphonage pipe in the system?	10
(b)	List the principles governing design of water supply in buildings.	10
8	What is a septic tank? Define effective volume and retention time. Using a diagram show the different components of a septic tank with a soak pit. Design a septic tank for a six storied residential building where 60 people reside.	20

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B.Sc. Engineering Examinations, Session: January 2020

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

Full Marks: 180 Time: 2 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) Distinguish between Act and Regulation. (10)

   (b) What is a procurement plan? In a tabular format show the information is to be disclosed in a procurement plan. (20)

2. (a) Describe the tender process using a flow-chart. (10)

   (b) List the essential elements of a tender document. (10)

   (c) List, in order of priority, the documents that form the Contract. (10)

3. (a) Describe the attributes of good specification. (10)

   (b) Write a specification for concrete works in foundation. (20)

4. (a) A tender data sheet is to be prepared for inviting a tender for construction of a 20 storied office building with an estimated cost of 100 crore taka. Prepare following TDS items: **(5x5=25)**

   (i) Specific experience required, (ii) General experience required, (iii) Turnover required, (iv) Tender security required, (v) Credit facility/Liquid asset required.

   (b) List the conditions for which the tender security of a bidder can be forfeited. **(5)**

SECTION – B: CE 301

There are FOUR questions, Answer any THREE

5. Discuss briefly the following: 30

Abstraction

Concreteness

Chronology of procedures of solicited major proposals

6. Briefly describe the following: **30**

Communication distractions

Important elements of first, second and third paragraph of a letter report

Points to keep in mind when rehearsing a talk

7. Describe the main points of the following: 30

"Breakdown of costs on building" or "civil engineering contracts"

Main contents of a detailed tender form

Collateral contract

8. Discuss the following with reference to the Code of Ethics for Engineers. 30

The preamble

Obtaining employment, professional engagements or advancement

Regarding engineers under supervision or cooperation with other engineers and students

DEPARTMENT OF CIVIL ENGINEERING, BUET

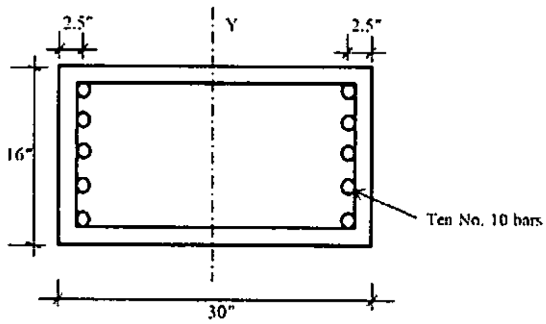
NAME OF THE EXAMINATION: B. Sc. Engg. Examination			SESSION: January, 2020
LEVEL: 3	TERM: 2		TIME: 2 hours
COURSE NO.: CE 317	COURSE TITLE: Design of Concrete Structures-II		FULL MARKS: 180

USE SEPARATE SCRIPTS FOR EACH SECTION

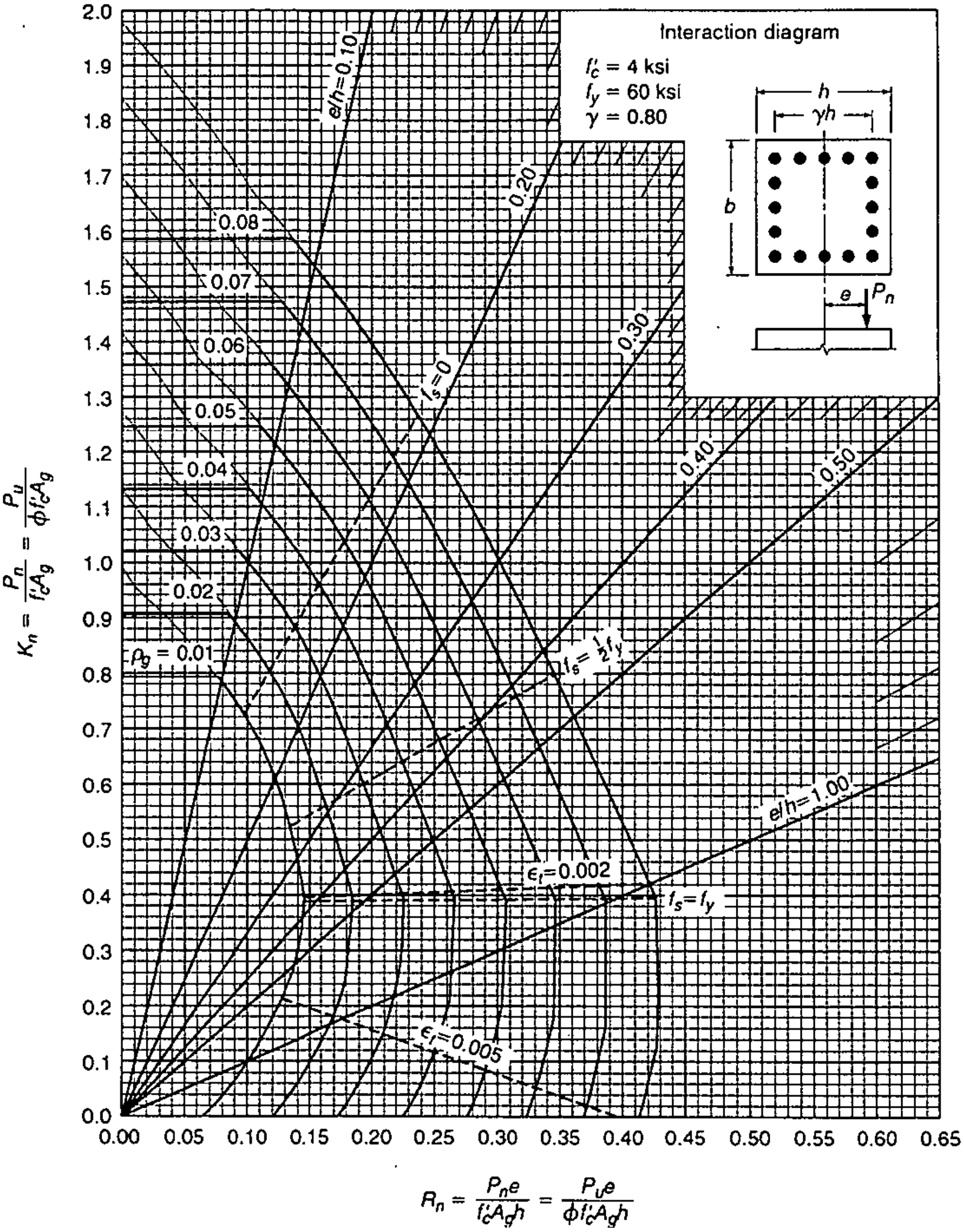
SECTION: A

- There are FOUR questions in this section. Answer any THREE questions.
Use USD Method of Design. Assume reasonable value for any missing data.

- Number of extra item/s included in this manuscript in the form of chart, table, etc.
1 Fig+2 Chart

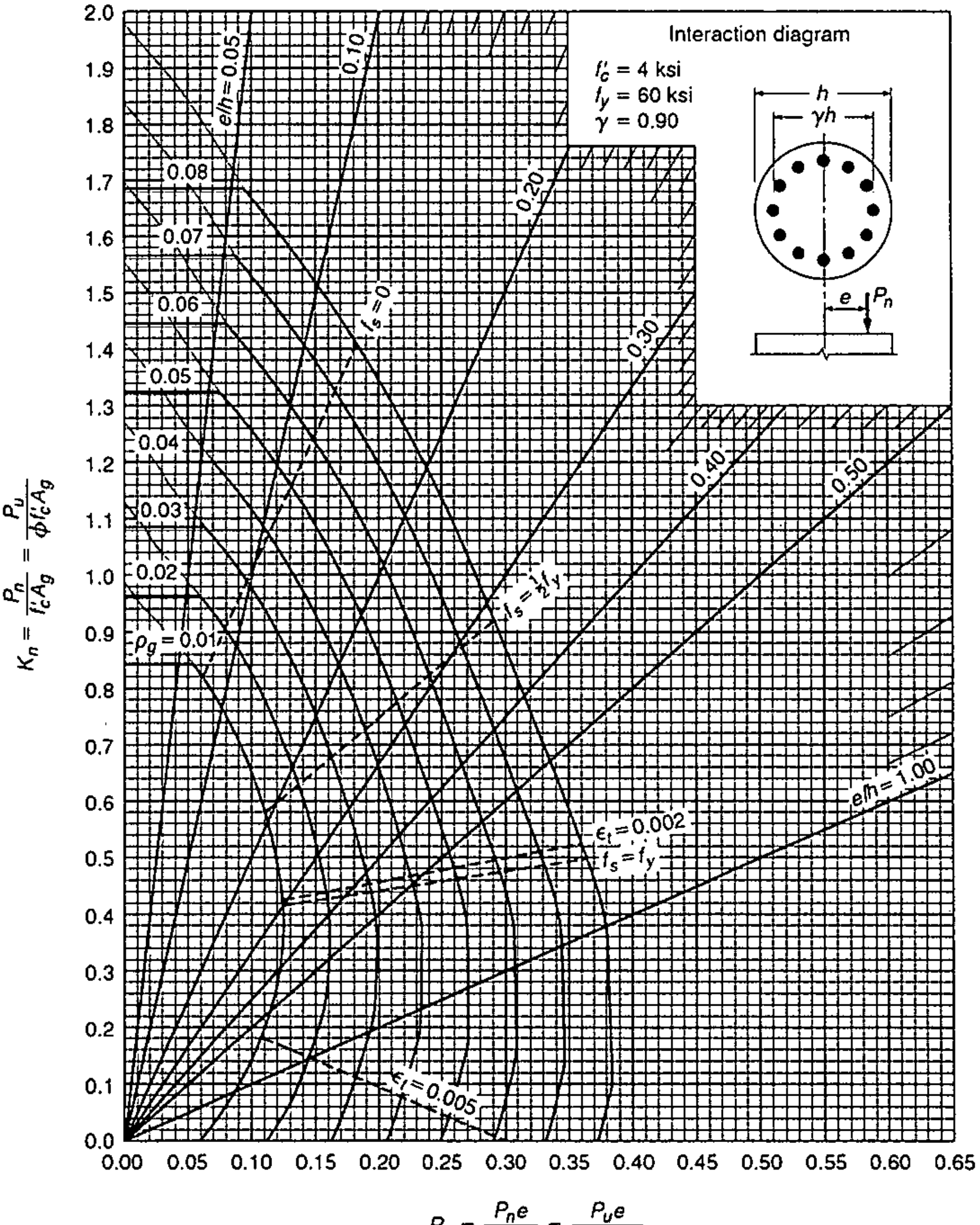
No.	Questions	Marks
1.	A 16 X 30 inch column is reinforced with Ten No. 10 bars as shown in Fig.1. For the column, find four points of the nominal strength interaction diagram corresponding to pure axial load, pure bending, balance condition and ε_s= 0.001 (tensile). Also find corresponding ϕ for the above points. Assume bending about Y-Y axis. Given: f_c'=4 ksi and f_y=60 ksi.	30
	 Fig. 1	
2.	A ground floor column of a multistoried building is to be designed for the following load combinations (axial force and uniaxial bending)- Gravity load condition P_u=750 kip, M_u=80 kip-ft Lateral load combination P_u=500 kip, M_u=300 kip-ft Architectural considerations require that a rectangular column with b=12in. and h=25 in. 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.	30
3.	A shear wall of a 15-storey building is subjected to following factored loads: P_u=400 kip V_u=750 kip	30

	M_u=5500 kip-ft The wall is 15 ft long, 150 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.	
4.	A 39 inch diameter circular tied column is reinforced with twenty-four No. 9 bars arranged uniformly around the column 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=2000 kip, M_{ux}=750 kip-ft, M_{uy}=600 kip-ft Use supplied column strength interaction diagram chart. Assume γ=0.9	30



GRAPH A.7

Column strength interaction diagram for rectangular section with bars on four faces and $\gamma = 0.80$.



GRAPH A.16

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

SECTION – B: CE 317

ASSUME ANY REASONABLE VALUE OF MISSING DATA

There are FOUR questions in this section. Answer any THREE

5. A commercial building is to be designed using a flat plate floor system. The interior columns are 21" x 21" and they are spaced 20ft c/c in one direction and 22ft c/c in other direction. Design an interior panel (20' x 22') and show the reinforcements in long direction only with neat sketch. Assume slab thickness 8". Specified LL = 60 psf and SDL = 80 psf in addition to self weight of slab. f'c = (3500 + R*5) psi and fy = 60 ksi, where R is last 3 digits of your student ID (If your student ID is 1604055, then R = 055) **30**

6. An exterior column of a residential building carries a service DL= 450 kip and LL= 250 kip. The column is 21" x 21" in cross section. The column is supported on a rectangular footing with the bottom at 5ft below grade. The width of the footing is 10 ft. Design the rectangular footing and show the reinforcements (in plan and sections) with neat sketches. The allowable soil bearing pressure is (3500 + R*5) psf, where R is last 3 digits of your student ID (If your student ID is 1604055, then R = 055). Use f'c = 3500psi and fy = 60,000psi for footing design. **30**

7. 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 (800+R) mm. The effective prestress force for steel is 850 MPa and allowable stress for concrete under working load is -12.0 MPa. **30**

8. A post-tensioned bonded concrete beam has a prestress of 1800 kN in the steel immediately after transfer, which eventually reduces to 1500 kN due to losses. The beam carries two live loads of 50 kN each at the third points in addition to its own weight. Compute the extreme fibre stresses at midspan: (i) under initial condition of full prestress without live load; (ii) under final working condition. **30**

   The beam has a rectangular cross-section of 300 mm x 800 mm and total prestressing steel of 1500 mm^2 laid parabolically with e = 250 mm at midspan and e = 0 at the ends. Span = 12.0 m (simply supported).

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA
L-3/T-2 B.Sc. Engineering Examinations: January 2020 Term

Sub: **CE 319** (Design of Steel Structures)

Full Marks: 180 Time: 2 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this Section. Answer any **THREE.**
(Each question carries 30 marks)
AISC Manual and other books are allowed to be used

1. (a) A compression member is to be designed. It has to carry a dead load of 165 kips and live load of 535 kips. The member is pin ended and 26ft long. Use grade 50 steel and AISC LRFD method to select the lightest W shape.
   (b) Prepare a model of the column using any structural design software and demonstrate that the selected column is adequate. Submit the graphical image of the model with stress level.
   [Problem 1(b) is a take home problem may be submitted in Teams after 24 hrs of the exam closing time].

2. Design the fillet welds to carry the member force of 105 kip (DL=25 kip; LL=80kip) in tension for the angle L5x5x3/8 from grade 50 materials. The angle is connected to a gusset plate of adequate strength. Use AISC LRFD method. Choose appropriate electrode.

3. A rectangular steel plate is welded as a cantilever to a vertical column and spports a single concentrated load of F= 60 kN as shown in Fig. 1. Check the adequacy of the 12mm fillet weld with weld length of 150 mm (total weld length =2x150 =300 mm) on top and bottom side of the cantilever plate and the allowable shear stress is 140 MPa. L =300 mm and the plate width is 100mm and thickness is 25mm. Include your recommendations on the given design.

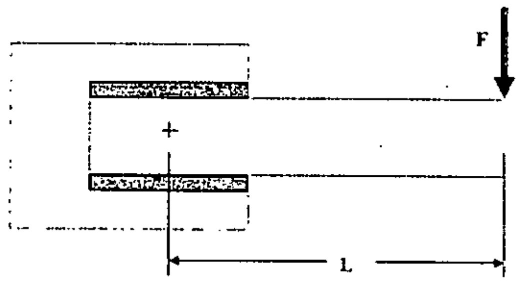


Fig. 1

4) A W 18x175 column transmits an axial compressive live load of 800 kip and dead load of 300 kip on to a concrete base. Determine the size of the base plate and concrete base if steel of A36 and concrete of 4 ksi is to be used. Use LRFD method.

SECTION-B: CE 319

There are **FIVE** questions in this section. Answer any **FOUR** questions.
Marks are in equal value.

5. A36 steel and ¾-in. bolts are used in the bolted splice shown in Fig.2. Considering all tension limit states of plates, determine the tension capacity, ϕT_n, of the splice in LRFD method.

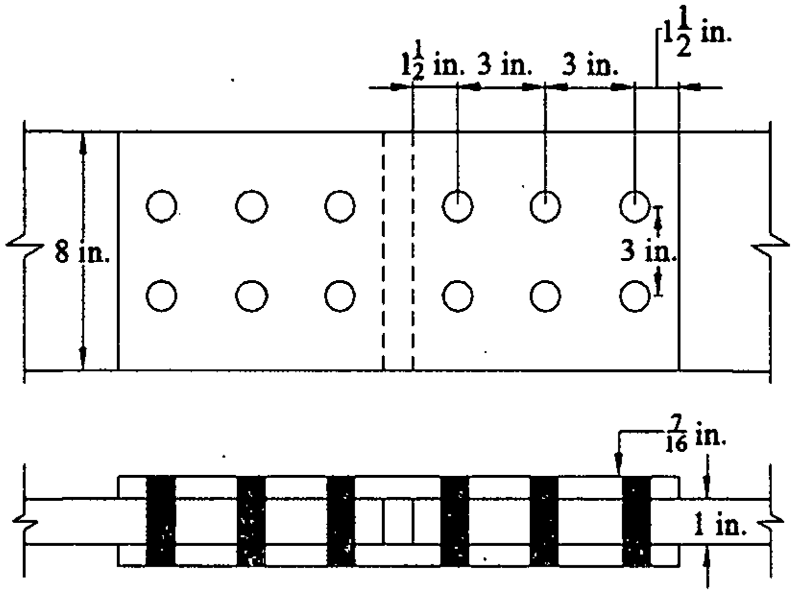


Fig.2

6. The bolted bracket plate shown in Fig.3 uses four 1/4-in. dia. A325 bolts. Based on bolt shear capacity, determine the maximum design load P that may be applied on the bracket as shown. Follow LRFD principle.

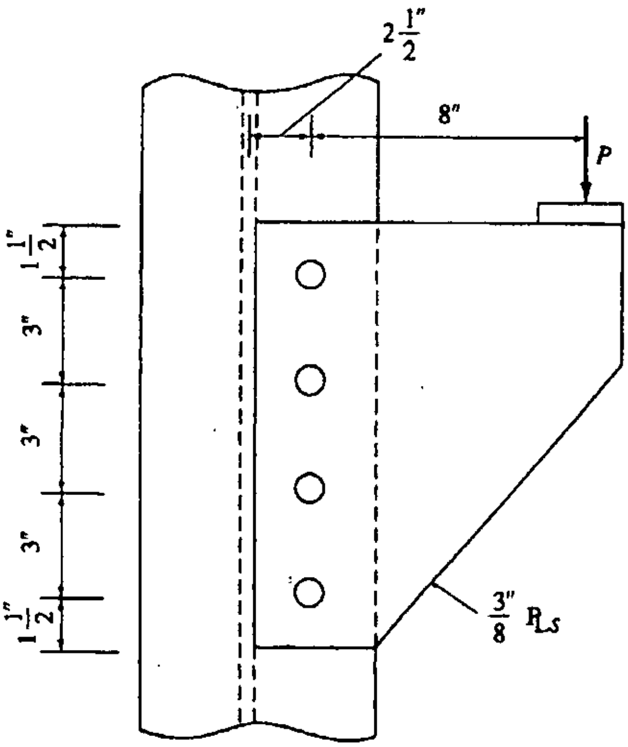


Fig.3

7. A W18x71 section made of A36 steel is subject to a shear force of 190 kip. Determine the portion of shear resisted by the web, maximum shear stress and the ratio of maximum and average shear stress.

8. The interaction between moment capacity, M_n, and unbraced length, L_b, of a beam can typically be represented as shown in Fig.4. For a W21x48 section, determine the value of moment and unbraced length corresponding to point A in Fig.4

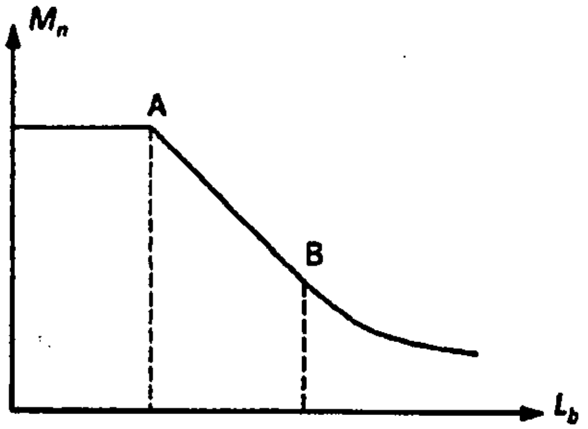


Fig.4

9. The beam-column shown in Fig.5 is pinned at both ends and is subjected to the loads shown. Bending is about the strong axis. Determine whether this member satisfies the appropriate AISC Specification interaction equation.

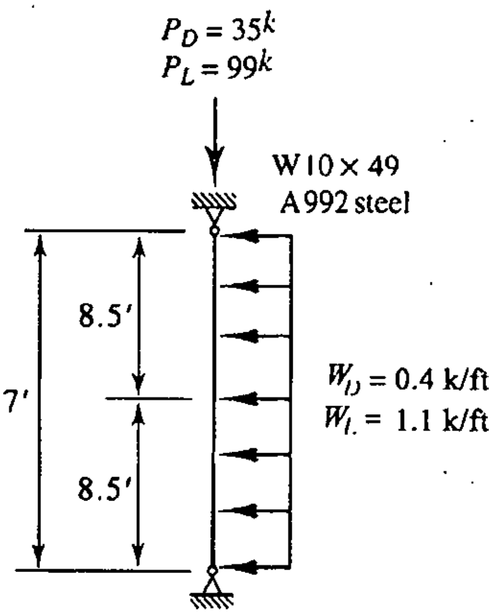


Fig.5

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA
L-3/T-II B.Sc. Engineering Examinations, Session: January 2020

Sub: **CE 325 for WRE** (Design of Concrete Structures-II)

Full Marks: 180 Time: 2 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.**

No.	Questions	Marks
	Question 1(a): A reinforced concrete circular spiral column as shown in Figure 1 (gross diameter = 20 inch reinforced with 8 #9 bars) of a building is subjected to following axial loads & moments (unfactored). Check the adequacy of the column section. Given: $f'_c = 4$ ksi, $f_y = 60$ ksi & interaction diagram is supplied at the end.	(20)
	(b): Compute frictional loss of the post-tensioned beam having three tendons (as shown in Figure 2) at anchor end. Given: jacking stress = 200 ksi, μ (friction co-efficient) = 0.15 and k (Wobble co-efficient) = 0.0001/foot.	(10)

(*unfactored)	Dead load	Live load
Axial force*	230 kip	250 kip
Moment*	95 kip-ft	140 kip-ft

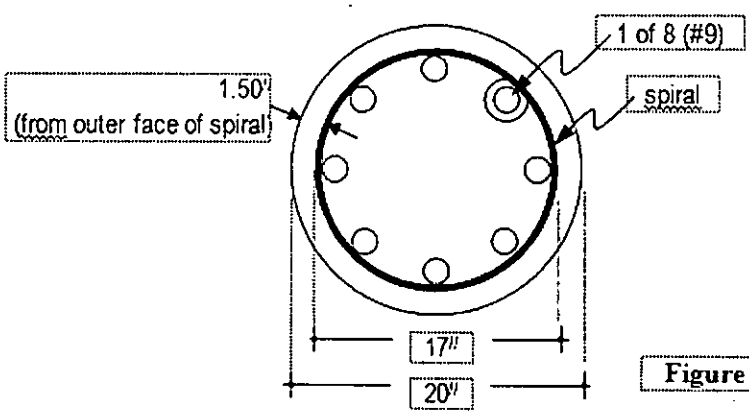


Figure 1

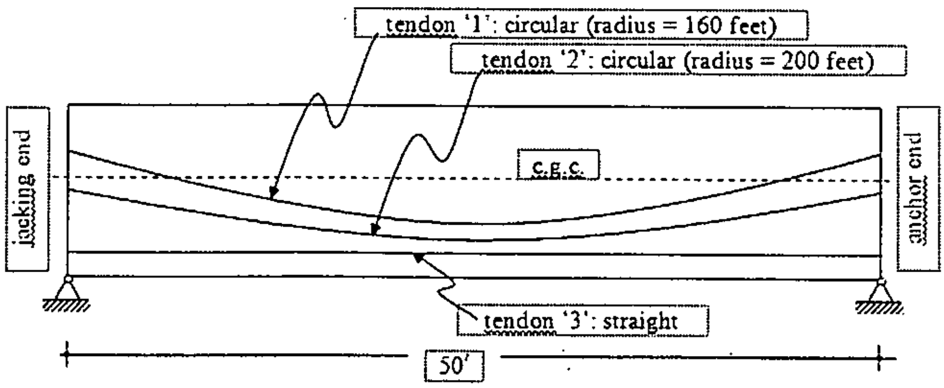


Figure 2

Question 2(a): Draw seismic stirrup detailing provisions (no need to show flexural steel requirements) for beams which are part of SMRF system as per BNBC.	(5)
2(b): Compute elastic shortening loss of the pre-stressed concrete simple beam at location A-A as shown in Figure 3. (i) The beam is pre-tensioned type and all tendons are tensioned at a time. (ii) The beam is post-tensioned type and three tendons are tensioned at a time. (iii) The beam is post-tensioned type and four tendons are tensioned at a time. Given: initial pre-stress = 200 ksi, pre-stressing strand = 12 (twelve) Nos. (270 grade 0.50 inch (=0.153 inch^2) nominal diameter 7-wire strand), f'_{ci} = 4500 psi, E_{ps} = 28500 ksi, beam cross-sectional area (A) = 1935 inch^2, moment of inertia of the beam section (I) = 1450000 inch^4, centroid to top ($\bar{y}_{top}$) = 25 inch & to bottom ($\bar{y}_{bottom}$) = 35 inch and eccentricity of tendon at end (over support) = 0 inch.	(25)

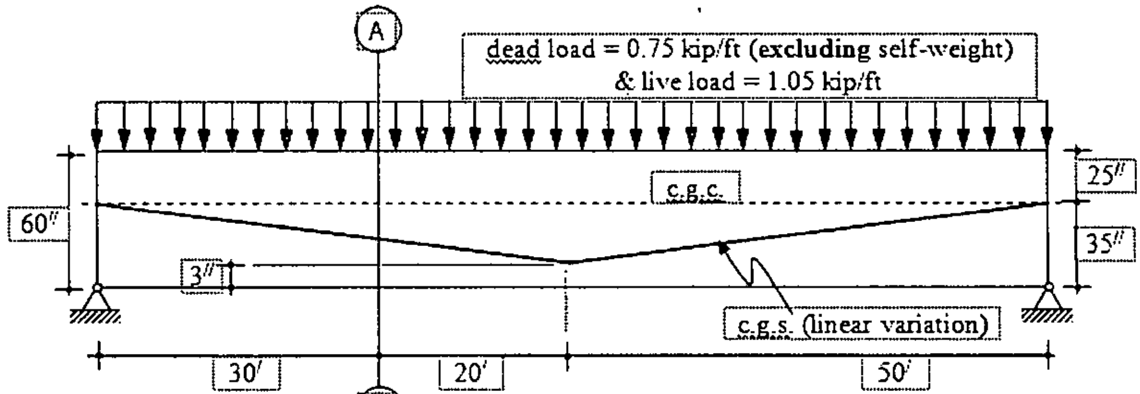


Figure 3

Question 3(a): Why factor 'α' is introduced in the column capacity equation? $$P_u = \alpha\varphi A_g[0.85f'_c(1-\rho_g)+\rho_g f_y]$$	(8)
Also write down the sources of pre-stressing losses.	
(b): A 16 × 18 inch column is reinforced with eight No. 9 bars as shown in Figure 4. Find two points (P_n & M_n) on the nominal strength interaction diagram which correspond to ε_s = 0.001 (tensile) & purely axial load. Also, determine 'φ' values for the above points. Assume bending about major/strong axis. Given: f'_c = 4 ksi, f_y = 60 ksi and E_s = 30000 ksi.	(22)

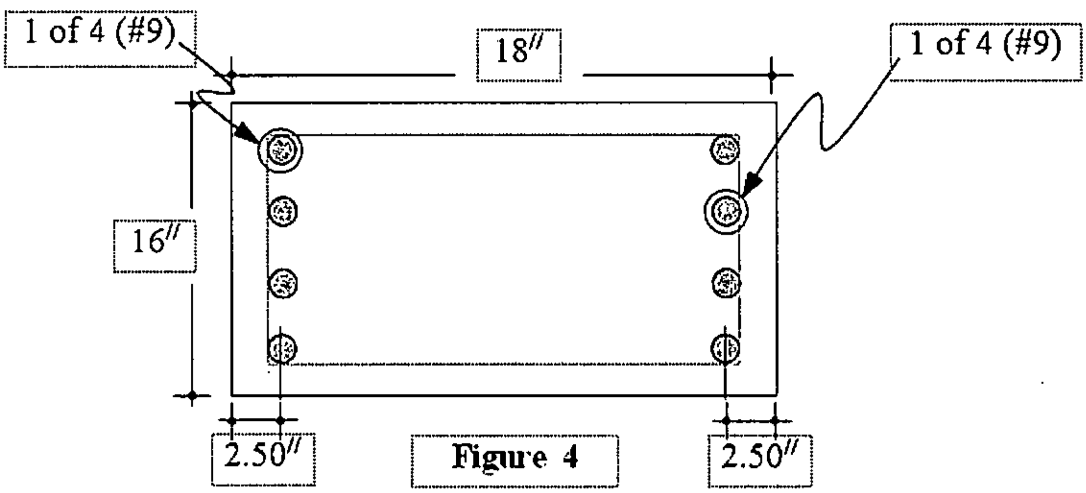


Figure 4

Question **4(a)**: Suppose, for a cantilever type free-standing RC shear wall (height=42 feet, length=18 feet, thickness=10 inch) having horizontal shear steel = #4 & 14 inch c/c in two layer. Determine the vertical shear steel spacing if #3 bar is chosen in two layers. Given: $f_c' =$ 4 ksi, $f_y = 60$ ksi. $\rho_h \geq 0.0025,\ \rho_v = \left[0.0025 + 0.50\left(2.5 - \frac{h_w}{l_w}\right)\right] \geq 0.0025$ & $\rho_h \geq \rho_v \geq 0.0025$	(10)
(b): Determine effective pre-stressing force needed to produce a top fiber stress of – 2 ksi (compression) at section near support, when external load acting on the beam is 2.75 kip/ft (including self-weight) on a cantilever span of 9.50 feet (see Figure 5). Also, determine initial pre-stressing force if a loss of 20% occurs at the end.	(20)

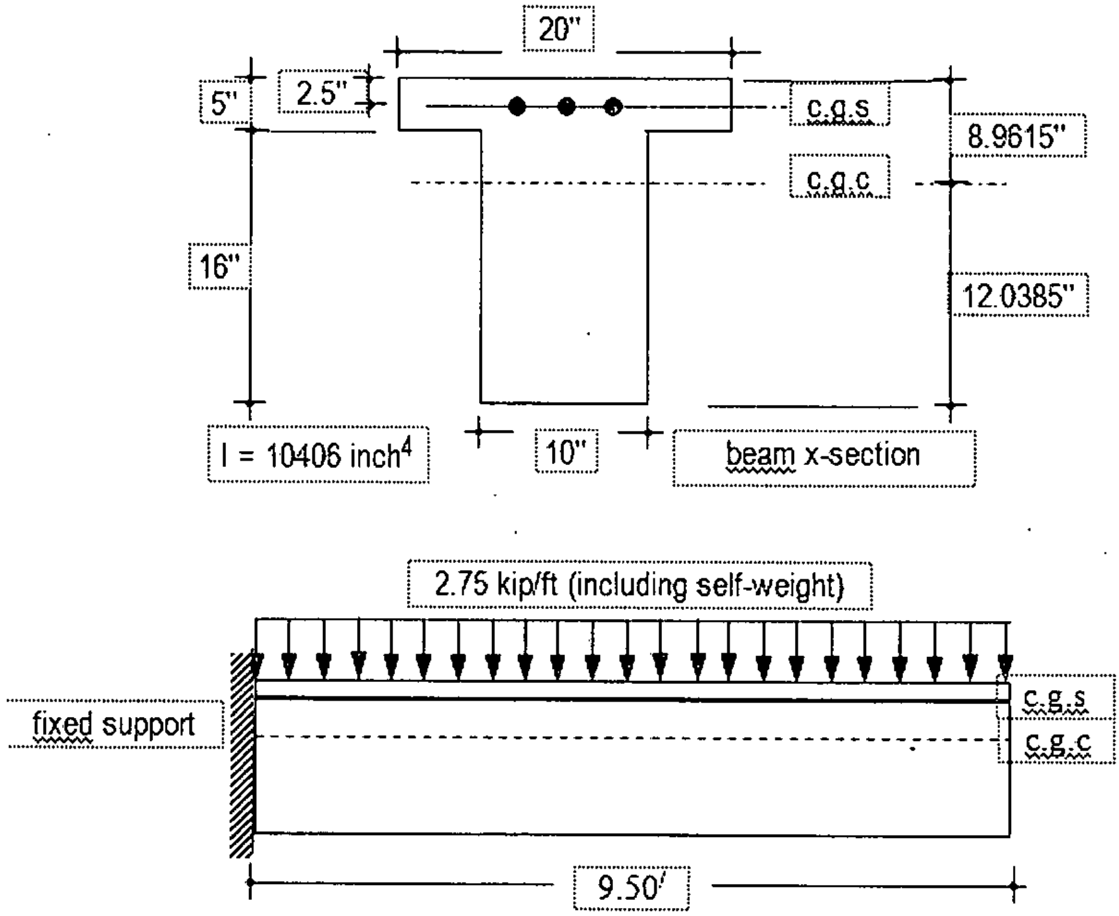
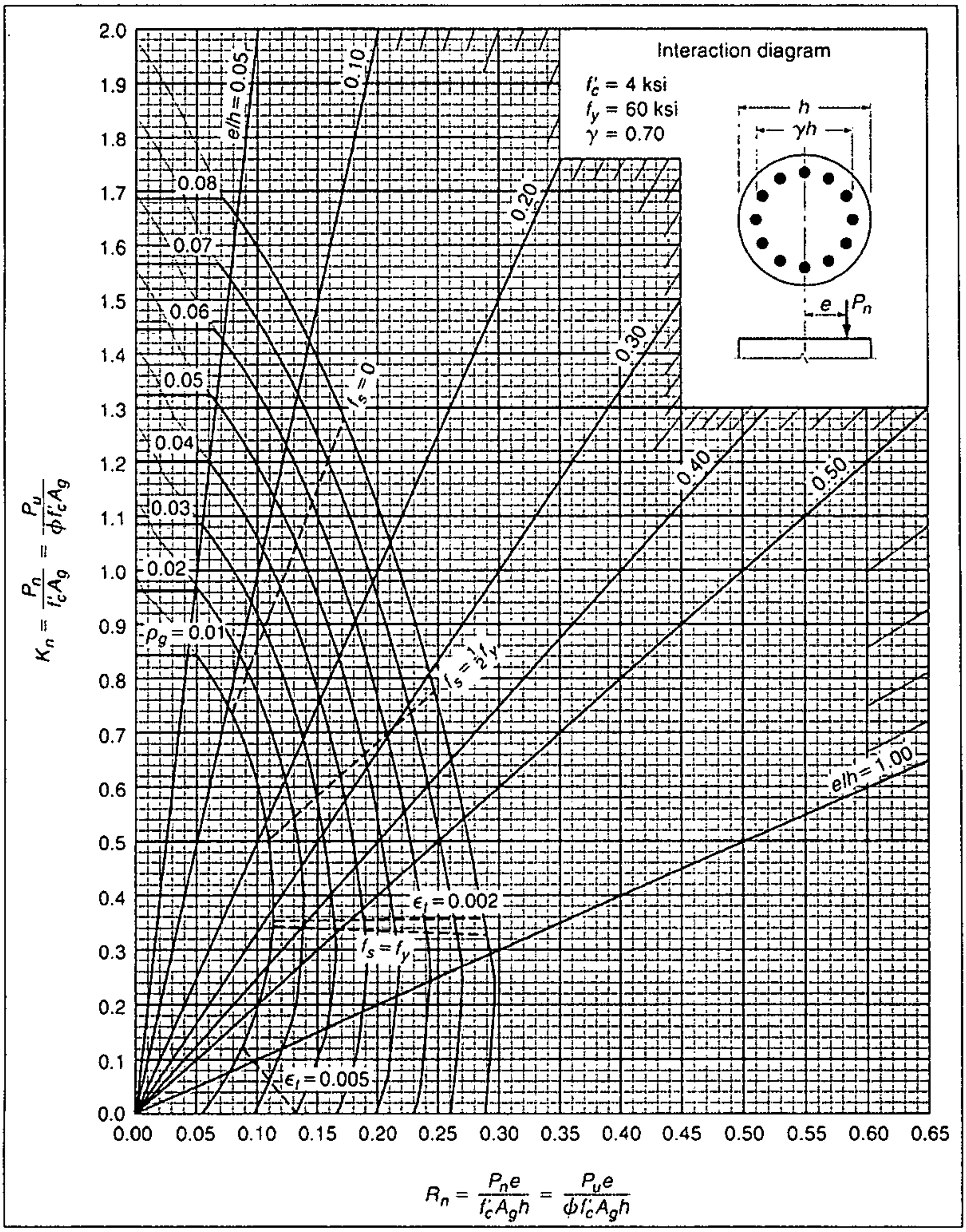


Figure 5

GRAPH 1: Column Strength Interaction Diagram
for Circular Section with $\gamma = 0.75$


Interaction diagram
f'_c = 4 ksi
f_y = 60 ksi
γ = 0.70
h
γh
e
P_n
$e/h = 0.05$
0.10
0.20
0.30
0.40
0.50
$e/h = 1.00$
$\rho_g = 0.01$
0.02
0.03
0.04
0.05
0.06
0.07
0.08
$f_s = 0$
$f_s = \frac{1}{2} f_y$
$f_s = f_y$
$\epsilon_t = 0.002$
$\epsilon_t = 0.005$
$K_n = \frac{P_n}{f'_c A_g} = \frac{P_u}{\phi f'_c A_g}$
$R_n = \frac{P_n e}{f'_c A_g h} = \frac{P_u e}{\phi f'_c A_g h}$
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0
0.00 0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45 0.50 0.55 0.60 0.65

SECTION-B: CE 325 FOR WRE

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

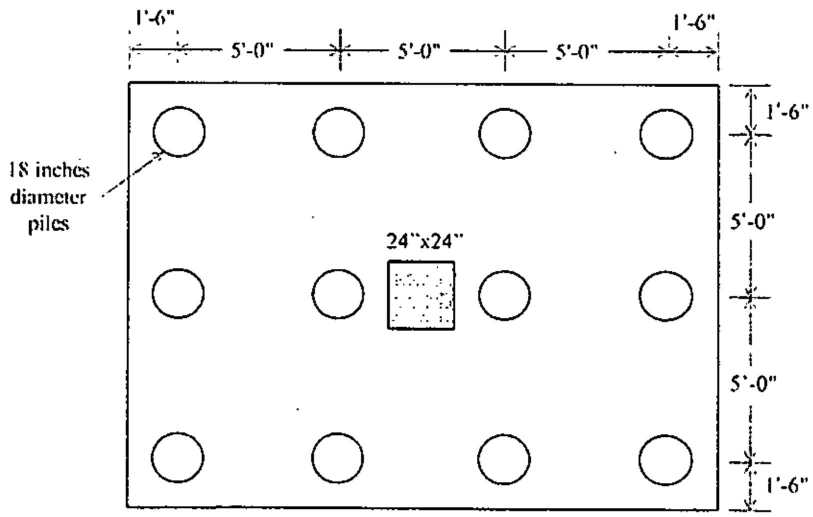
<table>
<tr><th>No.</th><th>Questions</th><th>Marks</th></tr>
<tr><td>5.</td><td>A residential building is to be designed using a flat plate floor system. The interior columns are 16 in. x 16 in. in size and are spaced at 21 ft c/c in one direction and 16 ft c/c in the other direction. Design the interior slab panel (21' x 16') in long direction and show reinforcement detailing in long direction only with appropriate bar cut-off points in neat sketch.
Assume slab thickness of 7.5 inches. In addition to the self-weight of the slab, assume specified live load = 40 psf, and floor finish = 25 psf. Given, f_c' = 4000 psi and f_y = 60000 psi.</td><td>30</td></tr>
<tr><td>6.</td><td>A square footing is to be constructed under an interior column (column size:18 in. x 18 in.). The column supports an unfactored dead load of 320 kips and an unfactored live load of 200 kips. The bottom of the footing is 5.5 ft below grade. The unit weight of soil is 120 pcf and, allowable bearing capacity of the soil is 5 ksf. Design the footing and show the reinforcement detailing in neat sketch. Assume effective depth of the footing, d = 22 inches. Given, f_c' = 4 ksi and f_y = 60 ksi.</td><td>30</td></tr>
<tr><td>7.</td><td>a) Under what situations, combined footing is needed? Describe with neat sketches.
b) The plan of a pile cap with twelve piles (18-inches diameter) supporting a square column (24 in. x 24 in.) is shown in Figure 6. The column carries a working dead load of 1000 kips (including self-weight of pile cap and fill soil above) and working live load of 600 kips. Check the punching shear capacity of the pile cap if the effective depth of the pile cap is 34 inches. Given, f_c' = 4 ksi and f_y = 60 ksi.


Figure 6</td><td>10
20</td></tr>
<tr><td>8.</td><td>In Figure 6, assume that the individual pile capacity is adequate. Design the pile cap in long direction only for the dead and live loads mentioned in Question 7(b) and show the reinforcement along long direction only in neat sketch. Assume effective depth of the pile cap, d = 42 inches. Flexural and punching shear are not needed to be checked. Given, f_c' = 4 ksi and f_y = 60 ksi.</td><td>30</td></tr>
</table>

Table 1: Flexural Resistance Factor, $R = \frac{M_u}{\varphi b d^2}$ with $f'_c = 4000$ psi & $f_y = 60000$ psi

$$R\ (\text{psi}) = \frac{M_u}{\varphi b d^2} = \rho f_y\left(1 - 0.59\frac{\rho f_y}{f'_c}\right)$$

ρ	ρ	R (psi)	ρ	R (psi)	ρ	R (psi)	ρ	R (psi)
$\rho_{minimum}$ for temperature & shrinkage	0.0018	106.28	0.0059	335.52	0.0100	546.90	0.0141	740.43
	0.0019	112.08	0.0060	340.88	0.0101	551.83	0.0142	744.93
	0.0020	117.88	0.0061	346.24	0.0102	556.75	0.0143	749.42
	0.0021	123.66	0.0062	351.59	0.0103	561.67	0.0144	753.89
	0.0022	129.43	0.0063	356.92	0.0104	566.57	0.0145	758.36
	0.0023	135.19	0.0064	362.25	0.0105	571.46	0.0146	762.81
	0.0024	140.94	0.0065	367.57	0.0106	576.34	0.0147	767.26
	0.0025	146.68	0.0066	372.87	0.0107	581.21	0.0148	771.69
	0.0026	152.41	0.0067	378.16	0.0108	586.06	0.0149	776.11
	0.0027	158.13	0.0068	383.45	0.0109	590.91	0.0150	780.53
	0.0028	163.84	0.0069	388.72	0.0110	595.75	0.0151	784.93
	0.0029	169.53	0.0070	393.98	0.0111	600.58	0.0152	789.32
	0.0030	175.22	0.0071	399.23	0.0112	605.39	0.0153	793.70
	0.0031	180.90	0.0072	404.47	0.0113	610.20	0.0154	798.07
	0.0032	186.56	0.0073	409.70	0.0114	614.99	0.0155	802.43
$\rho_{minimum}$ for flexure	0.0033	192.22	0.0074	414.92	0.0115	619.78	0.0156	806.78
	0.0034	197.86	0.0075	420.13	0.0116	624.55	0.0157	811.11
	0.0035	203.50	0.0076	425.33	0.0117	629.31	0.0158	815.44
	0.0036	209.12	0.0077	430.52	0.0118	634.06	0.0159	819.76
	0.0037	214.73	0.0078	435.69	0.0119	638.81	0.0160	824.06
	0.0038	220.33	0.0079	440.86	0.0120	643.54	0.0161	828.36
	0.0039	225.92	0.0080	446.02	0.0121	648.26	0.0162	832.64
	0.0040	231.50	0.0081	451.16	0.0122	652.97	0.0163	836.92
	0.0041	237.07	0.0082	456.30	0.0123	657.67	0.0164	841.18
	0.0042	242.63	0.0083	461.42	0.0124	662.35	0.0165	845.44
	0.0043	248.18	0.0084	466.53	0.0125	667.03	0.0166	849.68
	0.0044	253.72	0.0085	471.64	0.0126	671.70	0.0167	853.91
	0.0045	259.25	0.0086	476.73	0.0127	676.36	0.0168	858.13
	0.0046	264.76	0.0087	481.81	0.0128	681	0.0169	862.34
	0.0047	270.27	0.0088	486.88	0.0129	685.64	0.0170	866.54
	0.0048	275.77	0.0089	491.94	0.0130	690.26	0.0171	870.73
	0.0049	281.25	0.0090	496.99	0.0131	694.88	0.0172	874.91
	0.0050	286.73	0.0091	502.03	0.0132	699.48	0.0173	879.08
	0.0051	292.19	0.0092	507.06	0.0133	704.07	0.0174	883.23
	0.0052	297.64	0.0093	512.07	0.0134	708.65	0.0175	887.38
	0.0053	303.08	0.0094	517.08	0.0135	713.23	0.0176	891.52
	0.0054	308.52	0.0095	522.08	0.0136	717.79	0.0177	895.64
	0.0055	313.94	0.0096	527.06	0.0137	722.34	0.0178	899.76
	0.0056	319.35	0.0097	532.04	0.0138	726.88	0.0179	903.86
	0.0057	324.75	0.0098	537	0.0139	731.41	0.0180	907.96
	0.0058	330.14	0.0099	541.96	0.0140	735.92	0.0181	912.04

DEPARTMENT OF CIVIL ENGINEERING, BUET

NAME OF THE EXAMINATION: B.Sc. Engineering			SESSION: 2018-2019
LEVEL: 3	TERM: 2	EXAM DATE:	TIME: 2 hours
COURSE NO.: **CE 333**	COURSE TITLE: **Environmental Engineering II**,		FULL MARKS: 240

SECTION: **A**

- There are **FOUR** questions in this section. Answer any **THREE** questions.
- The figures in the margin indicate full marks.
- **Assume any reasonable value, if needed.**

1. a) Show in diagram different forms of water associated with typical secondary settled sludge. (20)

   b) For a completely mixed activated sludge process the following data are obtained: (20)

   Volume of aeration tank = 6150 m^3

   Sewage flow rate = 295 lps

   Sludge density index = 0.93

   Biodegradable soluble substrate concentration in influent = 310 mg/L

   Mixed liquor volatile suspended solids in aeration tank = 2.61 gm/L

   BOD_5 concentration in the final effluent = 20 mg/L

   Calculate – i) Sludge recirculation rate, ii) F/M ratio and iii) substrate utilization rate (r_{su})

2. a) Make comparison of different types of trickling filter used in biological treatment of wastewater. (10)

   b) Draw a neat sketch and show "Thioglycolate tubes test" for determination of microbial oxygen requirements.

   Write down the objectives of pre-aeration and floatation processes used in preliminary treatment of wastewater. (20)

3. a) Distinguish between natural needs and acquired needs of humans. State briefly the effects of environmental pollution on human health (20)

   b) Explain why flush tank type of supply control is used in the top most floors of tall buildings instead of flush valve type? (20)

4. a) What do you mean by self-siphonage and induced siphonage in plumbing drainage system? How can you avoid these? (15)

   b) In a 7 storied building, all the fixtures are flush tank operated (the fixture operating pressure varies from 4 psi to 8 psi) and the water supply is intermittent. The floor to floor height is 10 ft. Calculate the permissible pressure loss in the riser pipe to supply water in the top-most floor. Assume reasonable values for the missing data if required. (25)

SECTION – B: CE 333

[There are FOUR questions in this Section. Answer any THREE questions.]

5(a). Design a suitable latrine for a family of 7 members. The family uses tubewell-based water supply system, and estimated water use for the latrine is 10 lpcd. The long-term infiltration capacity of soil is estimated at 18 L/sq.m./day, and the groundwater level is 3.7 m below ground surface. The pit needs to be constructed with concrete rings. Two types of concrete rings are available: (i) 1.1 m in diameter, and (ii) 1.2 m in diameter. All concrete rings are 0.15 m in depth. 25

(i) What type of larine would you suggest for the family?

(ii) Design the latrine (including the venting system) using suitable concrete rings that would satisfy the design criteria, and estimate its design life. Show calculations for both ring sizes.

(iii) Draw a neat sketch (both plan and section) showing all elements of the designed latrine.

[Assume reasonable values for parameters not given]

5(b). What do you understand by fecal sludge and septage? What are the system elements of a fecal sludge management (FSM) system? Draw a flow diagram showing the common treatment processes employed for treatment of fecal sludge. For fecal sludge treatment, what solid-liquid separation systems are commonly employed in Bangladesh? 15

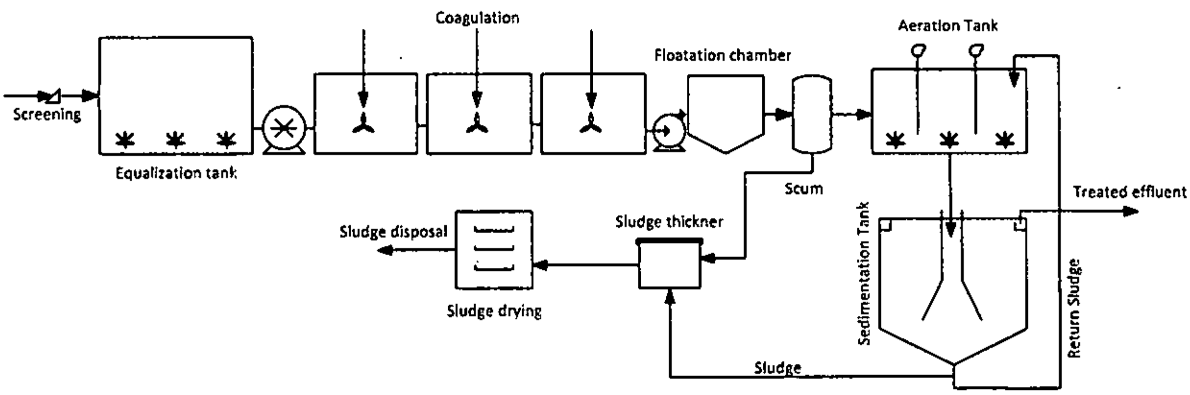
6(a) The following schematic diagram represents the treatment processes adopted at an ETP in a Textile Industry. Being the Environmental Engineer in charge of ETP operations it is your responsibility to identify the possible reason(s) for the problems and briefly suggest remedial measure(s) for each of these. Also, identify the sampling locations on the diagram for each the problems, if required. 25

i) On the day of commissioning the Equalization Tank is found to be forming foams/froths covering the entire top layer.

ii) On a certain workday it was observed that the flocs are breaking up at the flocculation chamber.

iii) On another day the BOD_5 of the effluent exceeded the discharge standard set by the DoE.

iv) On a separate day the Aeration Tank formed a sludge blanket at the top.



6(b). The conventional method of ranking a set of values for plotting Cumulative Density Function uses the expression **m/(n + 1)**. However, the Blom's Transformation suggests the use of the expression **(m-3/8)/(n + ¼)**. What is the justification of using Blom's Transformation compared to the conventional method? 15

7(a). Design a "septic tank" for a building where 2 families are living; each family has 6 members. The estimated wastewater flow rate is 95 lpcd, and the septic tank is to be desludged every 2.5 years. The hydraulic detention time of the septic tank should be at least 1 day in order to achieve acceptable effluent quality. Assume a design temperature of 20 °C. After determining the dimensions of the septic tank, draw: 25

(i) A plan view of the designed septic tank (consider a two-chamber tank)
(ii) A section showing depths of different zones of the septic tank
(iii) A section showing the size (diameter), positions and dimensions of the inlet and outlet devices.

[Assume reasonable values for parameters not given]

7(b). With an appropriate figure, show how disease is transmitted from excreta via different routes, along with sanitation barriers to prevent such transmission. What do you understand by a "hygienic latrine"? 15

8(a). A 2000mm dia. RCC pipe is laid with a slope of 0.002 for a Maximum flow of 1.0 m^3/sec and Minimum flow of 0.3 m^3/sec when flowing partially full having a width of 1.414m at the top. The sewer pipe provided is designed to carry domestic sewage having BOD5 of 200 mg/L and a maximum temperature of 30 °C. Determine the potential for Sulfide Generation (Z) and specify the appropriate measures to be taken for stability of the sewer. 25

8(b). You have been given the responsibility to plan crossing of a sewer line across the Airport road near Kuril Interchange. Which agencies do you need to contact during planning and construction stages. 15

DEPARTMENT OF CIVIL ENGINEERING, BUET

NAME OF THE EXAMINATION		**B.Sc. Engineering**	SESSION: JANUARY 2020
LEVEL 3	TERM 2	FULL MARKS: **180**	TIME: **2.0 Hours**
COURSE NO. **351**	COURSE TITLE: **CE 351 (Transportation Engineering – I)**		

SECTION **A**

- There are **FOUR** questions in this section. Answer any **THREE.**
- The figures in this margin indicate full marks.
- Special instructions (if any): **Need PLAIN Graph Papers**

1. (a) Explain different components, dimensions and interdisciplinary breadth of transportation system with figures.	10
(b) Explain the justification of road hierarchy in the light of accessibility and mobility need with facts and figures. Also discuss the state of road hierarchy in Dhaka city.	10
(c) How can you measure efficiency of transport system? Explain the performance measuring criteria with examples of various transportations modes.	10
2. (a) Define design vehicle, terminal, depot, workshop and PIEV.	10
(b) When to carry out the following studies: (i) Volume (iii) Origin – destination (ii) Speed (iv) Speed - delay	10
(c) Following data was collected while conducting spot speed studies at certain stretch of a road within the urban area.	10

Speed range (kmph)	Frequency (f)
0-5	0
5-10	12
10-15	35
15-20	55
20-25	105
25-30	205
30-35	240
35-40	110
40-45	65
45-50	25
50-55	11
55-60	5
60-65	3
65-70	0

Determine : i) Average speed of traffic stream. ii) Modal speed and pace of traffic stream. iii) Upper and lower speed limits. iv) Design speed.	
3. (a) What are the tools available to the Traffic Engineers in managing roadway congestion and safety problems? Why Traffic Engineering is so essential now-a-days especially in our country? Explain the benefits of providing street lighting?	11
(b) Where parking should be prohibited. What steps should be undertaken for systematic development of parking facilities? Differentiate between "on-street & off-street" parking facilities and "parallel & angular" method of parking.	11
(c) Spot speed data were collected at a section of highway during an improvement work. The speed characteristics are given below. Determine whether there was any significant difference between the average speeds at the 95% confidence level. Assume reasonable value for any missing data. $U_1 =$ 34.5 kmph $U_2 =$ 37.1 kmph $S_1 =$ 6.1 kmph $S_2 =$ 7.8 kmph $n_1 =$ 260 nos. $n_2 =$ 270 nos.	3
(d) An urban secondary street with 55 ft pavement width having a reflectance of 10%, carries a maximum of 1850 vph at night time in both directions. Design the street lighting system of the road considering mercury light as a source with mounting height of 30 ft and a maintenance factor of 0.85. Draw the lighting layout. Necessary information are given in Tables 1 to 4 and in Figure 1.	5
4. (a) Name the functional classification of traffic signs and give two examples for each. Differentiate between traffic signs and markings. Write down the importance of retro-reflective marking.	10
(b) Which UN convention standardized the uniform design of traffic control devices? At what circumstances all-red period is considered in traffic signal design? List different type of signal controllers and differentiate between simultaneous and progressive signal controllers.	10

(c) Design a two-phase signal of an isolated cross-junction for the following data. Assume reasonable value for any missing data. Draw the phase and cycle time bar diagram.
            N-S phase   E-W phase
ALL RED period = 3 sec   2 sec
Initial and final lost time = 2 sec   3 sec
 	
            North   South   East   West
Flow(pcu/hr) = 640   440   840   740
Saturation flow (pcu/hr) = 2040   1950   2140   2040
	10

FOR Q. 3(d)

TABLE 1 RECOMMENDED AVERAGE ILLUMINATION (LUMENS/FT^2)

Pedestrian traffic(1)	Vehicular traffic(2) (vph)			
	Very light (<150 vph)	Light (150 – 500 vph)	Medium (500 – 1,200 vph)	Heavy (>1,200 vph)
Heavy	-	0.8	1.0	1.2
Medium	-	0.6	0.8	1.0
Light	0.2	0.4	0.6	0.8

Notes:
(1) Heavy: As on main business street
Medium: As on secondary business streets
Light: As on local streets
(2) Night hour flow in both directions

TABLE 2 ADJUSTMENT FACTORS FOR RECOMMENDED AVERAGE ILLUMINATION VALUES

Surface Reflectance	Adjustment Factors
3 % or less	1.5
10%	1.0
20% or more	0.75

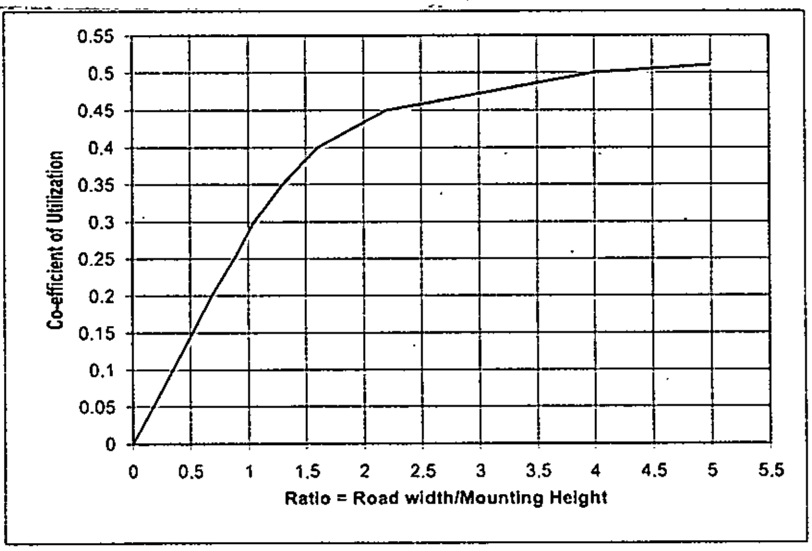
TABLE 3 LIGHTING SOURCE CHARACTERISTICS

Source Types	Expected Life (hrs)	Lighting Efficiency (Lumens/Watt)	Wattage (Watt)
Tungsten	1000	8 – 14	Up to 1000
Fluorescent	6000	50 – 75	Up to 250
Sodium	6000	100 – 120	Up to 160
Mercury	7500	20 – 60	Up to 400

TABLE 4 RECOMMENDED ARRANGEMENT OF STREET LIGHTING

Type of Arrangement	Pavement Width
One side	Width <= 30ft
Both sides – Staggered	30ft > Width <= 60ft
Both sides – Opposite	Width > 60ft

FIGURE 1 CO-EFFICIENT OF UTILIZATION CURVES (FOR LIGHT DISTRIBUTION TYPE III)



Note: Due to poor maintenance, the actual co-efficient of utilization is reduced by a factor usually 0.8 (i.e. taken as 80%).

Section-B: CE 351

There are EIGHT Questions, Answer any SIX questions

5. Give your assessment of Dhaka City for the 11 properties of the physical environment that have a direct impact on human behavior. 15

6. Give your evaluation of four major transportation systems in terms of three basic evaluation attributes. Assess whether Bangladesh transport sector investment in recent decades has followed that efficiency guidelines. 15

7. Explain why it is important to maintain road hierarchy for city road network. Evaluate the maintenance of city road network hierarchy in case of Dhaka city. 15

8. Explain the suitability of Bus Rapid Transit (BRT) and Improved Urban Bus service for different city situations of Bangladesh depending on their size and demands. 15

9. Develop a scenario and then explain the advantages of Intelligent Transport System (ITS) applications in case of Bangladesh Commercial vehicle operations and road safety improvement. 15

10. Discuss the problems of Bangladesh Rail and Water transport sectors and give your opinions for overcoming those problems. 15

11. Explain recognized components of future travel demand for travel demand modeling of any development project. 15

12. A calibration study resulted in the following utility equation for different modes in a particular city: 15

$$U_k = a_k - 025X_1 - 0.032X_2 - 0.015X_3 - 0.002X_4$$

Where, a_k = mode specific constant
X_1 = access plus egress time in minutes
X_2 = waiting time in minutes
X_3 = line-haul time in minutes
X_4 = out-of-pocket-cost in taka

	a_k	X_1	X_2	X_3	X_4
Automobile	-0.12	5	0	20	100
Bus	-0.22	10	15	40	50

From the above characteristics of two modes find the share of two modes or forecasted trips of 5000 using Logit model.

DEPARTMENT OF CIVIL ENGINEERING, BUET

NAME OF THE EXAMINATION: **B.URP Examination**			SESSION: **2018-19**
LEVEL: **3**	TERM: **II**	FULL MARKS: **180**	TIME: **2 Hours**
COURSE NO.: **CE 363**	COURSE TITLE: **Elements of Civil Engineering Structures**		

SECTION: A

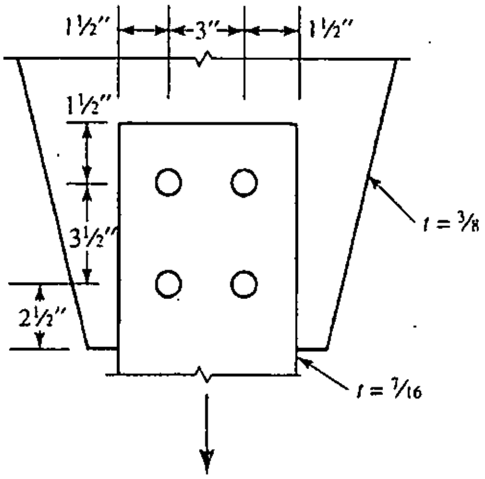
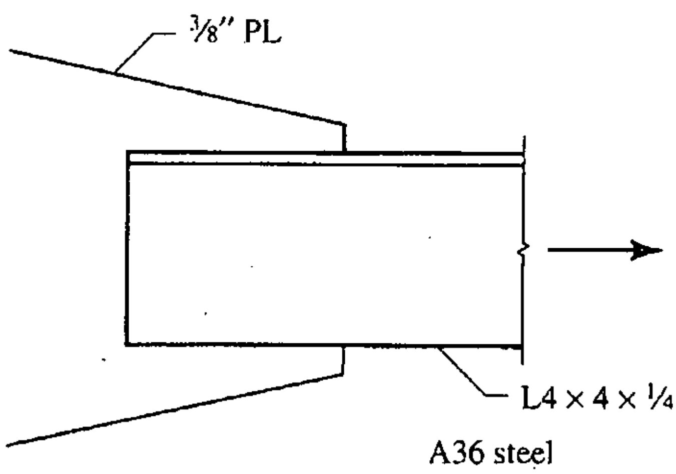
- There are **Four** questions in this section. Answer any **Three** questions.
- The figures in the margin indicate full marks.
- Special instructions (if any): Assume reasonable values for missing data, if any.

No.	Questions	Marks
1.	a. Draw a typical graph showing the relation between compressive strength of concrete and water-cement ratio.	4
	b. A 24" square column supports a dead load of 325 kips and a live load of 200 kips. The soil (fill) has a unit weight of 120 pcf. The allowable soil pressure q_a is 4 ksf. Design a square footing with base 6' below grade, using $f_c' = 4$ ksi and $f_y = 60$ ksi.	25
2.	a. Where will you provide corner reinforcements in slabs? Why is it necessary? Show the corner reinforcement requirements according to ACI Code with the help of neat sketches.	8
	b. A 10' wide and 40' long reinforced concrete slab is built integrally with its supports. The slab is continuous on one end. The service live load is 100 psf. The dead load consists of 50 psf partition wall load in addition to the self-weight of the slab. Design the slab following the provisions of the ACI Code. Assume compressive strength of concrete to be 4 ksi and yield stress of steel to be 60 ksi.	22

3.	a. Mention the sources of uncertainties in analysis, design, and construction of reinforced concrete structures.	10
	b. Design a square tied column to support an axial dead load of 500 kips and a live load of 300 kips. Use, $f_c' = 5000$ psi, $f_y = 60$ ksi and a steel ratio of about 3%. Design the necessary ties.	20
4.	a. Write short notes on: i. Clear cover ii. Fatigue iii. Doubly reinforced beam iv. Cantilever beam v. Shear cracks in beams	10
	b. A beam has a cross-section of 12"X18". It is reinforced with 3-#9 bars. The beam is simply supported with a span of 24'. The compressive strength of concrete is 5 ksi and yield stress of steel is 60 ksi. i. Determine the nominal moment M_n at which the beam will fail. ii. Determine the maximum service live load w_{LL} the beam can withstand.	20

SECTION-B: CE 363

There are **FOUR** questions in this section. Answer any **THREE** questions.
The figures in the margin indicate full marks.

No.	Questions	Marks
5.	(a) Write down the advantages and disadvantages of structural steel as building material. Define local buckling and classify steel section based on local buckling.	5+5=10
	(b) Investigate the tension capacity of the plate (PL $6 \times {}^{7}/_{16}$) attached to a gusset plate as shown in Figure 1. The bolts are ${}^{3}/_{4}$ inch in diameter and the material is A36 (F_y = 36 ksi, F_u = 58 ksi). Use LRFD method.  **Figure 1**	20
6.	(a) What is welding? Describe briefly about different types welded joint with neat sketches.	10
	(b) Design the fillet weld to develop the full strength of the angle shown in Figure 2 and show the welds on a sketch with dimensions. Follow AISC LRFD method and assume gusset plate does not govern. Material A36: F_y = 36 ksi, F_u = 58 ksi. Use E70XX electrode.  **Figure 2**	20

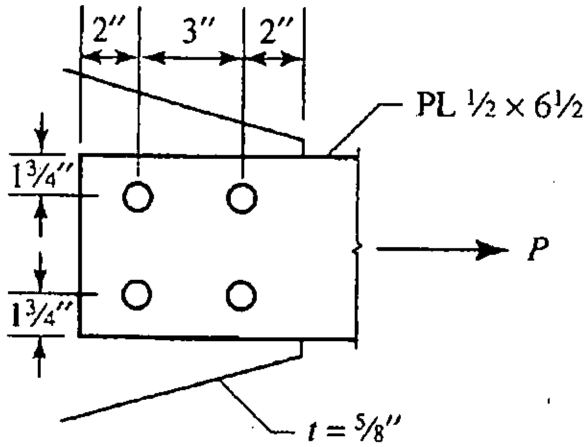
<table>
<tr><th>No.</th><th>Questions</th><th>Marks</th></tr>
<tr><td>7.</td><td>(a) Draw three AISC steel shape with proper designation commonly used in construction of steel structures.</td><td>6</td></tr>
<tr><td></td><td>(b) Investigate the capacity of the bolted connection shown in Figure 3 to resist a dead load of 20 kip and live load of 50 kip. The bolts are $^3/_4$ inch in diameter, A490 (F_{by} = 130 ksi, F_{bu} = 150 ksi and all plates are A36 steel (F_y = 36 ksi, F_u = 58 ksi).


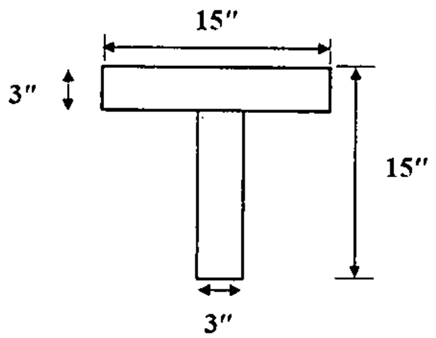
Figure 3</td><td>24</td></tr>
<tr><td>8.</td><td>(a) What is shape factor? Compute shape factor of the section shown in Figure 4 (All dimensions are in inch).


Figure 4</td><td>10</td></tr>
<tr><td></td><td>(b) Select a standard W shape of A992 steel (F_y = 50 ksi) for a simply supported beam of span 14 ft carrying a uniformly distributed live load of 1.3 k/ft and dead load of 0.9 k/ft in addition to its own weight. The compression flange of the beam is fully supported against lateral movement. Follow ASD principle.</td><td>20</td></tr>
</table>

ANNEXURE

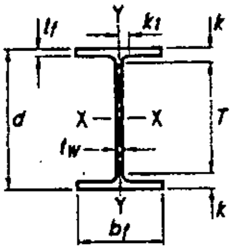


Table 1-1 (continued)
W Shapes
Dimensions

Shape	Area, A	Depth, d		Web Thickness, t_w		Web $\frac{t_w}{2}$	Flange Width, b_f		Flange Thickness, t_f		Distance k k_{des}	Distance k k_{det}	k_1	T	Workable Gage
	in.^{2}	in.		in.		in.	in.		in.		in.	in.	in.	in.	in.
W14×132	38.8	14.7	14 5/8	0.645	5/8	5/16	14.7	14 3/4	1.03	1	1.63	2 5/16	1 9/16	10	5 1/2
×120	35.3	14.5	14 1/2	0.590	9/16	5/16	14.7	14 5/8	0.940	15/16	1.54	2 1/4	1 1/2		
×109	32.0	14.3	14 3/8	0.525	1/2	1/4	14.6	14 5/8	0.860	7/8	1.46	2 3/16	1 1/2		
×99[f]	29.1	14.2	14 1/8	0.485	1/2	1/4	14.6	14 5/8	0.780	3/4	1.38	2 1/16	1 7/16		
×90[f]	26.5	14.0	14	0.440	7/16	1/4	14.5	14 1/2	0.710	11/16	1.31	2	1 7/16		
W14×82	24.0	14.3	14 1/4	0.510	1/2	1/4	10.1	10 1/8	0.855	7/8	1.45	1 11/16	1 1/16	10 7/8	5 1/2
×74	21.8	14.2	14 1/8	0.450	7/16	1/4	10.1	10 1/8	0.785	13/16	1.38	1 5/8	1 1/16		
×68	20.0	14.0	14	0.415	7/16	1/4	10.0	10	0.720	3/4	1.31	1 9/16	1 1/16		
×61	17.9	13.9	13 7/8	0.375	3/8	3/16	10.0	10	0.645	5/8	1.24	1 1/2	1		
W14×53	15.6	13.9	13 7/8	0.370	3/8	3/16	8.06	8	0.660	11/16	1.25	1 1/2	1	10 7/8	5 1/2
×48	14.1	13.8	13 3/4	0.340	5/16	3/16	8.03	8	0.595	5/8	1.19	1 7/16	1		
×43[c]	12.6	13.7	13 5/8	0.305	5/16	3/16	8.00	8	0.530	1/2	1.12	1 3/8	1		
W14×38[c]	11.2	14.1	14 1/8	0.310	5/16	3/16	6.77	6 3/4	0.515	1/2	0.915	1 1/4	13/16	11 5/8	3 1/2[g]
×34[c]	10.0	14.0	14	0.285	5/16	3/16	6.75	6 3/4	0.455	7/16	0.855	1 3/16	3/4		3 1/2
×30[c]	8.85	13.8	13 7/8	0.270	1/4	1/8	6.73	6 3/4	0.385	3/8	0.785	1 1/8	3/4		3 1/2
W14×26[c]	7.69	13.9	13 7/8	0.255	1/4	1/8	5.03	5	0.420	7/16	0.820	1 1/8	3/4	11 5/8	2 3/4[g]
×22[c]	6.49	13.7	13 3/4	0.230	1/4	1/8	5.00	5	0.335	5/16	0.735	1 1/16	3/4	11 5/8	2 3/4[g]
W12×336[h]	98.8	16.8	16 7/8	1.78	1 3/4	7/8	13.4	13 3/8	2.96	2 15/16	3.55	3 7/8	1 11/16	9 1/8	5 1/2
×305[h]	89.6	16.3	16 3/8	1.63	1 5/8	13/16	13.2	13 1/4	2.71	2 11/16	3.30	3 5/8	1 5/8		
×279[h]	81.9	15.9	15 7/8	1.53	1 1/2	3/4	13.1	13 1/8	2.47	2 1/2	3.07	3 3/8	1 5/8		
×252[h]	74.0	15.4	15 3/8	1.40	1 3/8	11/16	13.0	13	2.25	2 1/4	2.85	3 1/8	1 1/2		
×230[h]	67.7	15.1	15	1.29	1 5/16	11/16	12.9	12 7/8	2.07	2 1/16	2.67	2 15/16	1 1/2		
×210	61.8	14.7	14 3/4	1.18	1 3/16	5/8	12.8	12 3/4	1.90	1 7/8	2.50	2 13/16	1 7/16		
×190	55.8	14.4	14 3/8	1.06	1 1/16	9/16	12.7	12 5/8	1.74	1 3/4	2.33	2 5/8	1 3/8		
×170	50.0	14.0	14	0.960	15/16	1/2	12.6	12 5/8	1.56	1 9/16	2.16	2 7/16	1 5/16		
×152	44.7	13.7	13 3/4	0.870	7/8	7/16	12.5	12 1/2	1.40	1 3/8	2.00	2 5/16	1 1/4		
×136	39.9	13.4	13 3/8	0.790	13/16	7/16	12.4	12 3/8	1.25	1 1/4	1.85	2 1/8	1 1/4		
×120	35.3	13.1	13 1/8	0.710	11/16	3/8	12.3	12 3/8	1.11	1 1/8	1.70	2	1 3/16		
×106	31.2	12.9	12 7/8	0.610	5/8	5/16	12.2	12 1/4	0.990	1	1.59	1 7/8	1 1/8		
×96	28.2	12.7	12 3/4	0.550	9/16	5/16	12.2	12 1/8	0.900	7/8	1.50	1 13/16	1 1/8		
×87	25.6	12.5	12 1/2	0.515	1/2	1/4	12.1	12 1/8	0.810	13/16	1.41	1 11/16	1 1/16		
×79	23.2	12.4	12 3/8	0.470	1/2	1/4	12.1	12 1/8	0.735	3/4	1.33	1 5/8	1 1/16		
×72	21.1	12.3	12 1/4	0.430	7/16	1/4	12.0	12	0.670	11/16	1.27	1 9/16	1 1/16		
×65[f]	19.1	12.1	12 1/8	0.390	3/8	3/16	12.0	12	0.605	5/8	1.20	1 1/2	1		

[c] Shape is slender for compression with F_y = 50 ksi.
[f] Shape exceeds compact limit for flexure with F_y = 50 ksi.
[g] The actual size, combination, and orientation of fastener components should be compared with the geometry of the cross-section to ensure compatibility.
[h] Flange thickness greater than 2 in. Special requirements may apply per AISC Specification Section A3.1c.

ANNEXURE

Table 1-1 (continued)
W Shapes
Properties

W14 – W12

Nom-inal Wt.	Compact Section Criteria		Axis X-X				Axis Y-Y				r_{ts}	h_o	Torsional Properties	
	$\frac{b_f}{2t_f}$	$\frac{h}{t_w}$	I	S	r	Z	I	S	r	Z			J	C_w
lb/ft			in.^{4}	in.^{3}	in.	in.^{3}	in.^{4}	in.^{3}	in.	in.^{3}	in.	in.	in.^{4}	in.^{6}
132	7.15	17.7	1530	209	6.28	234	548	74.5	3.76	113	4.23	13.6	12.3	25500
120	7.80	19.3	1380	190	6.24	212	495	67.5	3.74	102	4.20	13.5	9.37	22700
109	8.49	21.7	1240	173	6.22	192	447	61.2	3.73	92.7	4.17	13.5	7.12	20200
99	9.34	23.5	1110	157	6.17	173	402	55.2	3.71	83.6	4.14	13.4	5.37	18000
90	10.2	25.9	999	143	6.14	157	362	49.9	3.70	75.6	4.11	13.3	4.06	16000
82	5.92	22.4	881	123	6.05	139	148	29.3	2.48	44.8	2.85	13.5	5.07	6710
74	6.41	25.4	795	112	6.04	126	134	26.6	2.48	40.5	2.82	13.4	3.87	5990
68	6.97	27.5	722	103	6.01	115	121	24.2	2.46	36.9	2.80	13.3	3.01	5380
61	7.75	30.4	640	92.1	5.98	102	107	21.5	2.45	32.8	2.78	13.2	2.19	4710
53	6.11	30.9	541	77.8	5.89	87.1	57.7	14.3	1.92	22.0	2.22	13.3	1.94	2540
48	6.75	33.6	484	70.2	5.85	78.4	51.4	12.8	1.91	19.6	2.20	13.2	1.45	2240
43	7.54	37.4	428	62.6	5.82	69.6	45.2	11.3	1.89	17.3	2.18	13.1	1.05	1950
38	6.57	39.6	385	54.6	5.87	61.5	26.7	7.88	1.55	12.1	1.82	13.6	0.798	1230
34	7.41	43.1	340	48.6	5.83	54.6	23.3	6.91	1.53	10.6	1.80	13.5	0.569	1070
30	8.74	45.4	291	42.0	5.73	47.3	19.6	5.82	1.49	8.99	1.77	13.5	0.380	887
26	5.98	48.1	245	35.3	5.65	40.2	8.91	3.55	1.08	5.54	1.31	13.5	0.358	405
22	7.46	53.3	199	29.0	5.54	33.2	7.00	2.80	1.04	4.39	1.27	13.4	0.208	314
336	2.26	5.47	4060	483	6.41	603	1190	177	3.47	274	4.13	13.9	243	57000
305	2.45	5.98	3550	435	6.29	537	1050	159	3.42	244	4.05	13.6	185	48600
279	2.66	6.35	3110	393	6.16	481	937	143	3.38	220	4.00	13.4	143	42000
252	2.89	6.96	2720	353	6.06	428	828	127	3.34	196	3.93	13.2	108	35800
230	3.11	7.56	2420	321	5.97	386	742	115	3.31	177	3.87	13.0	83.8	31200
210	3.37	8.23	2140	292	5.89	348	664	104	3.28	159	3.82	12.8	64.7	27200
190	3.65	9.16	1890	263	5.82	311	589	93.0	3.25	143	3.76	12.6	48.8	23600
170	4.03	10.1	1650	235	5.74	275	517	82.3	3.22	126	3.71	12.5	35.6	20100
152	4.46	11.2	1430	209	5.66	243	454	72.8	3.19	111	3.66	12.3	25.8	17200
136	4.96	12.3	1240	186	5.58	214	398	64.2	3.16	98.0	3.61	12.2	18.5	14700
120	5.57	13.7	1070	163	5.51	186	345	56.0	3.13	85.4	3.56	12.0	12.9	12400
106	6.17	15.9	933	145	5.47	164	301	49.3	3.11	75.1	3.52	11.9	9.13	10700
96	6.76	17.7	833	131	5.44	147	270	44.4	3.09	67.5	3.49	11.8	6.85	9410
87	7.48	18.9	740	118	5.38	132	241	39.7	3.07	60.4	3.46	11.7	5.10	8270
79	8.22	20.7	662	107	5.34	119	216	35.8	3.05	54.3	3.43	11.6	3.84	7330
72	8.99	22.6	597	97.4	5.31	108	195	32.4	3.04	49.2	3.40	11.6	2.93	6540
65	9.92	24.9	533	87.9	5.28	96.8	174	29.1	3.02	44.1	3.38	11.5	2.18	5780

ANNEXURE

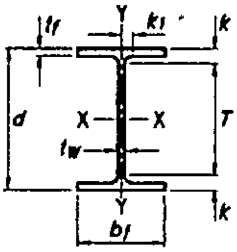


Table 1-1 (continued)
W Shapes
Dimensions

Shape	Area, A	Depth, d		Web			Flange				Distance				
				Thickness, t_w		$\frac{t_w}{2}$	Width, b_f		Thickness, t_f		k		k_1	T	Workable Gage
											k_{des}	k_{det}			
	in.^{2}	in.		in.		in.	in.		in.		in.	in.	in.	in.	in.
W12×58	17.0	12.2	12 1/4	0.360	3/8	3/16	10.0	10	0.640	5/8	1.24	1 1/2	15/16	9 1/4	5 1/2
×53	15.6	12.1	12	0.345	3/8	3/16	10.0	10	0.575	9/16	1.18	1 3/8	15/16	9 1/4	5 1/2
W12×50	14.6	12.2	12 1/4	0.370	3/8	3/16	8.08	8 1/8	0.640	5/8	1.14	1 1/2	15/16	9 1/4	5 1/2
×45	13.1	12.1	12	0.335	5/16	3/16	8.05	8	0.575	9/16	1.08	1 3/8	15/16	↓	↓
×40	11.7	11.9	12	0.295	5/16	3/16	8.01	8	0.515	1/2	1.02	1 3/8	7/8	↓	↓
W12×35[c]	10.3	12.5	12 1/2	0.300	5/16	3/16	6.56	6 1/2	0.520	1/2	0.820	1 3/16	3/4	10 1/8	3 1/2
×30[c]	8.79	12.3	12 3/8	0.260	1/4	1/8	6.52	6 1/2	0.440	7/16	0.740	1 1/8	3/4	↓	↓
×26[c]	7.65	12.2	12 1/4	0.230	1/4	1/8	6.49	6 1/2	0.380	3/8	0.680	1 1/16	3/4	↓	↓
W12×22[c]	6.48	12.3	12 1/4	0.260	1/4	1/8	4.03	4	0.425	7/16	0.725	15/16	5/8	10 3/8	2 1/4[g]
×19[c]	5.57	12.2	12 1/8	0.235	1/4	1/8	4.01	4	0.350	3/8	0.650	7/8	9/16	↓	↓
×16[c]	4.71	12.0	12	0.220	1/4	1/8	3.99	4	0.265	1/4	0.565	13/16	9/16	↓	↓
×14[c,v]	4.16	11.9	11 7/8	0.200	3/16	1/8	3.97	4	0.225	1/4	0.525	3/4	9/16	↓	↓
W10×112	32.9	11.4	11 3/8	0.755	3/4	3/8	10.4	10 3/8	1.25	1 1/4	1.75	1 15/16	1	7 1/2	5 1/2
×100	29.4	11.1	11 1/8	0.680	11/16	3/8	10.3	10 3/8	1.12	1 1/8	1.62	1 13/16	1	↓	↓
×88	25.9	10.8	10 7/8	0.605	5/8	5/16	10.3	10 1/4	0.990	1	1.49	1 11/16	15/16	↓	↓
×77	22.6	10.6	10 5/8	0.530	1/2	1/4	10.2	10 1/4	0.870	7/8	1.37	1 9/16	7/8	↓	↓
×68	20.0	10.4	10 3/8	0.470	1/2	1/4	10.1	10 1/8	0.770	3/4	1.27	1 7/16	7/8	↓	↓
×60	17.6	10.2	10 1/4	0.420	7/16	1/4	10.1	10 1/8	0.680	11/16	1.18	1 3/8	13/16	↓	↓
×54	15.8	10.1	10 1/8	0.370	3/8	3/16	10.0	10	0.615	5/8	1.12	1 5/16	13/16	↓	↓
×49	14.4	10.0	10	0.340	5/16	3/16	10.0	10	0.560	9/16	1.06	1 1/4	13/16	↓	↓
W10×45	13.3	10.1	10 1/8	0.350	3/8	3/16	8.02	8	0.620	5/8	1.12	1 5/16	13/16	7 1/2	5 1/2
×39	11.5	9.92	9 7/8	0.315	5/16	3/16	7.99	8	0.530	1/2	1.03	1 3/16	13/16	↓	↓
×33	9.71	9.73	9 3/4	0.290	5/16	3/16	7.96	8	0.435	7/16	0.935	1 1/8	3/4	↓	↓
W10×30	8.84	10.5	10 1/2	0.300	5/16	3/16	5.81	5 3/4	0.510	1/2	0.810	1 1/8	11/16	8 1/4	2 3/4[g]
×26	7.61	10.3	10 3/8	0.260	1/4	1/8	5.77	5 3/4	0.440	7/16	0.740	1 1/16	11/16	↓	↓
×22[c]	6.49	10.2	10 1/8	0.240	1/4	1/8	5.75	5 3/4	0.360	3/8	0.660	15/16	5/8	↓	↓
W10×19	5.62	10.2	10 1/4	0.250	1/4	1/8	4.02	4	0.395	3/8	0.695	15/16	5/8	8 3/8	2 1/4[g]
×17[c]	4.99	10.1	10 1/8	0.240	1/4	1/8	4.01	4	0.330	5/16	0.630	7/8	9/16	↓	↓
×15[c]	4.41	10.0	10	0.230	1/4	1/8	4.00	4	0.270	1/4	0.570	13/16	9/16	↓	↓
×12[c,f]	3.54	9.87	9 7/8	0.190	3/16	1/8	3.96	4	0.210	3/16	0.510	3/4	9/16	↓	↓

[c] Shape is slender for compression with F_y = 50 ksi.
[f] Shape exceeds compact limit for flexure with F_y = 50 ksi.
[g] The actual size, combination, and orientation of fastener components should be compared with the geometry of the cross-section to ensure compatibility.
[v] Shape does not meet the h/t_w limit for shear in Specification Section G2.1a with F_y = 50 ksi.

ANNEXURE

Table 1-1 (continued)
W Shapes
Properties

W12 – W10

Nom-inal Wt.	Compact Section Criteria		Axis X-X				Axis Y-Y				r_{ts}	h_o	Torsional Properties	
	$\frac{b_f}{2t_f}$	$\frac{h}{t_w}$	I	S	r	Z	I	S	r	Z			J	C_w
lb/ft			in.^{4}	in.^{3}	in.	in.^{3}	in.^{4}	in.^{3}	in.	in.^{3}	in.	in.	in.^{4}	in.^{6}
58	7.82	27.0	475	78.0	5.28	86.4	107	21.4	2.51	32.5	2.82	11.6	2.10	3570
53	8.69	28.1	425	70.6	5.23	77.9	95.8	19.2	2.48	29.1	2.79	11.5	1.58	3160
50	6.31	26.8	391	64.2	5.18	71.9	56.3	13.9	1.96	21.3	2.25	11.6	1.71	1880
45	7.00	29.6	348	57.7	5.15	64.2	50.0	12.4	1.95	19.0	2.23	11.5	1.26	1650
40	7.77	33.6	307	51.5	5.13	57.0	44.1	11.0	1.94	16.8	2.21	11.4	0.906	1440
35	6.31	36.2	285	45.6	5.25	51.2	24.5	7.47	1.54	11.5	1.79	12.0	0.741	879
30	7.41	41.8	238	38.6	5.21	43.1	20.3	6.24	1.52	9.56	1.77	11.9	0.457	720
26	8.54	47.2	204	33.4	5.17	37.2	17.3	5.34	1.51	8.17	1.75	11.8	0.300	607
22	4.74	41.8	156	25.4	4.91	29.3	4.66	2.31	0.848	3.66	1.04	11.9	0.293	164
19	5.72	46.2	130	21.3	4.82	24.7	3.76	1.88	0.822	2.98	1.02	11.8	0.180	131
16	7.53	49.4	103	17.1	4.67	20.1	2.82	1.41	0.773	2.26	0.982	11.7	0.103	96.9
14	8.82	54.3	88.6	14.9	4.62	17.4	2.36	1.19	0.753	1.90	0.962	11.7	0.0704	80.4
112	4.17	10.4	716	126	4.66	147	236	45.3	2.68	69.2	3.07	10.1	15.1	6020
100	4.62	11.6	623	112	4.60	130	207	40.0	2.65	61.0	3.03	10.0	10.9	5150
88	5.18	13.0	534	98.5	4.54	113	179	34.8	2.63	53.1	2.99	9.85	7.53	4330
77	5.86	14.8	455	85.9	4.49	97.6	154	30.1	2.60	45.9	2.95	9.73	5.11	3630
68	6.58	16.7	394	75.7	4.44	85.3	134	26.4	2.59	40.1	2.91	9.63	3.56	3100
60	7.41	18.7	341	66.7	4.39	74.6	116	23.0	2.57	35.0	2.88	9.54	2.48	2640
54	8.15	21.2	303	60.0	4.37	66.6	103	20.6	2.56	31.3	2.86	9.48	1.82	2320
49	8.93	23.1	272	54.6	4.35	60.4	93.4	18.7	2.54	28.3	2.84	9.42	1.39	2070
45	6.47	22.5	248	49.1	4.32	54.9	53.4	13.3	2.01	20.3	2.27	9.48	1.51	1200
39	7.53	25.0	209	42.1	4.27	46.8	45.0	11.3	1.98	17.2	2.24	9.39	0.976	992
33	9.15	27.1	171	35.0	4.19	38.8	36.6	9.20	1.94	14.0	2.20	9.30	0.583	791
30	5.70	29.5	170	32.4	4.38	36.6	16.7	5.75	1.37	8.84	1.60	10.0	0.622	414
26	6.56	34.0	144	27.9	4.35	31.3	14.1	4.89	1.36	7.50	1.58	9.89	0.402	345
22	7.99	36.9	118	23.2	4.27	26.0	11.4	3.97	1.33	6.10	1.55	9.81	0.239	275
19	5.09	35.4	96.3	18.8	4.14	21.6	4.29	2.14	0.874	3.35	1.06	9.85	0.233	104
17	6.08	36.9	81.9	16.2	4.05	18.7	3.56	1.78	0.845	2.80	1.04	9.78	0.156	85.1
15	7.41	38.5	68.9	13.8	3.95	16.0	2.89	1.45	0.810	2.30	1.01	9.72	0.104	68.3
12	9.43	46.6	53.8	10.9	3.90	12.6	2.18	1.10	0.785	1.74	0.983	9.66	0.0547	50.9

ANNEXURE

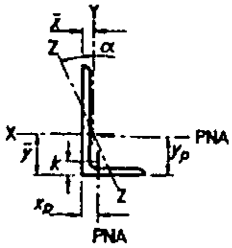


Table 1–7 (continued)
Angles
Properties

Shape	k	Wt.	Area, A	Axis X-X						Flexural-Torsional Properties		
				I	S	r	$\bar{y}$	Z	y_p	J	C_w	$\bar{r}_o$
	in.	lb/ft	in.^{2}	in.^{4}	in.^{3}	in.	in.	in.^{3}	in.	in.^{4}	in.^{6}	in.
L6×4×7/8	1 3/8	27.2	7.98	27.7	7.13	1.86	2.12	12.7	1.44	2.03	4.04	2.82
×3/4	1 1/4	23.6	6.94	24.5	6.23	1.88	2.07	11.1	1.38	1.31	2.64	2.85
×5/8	1 1/8	20.0	5.86	21.0	5.29	1.89	2.03	9.44	1.31	0.775	1.59	2.88
×9/16	1 1/16	18.1	5.31	19.2	4.81	1.90	2.00	8.59	1.28	0.572	1.18	2.90
×1/2	1	16.2	4.75	17.3	4.31	1.91	1.98	7.71	1.25	0.407	0.843	2.91
×7/16	15/16	14.3	4.18	15.4	3.81	1.92	1.95	6.81	1.22	0.276	0.575	2.93
×3/8	7/8	12.3	3.61	13.4	3.30	1.93	1.93	5.89	1.19	0.177	0.369	2.94
×5/16	13/16	10.3	3.03	11.4	2.77	1.94	1.90	4.96	1.16	0.104	0.217	2.96
L6×3 1/2×1/2	1	15.3	4.50	16.6	4.23	1.92	2.07	7.49	1.48	0.386	0.779	2.88
×3/8	7/8	11.7	3.42	12.9	3.23	1.93	2.02	5.74	1.41	0.168	0.341	2.90
×5/16	13/16	9.80	2.87	10.9	2.72	1.94	2.00	4.84	1.38	0.0990	0.201	2.92
L5×5×7/8	1 3/8	27.2	7.98	17.8	5.16	1.49	1.56	9.31	0.802	2.07	3.53	2.64
×3/4	1 1/4	23.6	6.94	15.7	4.52	1.50	1.52	8.14	0.698	1.33	2.32	2.67
×5/8	1 1/8	20.0	5.86	13.6	3.85	1.52	1.47	6.93	0.590	0.792	1.40	2.70
×1/2	1	16.2	4.75	11.3	3.15	1.53	1.42	5.66	0.479	0.417	0.744	2.73
×7/16	15/16	14.3	4.18	10.0	2.78	1.54	1.40	5.00	0.422	0.284	0.508	2.74
×3/8	7/8	12.3	3.61	8.76	2.41	1.55	1.37	4.33	0.365	0.183	0.327	2.76
×5/16	13/16	10.3	3.03	7.44	2.04	1.56	1.35	3.65	0.307	0.108	0.193	2.77
L5×3 1/2×3/4	1 3/16	19.8	5.81	13.9	4.26	1.55	1.74	7.60	1.12	1.09	1.52	2.36
×5/8	1 1/16	16.8	4.92	12.0	3.63	1.56	1.69	6.50	1.06	0.651	0.918	2.39
×1/2	15/16	13.6	4.00	9.96	2.97	1.58	1.65	5.33	0.997	0.343	0.491	2.42
×3/8	13/16	10.4	3.05	7.75	2.28	1.59	1.60	4.09	0.933	0.150	0.217	2.45
×5/16	3/4	8.70	2.56	6.58	1.92	1.60	1.57	3.45	0.901	0.0883	0.128	2.47
×1/4	11/16	7.00	2.06	5.36	1.55	1.61	1.55	2.78	0.868	0.0464	0.0670	2.48
L5×3×1/2	15/16	12.8	3.75	9.43	2.89	1.58	1.74	5.12	1.25	0.322	0.444	2.38
×7/16	7/8	11.3	3.31	8.41	2.56	1.59	1.72	4.53	1.21	0.220	0.304	2.39
×3/8	13/16	9.80	2.86	7.35	2.22	1.60	1.69	3.93	1.18	0.141	0.196	2.41
×5/16	3/4	8.20	2.40	6.24	1.87	1.61	1.67	3.32	1.15	0.0832	0.116	2.42
×1/4	11/16	6.60	1.94	5.09	1.51	1.62	1.64	2.68	1.12	0.0438	0.0606	2.43
L4×4×3/4	1 1/8	18.5	5.44	7.62	2.79	1.18	1.27	5.02	0.679	1.02	1.12	2.10
×5/8	1	15.7	4.61	6.62	2.38	1.20	1.22	4.28	0.576	0.610	0.680	2.13
×1/2	7/8	12.8	3.75	5.52	1.96	1.21	1.18	3.50	0.468	0.322	0.366	2.16
×7/16	13/16	11.3	3.31	4.93	1.73	1.22	1.15	3.10	0.413	0.220	0.252	2.18
×3/8	3/4	9.80	2.86	4.32	1.50	1.23	1.13	2.69	0.357	0.141	0.162	2.19
×5/16	11/16	8.20	2.40	3.67	1.27	1.24	1.11	2.26	0.300	0.0832	0.0963	2.21
×1/4	5/8	6.60	1.94	3.00	1.03	1.25	1.08	1.82	0.242	0.0438	0.0505	2.22

Note: For compactness criteria, refer to the end of Table 1–7.

Table 1-7 (continued)
Angles
Properties

L6-L4

Shape	Axis Y-Y						Axis Z-Z				Q_s
	I	S	r	$\bar{x}$	Z	x_p	I	S	r	Tan α	$F_y = 36$ ksi
	in.^{4}	in.^{3}	in.	in.	in.^{3}	in.	in.^{4}	in.^{3}	in.		
L6×4×7/8	9.70	3.37	1.10	1.12	6.26	0.665	5.82	1.90	0.854	0.421	1.00
×3/4	8.63	2.95	1.12	1.07	5.42	0.578	5.08	1.66	0.856	0.428	1.00
×5/8	7.48	2.52	1.13	1.03	4.56	0.488	4.32	1.42	0.859	0.435	1.00
×9/16	6.86	2.29	1.14	1.00	4.13	0.442	3.94	1.30	0.861	0.438	1.00
×1/2	6.22	2.06	1.14	0.981	3.69	0.396	3.55	1.17	0.864	0.440	1.00
×7/16	5.56	1.83	1.15	0.957	3.24	0.349	3.14	1.04	0.867	0.443	0.973
×3/8	4.86	1.58	1.16	0.933	2.79	0.301	2.73	0.908	0.870	0.446	0.912
×5/16	4.13	1.34	1.17	0.908	2.33	0.252	2.31	0.769	0.874	0.449	0.826
L6×3½×1/2	4.24	1.59	0.968	0.829	2.88	0.376	2.58	0.914	0.756	0.343	1.00
×3/8	3.33	1.22	0.984	0.781	2.18	0.287	2.00	0.714	0.763	0.349	0.912
×5/16	2.84	1.03	0.991	0.756	1.82	0.241	1.70	0.609	0.767	0.352	0.826
L5×5×7/8	17.8	5.16	1.49	1.56	9.30	0.802	7.56	2.14	0.971	1.00	1.00
×3/4	15.7	4.52	1.50	1.52	8.14	0.698	6.59	1.86	0.972	1.00	1.00
×5/8	13.6	3.85	1.52	1.47	6.92	0.590	5.61	1.59	0.975	1.00	1.00
×1/2	11.3	3.15	1.53	1.42	5.66	0.479	4.60	1.30	0.980	1.00	1.00
×7/16	10.0	2.78	1.54	1.40	5.00	0.422	4.08	1.15	0.983	1.00	1.00
×3/8	8.76	2.41	1.55	1.37	4.33	0.365	3.55	1.00	0.986	1.00	0.983
×5/16	7.44	2.04	1.56	1.35	3.65	0.307	3.01	0.850	0.990	1.00	0.912
L5×3½×3/4	5.52	2.20	0.974	0.993	4.07	0.582	3.22	1.22	0.744	0.464	1.00
×5/8	4.80	1.88	0.987	0.947	3.43	0.493	2.74	1.05	0.746	0.472	1.00
×1/2	4.02	1.55	1.00	0.901	2.79	0.400	2.25	0.862	0.750	0.479	1.00
×3/8	3.15	1.19	1.02	0.854	2.12	0.305	1.74	0.670	0.755	0.485	0.983
×5/16	2.69	1.01	1.02	0.829	1.77	0.256	1.47	0.569	0.758	0.489	0.912
×1/4	2.20	0.816	1.03	0.804	1.42	0.207	1.19	0.463	0.761	0.491	0.804
L5×3×1/2	2.55	1.13	0.824	0.746	2.08	0.375	1.55	0.645	0.642	0.357	1.00
×7/16	2.29	1.00	0.831	0.722	1.82	0.331	1.37	0.575	0.644	0.361	1.00
×3/8	2.01	0.874	0.838	0.698	1.57	0.286	1.20	0.503	0.646	0.364	0.983
×5/16	1.72	0.739	0.846	0.673	1.31	0.241	1.01	0.428	0.649	0.368	0.912
×1/4	1.41	0.600	0.853	0.648	1.05	0.194	0.825	0.350	0.652	0.371	0.804
L4×4×3/4	7.62	2.79	1.18	1.27	5.01	0.679	3.25	1.15	0.774	1.00	1.00
×5/8	6.62	2.38	1.20	1.22	4.28	0.576	2.76	0.975	0.774	1.00	1.00
×1/2	5.52	1.96	1.21	1.18	3.50	0.468	2.25	0.797	0.776	1.00	1.00
×7/16	4.93	1.73	1.22	1.15	3.10	0.413	2.00	0.706	0.777	1.00	1.00
×3/8	4.32	1.50	1.23	1.13	2.68	0.357	1.73	0.613	0.779	1.00	1.00
×5/16	3.67	1.27	1.24	1.11	2.26	0.300	1.46	0.517	0.781	1.00	0.997
×1/4	3.00	1.03	1.25	1.08	1.82	0.242	1.18	0.419	0.783	1.00	0.912

Note: For compactness criteria, refer to the end of Table 1-7.

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-II B.Sc. Engineering Examinations, Session: January 2020

Sub: **CE 371** (Environmental Engineering (for WRE))

Full Marks: 240 Time: 2 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) Define BOD and COD. Why COD of a wastewater sample is greater than BOD? 20

   (b) BOD_5 of wastewater sample is 200 mg/L at 20^0C. K_1=0.23/d at 20^0C (base e). Determine BOD_7 at 30^0C, assuming Θ=1.05 20

2) Briefly discuss with sketch a conventional Pit Latrine. What are the disadvantages of this system? 40

3) Briefly describe the various collection system of solid wastes. Which type is the most appropriate for the city of Dhaka and why? 40

4) (a) Briefly discuss the Volumetric Loading and Surface Loading of Wastewater stabilization ponds system. Why is fecal coliform removal more in waste stabilization pond than any other waste treatment system? 20

   (c) Determine no. of maturation ponds for the following condition:

   $N_i=4x10^7/100ml$, $Ne=100/100ml$, $t_a=5d$, $t_f=30d$, $K_b=2.6/d$ 20

Section-B: CE 371 for WRE

There are **FOUR** questions in this section, answer any **THREE**.

5. Why is the hydrologic cycle important? Explain the problems associated with groundwater exploration in Bangladesh. What are the main assumptions to derive the equation of the yield of a well in an unconfined aquifer?	**(40)**
6. What are the different unit processes that commonly used in Bangladesh to treat water for domestic water supply? State the theory of Filtration. What are the common methods of water distribution system?	**(40)**
7. State the five critical factors affecting per capita water consumption in the context of Bangladesh. From a clear water reservoir 3.5m deep and maximum water level (MWL) at RL= 30 m, water is to be pumped to an elevated reservoir MWL at RL=70m at a constant rate of 850,000 litre per hour. The horizontal distance between clear water reservoir and elevated reservoir is 1000m. The centre level of the pump is at RL= 32.5 m and the ground level is at RL=32 m. Draw the schematic digram of pipe and estimate the capacity of the pumping unit. For economical pipe diameter (D), consider D=(0.97 to 1.22) $\sqrt{Q}$.	**(40)**
8. What are main purposes of EIA? List important methodologies used for EIA. What are main goals of Environmental Management? Distinguish between guideline and standard.	**(40)**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-II, B.Sc. Engineering Examinations, Session: January 2020

Sub: **CE 391** (Transportation Engineering)

Full Marks: 240 Time: 2 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.

No.	Questions	Marks
1(a)	Describe the advantages of railway from economics, political and social perspectives. Briefly describe the three components of the rolling stock of a railway i.e., locomotives, coaches, wagons.	15+5
(b)	A five degrees curve branches off from a two degrees main curve in an opposite direction in the layout of a broad-gauge yard. If the speed on the branch line is restricted to 35 kmph, determine the speed restriction on the main line. Assume permissible deficiency in cant as 76 mm.	20

2(a)	With a neat sketch, show different constituents of a railway left-hand turnout. Compare between airfield and highway pavements.	12+8
(b)	What are the functions of a pavement? Compare between rigid and flexible pavements.	5+15

3(a)	Design a rigid pavement using the AASHTO Method for the following design criteria: Effective modulus of subgrade reaction, $k = 72$ lb/in^3 Concrete elastic modulus, $E_c = 5 \times 10^6$ Mean concrete modulus of rupture, $S'_c = 650$ psi Load transfer coefficient, $J = 3.2$ Drainage coefficient, $C_d = 1.0$ Present serviceability index, $P_i = 4.8$ Final serviceability index, $P_t = 2.3$ Reliability, $R = 95\%$ Overall standard deviation, $S_o = 0.25$ ESAL $= 7.2 \times 10^6$ Use the attached design charts.	20
(b)	Draw cross-sections of rigid pavement and flexible pavement. Classify the joints used in a rigid pavement. Briefly describe contraction joints and construction joints.	10+10

4(a)	Describe aggregate blending. Explain the importance of aggregative blending. What are the common methods used for blending aggregates?	4+10+6
(b)	An existing 6.2m wide Regional Road on embankment requires full reconstruction. A check has been made and the existing road surface is 1.0m above the Highest Flood Level for a 50 year return period. Accordingly the embankment does not require to be raised. A number of trial pits were undertaken and the CBR of the sub-grade beneath the existing road was found to be 2%. Design a flexible pavement based on the 24-hour classified traffic count which was carried out on a typical weekday shown below and show the thicknesses of different layers of the pavement using a neat sketch. Use the attached design charts.	20

	Existing Flow/ day (0.5 x two-way flow)	ESA Factor
Heavy truck	70	4.8
Medium truck	250	4.62
Light truck	90	1.00
Large Bus	130	1.00

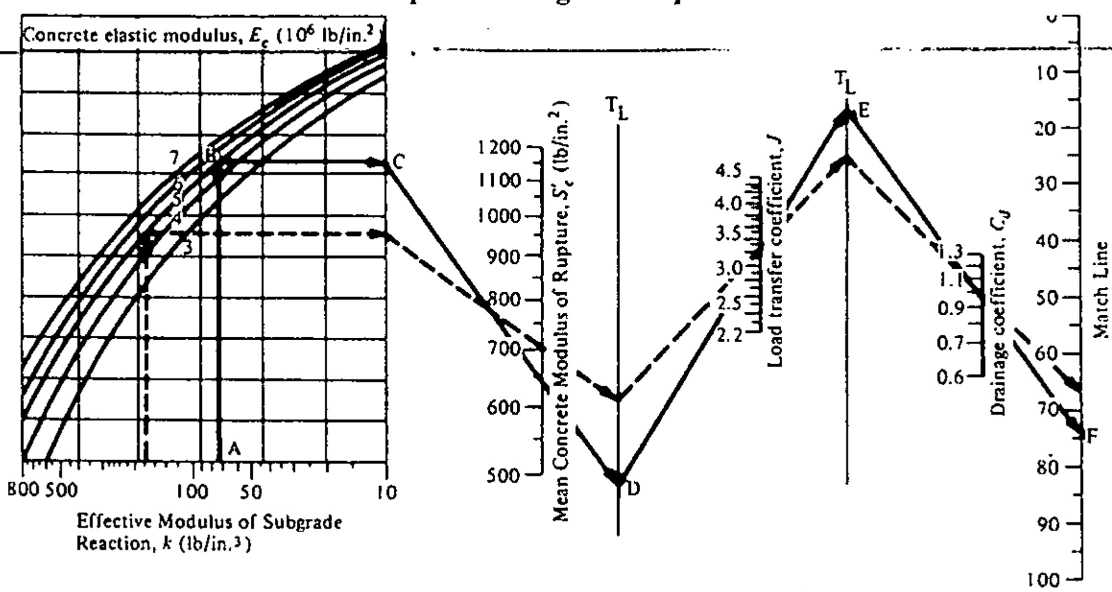
mm	Surfacing (mm)		Roadbases (mm)* (Select one type)			Sub-bases (mm)** Subgrade CBR %		
Traffic ESA (mill)	Asphalt Wearing Course	Asphalt Base-Course	Cement-bound Granular	Granular Base Type I	Granular Base Type II	5	8 - 25	> 25
60 - 80	40	155	Refer to BRRL for design advice	N/A	N/A	300	150	0
40 - 60		140						
30 - 40		125						
25 - 30		110		250	300	250		
17 - 25		105						
15 - 17		95				200		
11 - 15		90						
9 - 11		80		200	250			
7 - 9		70						
6 - 7		65						
5 - 6		60						
4 - 5		55						
3 - 4		45		175	200	175		
< 3		35		150	175	150		

* CBR of granular base type I is min. 80% N/A. = not applicable
* CBR of granular base type II is min. 50%
** CBR of sub-base material is 25%

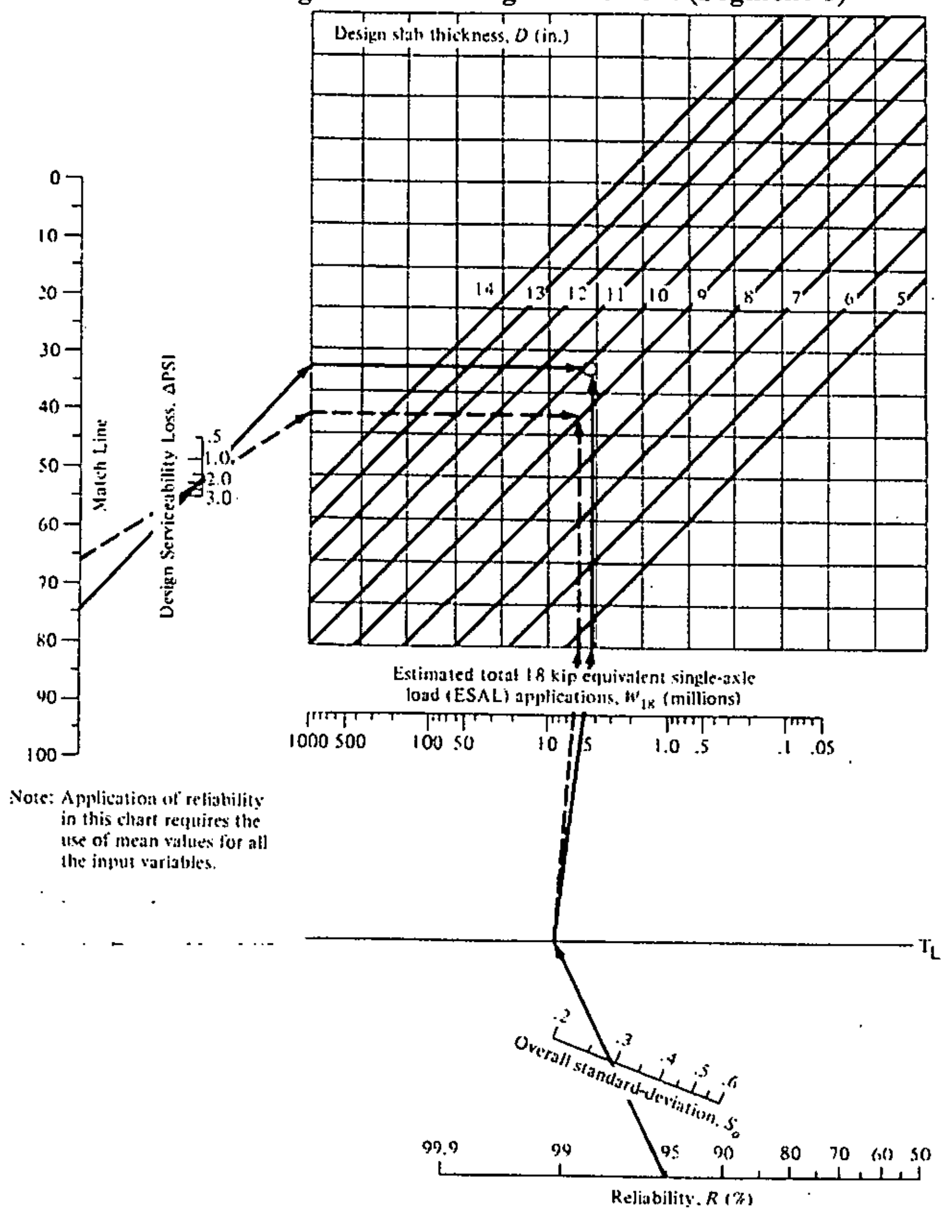
Thickness design table for flexible pavement

CBR Required	Compacted Thickness of additional layer to provide required CBR			
	CBR of Underlying layer			
	2%	3%	4%	5%
5%	250 mm	150 mm	100 mm	-

Improved subgrade requirement



AASHTO Design Chart for Rigid Pavement (Segment-1)



AASHTO Design Chart for Rigid Pavement (Segment-2)

SECTION-B: CE 391

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

No.	Questions	Marks
5.	(a) State the purpose and implications of road classification systems. Explain schematically the relationship between access and movement function of road.	10
	(b) The owner of a parking garage located in a CBD has observed that 20 of those wishing to park are turned back every day during the open hours of 8 am to 6 pm because of lack of parking spaces. An analysis of data collected at the garage indicates that 60 of those who park are commuters, with an average parking duration of 9 hr, and the remaining are shoppers, whose average parking duration is 2 hr. If 20 of those who cannot park are commuters and the rest are shoppers, and a total of 200 vehicles currently park daily in the garage, determine the number of additional spaces required to meet the excess demand. Assume parking efficiency is 0.90.	15
	(c) A sag vertical curve is to be designed to join a -4% grade to a +3% grade. If the design speed is 45 mph, determine the minimum length of the curve that will satisfy all criteria. Assume all reasonable values.	15
6.	(a) Explain the traffic movement for a grade separated T-intersection in the context of traffic conditions in Bangladesh.	10
	(b) With neat sketches demonstrate the conflict points at a 4-legged intersection.	10
	(c) Using the capacity restrained assignment technique, assign the vehicle trips shown in **Table 1** to the network shown in **Figure 1** by one step. To summarize your results, list all link in the network and their corresponding traffic volume. Assume, link capacity=550 veh/hr.	20

Table 1: OD Trip

From/ To	Trips Between Zones			
	1	**2**	**3**	**4**
1	0	100	100	200
2	400	0	200	100
3	200	100	0	100
4	250	150	300	0

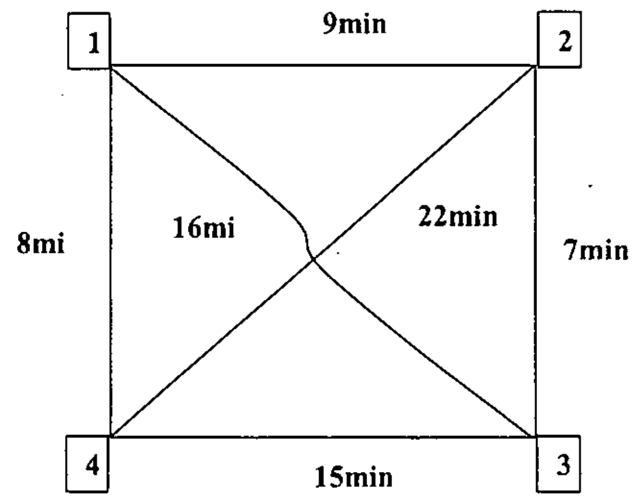


Figure 1

7.		Type equa
	(a) Show diagrammatically the distance d_1, d_2, d_3 and d_4 in the calculation of minimum passing sight distance for a two-lane two-way state highway in the context of Bangladesh.	15
	(b) Briefly explain the followings: (i) PHF (ii) 30th highest Hourly Volume (iii) PIEV time	15
	(c) Four vehicles are found to be travelling at constant speeds between section X and Y (360 m apart) at a particular instant in time. An observer at point X found the four vehicles passing point X during a period of 15 seconds. The speeds of the vehicles are measured as 46, 42, 65 and 54 km/hr respectively. Calculate the flow, density, time mean speed and space mean speed of the vehicles.	10
8.	(a) Explain diagrammatically the method of attaining super elevation considering a crowned pavement revolved about the profile of the inside edge.	10
	(b) What are the criteria to ensure an efficient water transport system? State the features of successful water transit.	10
	(c) Design a two-phase signal of an isolated cross-junction for the following data. Also draw the phase and cycle time bar diagram and find all red time. Assume reasonable values for any missing data.	20

	N-S	E-W
Inter-green periods(sec)	3	5
Initial and final lost time (sec)	3	2

	N	S	E	W
Flow (PCU/hr)	720	480	900	750
Saturation Flow (PCU/hr)	2300	2000	2100	2200

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

B.Sc. Engineering Examinations, Session: January 2020

Sub: **CE 403** (Socio-economic Aspects of Development Projects)

Full Marks: 180 Time: 2 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) 'Economic development is not possible without economic growth' --- Explain this statement with example. (12)

b) What are the key parameters of measuring economic growth and sustainable development? Describe. (18)

2.

a) What is the role of Equity in human development? Explain with example. (12)

b) How does Climate change influence Sustainable Development Goal (SDG 2030)? Explain. (18)

3.

a) 'Going deeper and too far is not a sustainable solution for attaining SDG 6.1' – Do you agree with this statement? Justify your answer. (12)

b) Are there any national policy and legal framework to handle the land acquisition and resettlement issue due to infrastructural projects? Describe in detail with pros and cons of this. (18)

4.

a) List the socio-economic issues that must be considered in a project concerning water quality management planning (15)

b) Discuss the strategic issues to be considered for the success of WSS projects in Bangladesh. Explain how this can be achieved. (15)

SECTION-B: CE 403

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

1. Dhaka North and South City Corporations are planning to build several new inter-district bus terminals on the outskirts of Dhaka city. Four preliminary spots have been selected: Gram Vaduria in Ashulia (MRT line 6), Hemayetpur in Savar (Dhaka-Aricha Highway), Jhilmil (south of Dhaka-Mawa Highway), and Kanchpur (south of Dhaka-Chittagong Highway). 35-60 acres of land would have to be acquired for each terminal.

(a) What are the relevant social and economic impacts you may need to consider for assessing the socio-economic impacts of this project, explicitly associated with land acquisition, relocation, and resettlement? List at least ten factors. 20

(b) How do you collect the relevant data to assess the socio-economic impacts of this project? 10

2.

(a) Propose feasible mitigation measures to minimize various negative socio-economic impacts of inter-district bus terminals project described in Question 1. 15

(b) Propose a framework for implementing the mitigation measures for inter-district bus terminals project. Your response should cover management and monitoring plans, grievance management, etc. 15

3. (a) Briefly discuss methodologies in practice to ensure community participation in a development project. 20

(b) What are the objectives of the Gender Action Plan for implementing a development project? 10

4. (a) What are the advantages and features of Social Impact Assessment (SIA) process? 20

(b) What are the objectives of public consultation and participation for implementing a development project? 10

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

Subject: CE 411 (Structural Analysis and Design-III)- Self Study

Full Marks: 180 Time: 2 Hours

Figures in the margin indicate full marks. Symbols carry their usual meaning. Assume reasonable values for missing data, if any.

UPLOAD SEPARATE FILES FOR EACH SECTION

SECTION-A

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

1. a. Define the following terms: (i) Stiffness; (ii) Fixed end moment. **7.5**

   b. The prismatic beam AB shown in Fig. 1 is subjected to a displacement, Δ, at end, B with respect to end A, (i) Calculate end moments M_{AB} and M_{BA} from the basics. (ii) If the other end (End B) is simply supported, calculate the moment at the fixed end. **15**

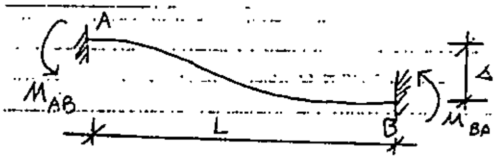


Figure 1

2. Answer either (a) or (b) **22.5**

   a. Obtain support moments for the continuous beam shown in Figure 2. Given that θ_A = + 0.001 rad/clockwise, Δ_A = 0.01 ft downward, Δ_B = 0.04 ft downward, Δ_C = 0.0175 ft downward, E = 30 x 10^3 ksi, I = 1,000 in^4.

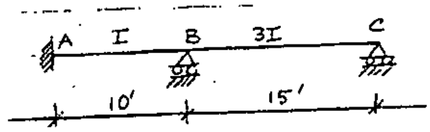


Figure 2

OR

   b. Show that the moment applied at a joint of a rigid-jointed frame is distributed among the connected members in proportion to their flexural stiffness.

3. Answer either (a) or (b) **22.5**

   a. Analyze the frame shown in Fig 3. Draw bending moment diagram and sketch the deflected shape. Use flexibility method.

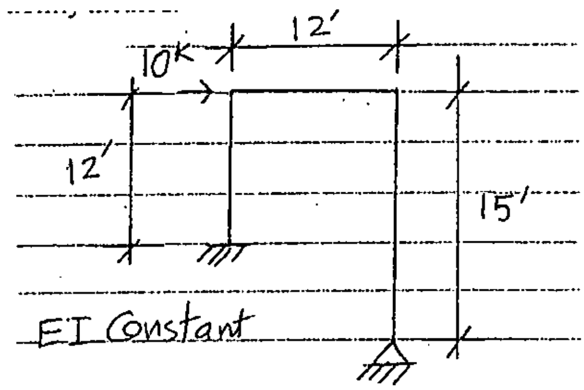


Figure 3

OR

   b. Analyze the frame shown in Fig 3. Draw bending moment diagram and sketch the deflected shape. Use moment distribution method.

4. Answer either (a) or (b) **22.5**

   a. "The influence line for a statically determinate structure is composed of straight line(s); while that for a statically indeterminate structure is curved". Explain the reason(s) citing Muller Breslau's principle.

OR

   b. For the continuous beam of Figure 4, draw qualitative shape of influence lines for M_A, R_A, R_C and V_{CR}.

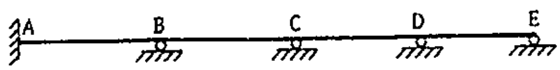


Figure 4

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-II B.Sc. Engineering Examinations, Session: January 2020

Sub: **CE 413** (Introduction to Steel Concrete Composite Structures)

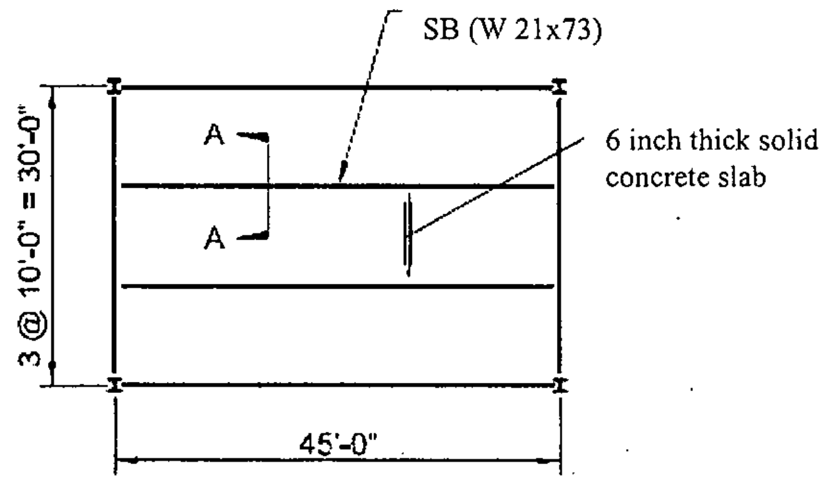
Full Marks: 120 Time: 2 Hours

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**.

No.	Questions	Marks
1.	A typical bay of a composite floor system consisting of solid concrete slab (t=6 inch) is illustrated in **Fig.1.** Calculate the service load flexural stresses in concrete and steel of the secondary composite beam **SB1 (W21x73)** for unshored construction. In addition to the self-weight of the slab and beam consider 80 psf of partition wall load, 30 psf for floor finish, 20 psf for construction live load and 60 psf for service live load. Assume, full interaction between steel and concrete. *Given:* $f_c'=4ksi$ *and* $E_c=3600$ *ksi*; $F_y=50$ *ksi* and $E_s=29000$ *ksi*  **Fig. 1**	20
2.	Determine the midspan deflection of the partially composite beam shown in **Fig. 2**, for unshored construction. The steel shape is **W18x35**. The floor has 5.5 inch normal weight concrete on metal deck with 2.5 inch ribs. This is an interior beam; spacing of the beam is 6 ft. Calculate the total vertical deflection for composite as well as for precomposite stage and compare the values with the allowable limits for total deflection (i.e. L/240) specified in AISC guide. The calculated uniformly distributed service loads on the beam is 0.5 k/ft for self weight of slab, deck and beam; 0.1 k/ft for construction live load; 0.2 k/ft for floor finish; 0.4 k/ft for partition walls and 1 k/ft floor live load. Consider 70% composite action for the beam. Given: For concrete $f_c'=4$ *ksi and* $E_c=3600$ *ksi*; for steel $F_y=50$ *ksi* and $E_s=29000$ *ksi*	20

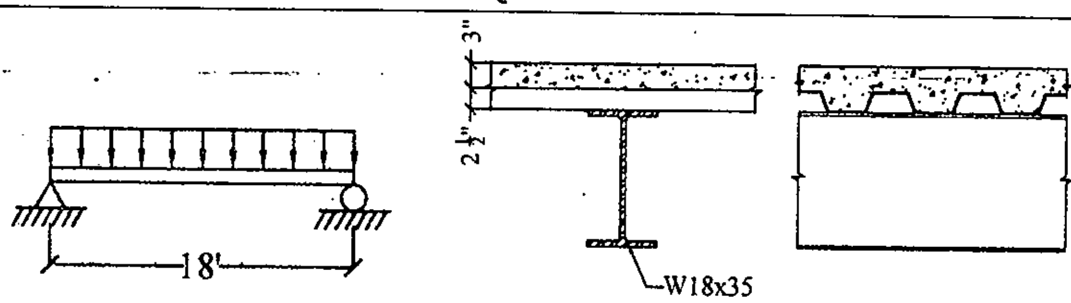
<table>
<tr><th>No.</th><th>Questions</th><th>Marks</th></tr>
<tr><td></td><td>

Fig. 2</td><td></td></tr>
<tr><td>3.</td><td>Determine the number and placement of 0.75 inch diameter stud type shear connectors for the composite beam shown in Fig.2, to develop the design moment capacity of the beam under 70% composite action. Show the detailing in a neat sketch. (use AISC-ASD method)

Assume: R_p=0.6, R_g=0.85 and F_u=65 ksi for shear connectors
Given: For concrete $f_c'=4$ *ksi and* $E_c=3600$ *ksi*; for steel $F_y=50$ *ksi* and $E_s=29000$ *ksi*</td><td>20</td></tr>
<tr><td>4.</td><td>Determine the nominal flexural strength (use AISC-LRFD method) of the following composite beam:
• W21×44, $F_y=50$ ksi
• $f_c'=4$ksi and $E_c=3600$ ksi
• effective slab width= 72 inch
• total slab thickness 5 inch
• span length =30 ft
• formed steel deck is used (**Fig. 3**)

Studs are ¾ inch × 3 inch, one in every third rib (deck ribs are oriented perpendicular to the beam span). Assume: R_p=0.75, R_g=1.0 and F_u=65 ksi for shear connectors

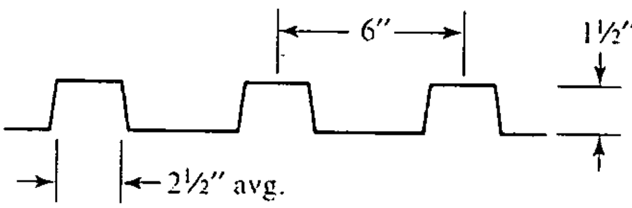
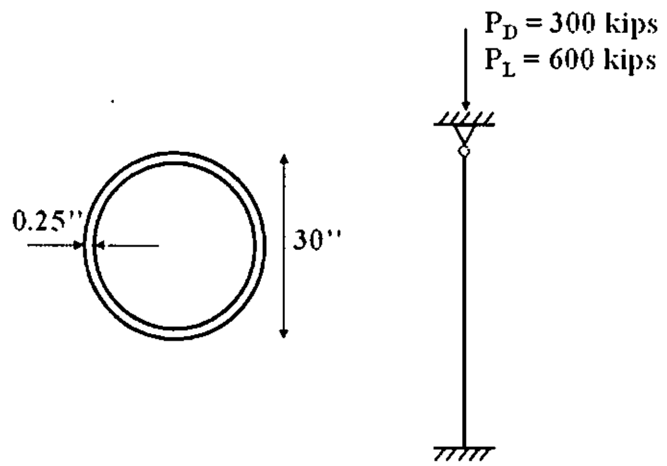


Fig. 3</td><td>20</td></tr>
</table>

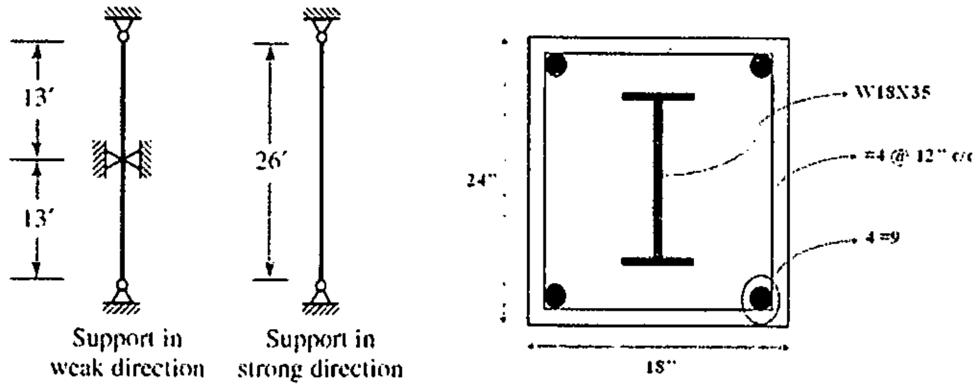
SECTION B: CE 413

There are **Four** questions in this section. Answer any **Three** questions

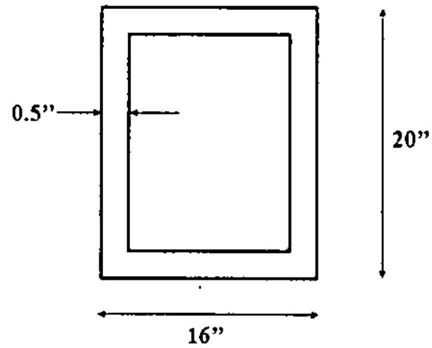
<table>
<tr><th>No.</th><th>Questions</th><th>Marks</th></tr>
<tr><td>5.</td><td>(a) A Concrete Filled Tubular (CFT) column section is shown in Figure 4. Check whether the geometric and material properties of the given section satisfies the AISC code specified limits.
Given: $f_y = 50$ ksi; $f'_c = 4$ ksi; $E_s = 29{,}000$ ksi; $E_c = 3600$ ksi.</td><td>5</td></tr>
<tr><td></td><td>(b) Determine the design axial capacity in compression and tension of the given CFT section. Consider the effective length of the column to be 20 ft. Use AISC-LRFD method.



<u>Figure 4</u></td><td>15</td></tr>
<tr><td>6.</td><td>The composite compression member shown in Figure 5 has lateral support at mid-height in the weak direction only. Compute the nominal strength. Assume a concrete cover of 2.5 inches to the center of the longitudinal reinforcement.
Given: $F_y = F_{yr} = 60$ ksi; $f'_c = 8$ ksi; $E_s = 29000$ ksi and $E_c = 3600$ ksi



<u>Figure 5</u></td><td>20</td></tr>
</table>

7.	Using basic principles, calculate the nominal axial load and bending moment for the four points in the P-M interaction diagram about strong axis bending of the Concrete Filled Tubular (CFT) column shown in Figure 6. The length of the column is 15 ft and the column is pin-pin connected in both axes. Show the diagram in a neat sketch. Given: $f_y = 50$ ksi; $f'_c = 4$ ksi; $E_s = 29{,}000$ ksi; $E_c = 3600$ ksi.  **<u>Figure 6</u>**	20
8.	For the Fully Encased Composite (FEC) column section shown in Figure 5, check the design adequacy of the FEC section for a factored axial compressive load of 200 kips and a factored bending moment of 150 kip-ft about weak axis using both interaction equation and basic principles. Use the data provided in Question 6 (b) as required. Follow AISC-LRFD method.	20

ANNEXURE

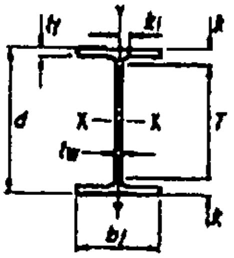


Table 1-1 (continued)
W Shapes
Dimensions

Shape	Area, A	Depth, d		Web Thickness, t_w		$\frac{t_w}{2}$	Flange Width, b_f		Flange Thickness, t_f		Distance k: k_{des}	k_{det}	k_1	T	Workable Gage
	in.^{2}	in.		in.		in.	in.		in.		in.	in.	in.	in.	in.
W21×93	27.3	21.6	21 5/8	0.580	9/16	5/16	8.42	8 3/8	0.930	15/16	1.43	1 5/8	15/16	18 3/8	5 1/2
×83[c]	24.3	21.4	21 3/8	0.515	1/2	1/4	8.36	8 3/8	0.835	13/16	1.34	1 1/2	7/8		
×73[c]	21.5	21.2	21 1/4	0.455	7/16	1/4	8.30	8 1/4	0.740	3/4	1.24	1 7/16	7/8		
×68[c]	20.0	21.1	21 1/8	0.430	7/16	1/4	8.27	8 1/4	0.685	11/16	1.19	1 3/8	7/8		
×62[c]	18.3	21.0	21	0.400	3/8	3/16	8.24	8 1/4	0.615	5/8	1.12	1 5/16	13/16		
×55[c]	16.2	20.8	20 3/4	0.375	3/8	3/16	8.22	8 1/4	0.522	1/2	1.02	1 3/16	13/16		
×48[c,f]	14.1	20.6	20 5/8	0.350	3/8	3/16	8.14	8 1/8	0.430	7/16	0.930	1 1/8	13/16	↓	↓
W21×57[c]	16.7	21.1	21	0.405	3/8	3/16	6.56	6 1/2	0.650	5/8	1.15	1 5/16	13/16	18 3/8	3 1/2
×50[c]	14.7	20.8	20 7/8	0.380	3/8	3/16	6.53	6 1/2	0.535	9/16	1.04	1 1/4	13/16		
×44[c]	13.0	20.7	20 5/8	0.350	3/8	3/16	6.50	6 1/2	0.450	7/16	0.850	1 1/8	13/16	↓	↓
W18×311[h]	91.6	22.3	22 3/8	1.52	1 1/2	3/4	12.0	12	2.74	2 3/4	3.24	3 7/16	1 3/8	15 1/2	5 1/2
×283[h]	83.3	21.9	21 7/8	1.40	1 3/8	11/16	11.9	11 7/8	2.50	2 1/2	3.00	3 3/16	1 5/16		
×258[h]	75.9	21.5	21 1/2	1.28	1 1/4	5/8	11.8	11 3/4	2.30	2 5/16	2.70	3	1 1/4		
×234[h]	68.8	21.1	21	1.16	1 3/16	5/8	11.7	11 5/8	2.11	2 1/8	2.51	2 3/4	1 3/16		
×211	62.1	20.7	20 5/8	1.06	1 1/16	9/16	11.6	11 1/2	1.91	1 15/16	2.31	2 9/16	1 3/16		
×192	56.4	20.4	20 3/8	0.960	15/16	1/2	11.5	11 1/2	1.75	1 3/4	2.15	2 7/16	1 1/8	↓	
×175	51.3	20.0	20	0.890	7/8	7/16	11.4	11 3/8	1.59	1 9/16	1.99	2 7/16	1 1/4	15 1/8	
×158	46.3	19.7	19 3/4	0.810	13/16	7/16	11.3	11 1/4	1.44	1 7/16	1.84	2 3/8	1 1/4		
×143	42.1	19.5	19 1/2	0.730	3/4	3/8	11.2	11 1/4	1.32	1 5/16	1.72	2 3/16	1 3/16		
×130	38.2	19.3	19 1/4	0.670	11/16	3/8	11.2	11 1/8	1.20	1 3/16	1.60	2 1/16	1 3/16		
×119	35.1	19.0	19	0.655	5/8	5/16	11.3	11 1/4	1.06	1 1/16	1.46	1 15/16	1 3/16		
×106	31.1	18.7	18 3/4	0.590	9/16	5/16	11.2	11 1/4	0.940	15/16	1.34	1 13/16	1 1/8		
×97	28.5	18.6	18 5/8	0.535	9/16	5/16	11.1	11 1/8	0.870	7/8	1.27	1 3/4	1 1/8		
×86	25.3	18.4	18 3/8	0.480	1/2	1/4	11.1	11 1/8	0.770	3/4	1.17	1 5/8	1 1/16		
×76[c]	22.3	18.2	18 1/4	0.425	7/16	1/4	11.0	11	0.680	11/16	1.08	1 9/16	1 1/16	↓	↓
W18×71	20.8	18.5	18 1/2	0.495	1/2	1/4	7.64	7 5/8	0.810	13/16	1.21	1 1/2	7/8	15 1/2	3 1/2[g]
×65	19.1	18.4	18 3/8	0.450	7/16	1/4	7.59	7 5/8	0.750	3/4	1.15	1 7/16	7/8		
×60[c]	17.6	18.2	18 1/4	0.415	7/16	1/4	7.56	7 1/2	0.695	11/16	1.10	1 3/8	13/16		
×55[c]	16.2	18.1	18 1/8	0.390	3/8	3/16	7.53	7 1/2	0.630	5/8	1.03	1 5/16	13/16		
×50[c]	14.7	18.0	18	0.355	3/8	3/16	7.50	7 1/2	0.570	9/16	0.972	1 1/4	13/16	↓	↓
W18×46[c]	13.5	18.1	18	0.360	3/8	3/16	6.06	6	0.605	5/8	1.01	1 1/4	13/16	15 1/2	3 1/2[g]
×40[c]	11.8	17.9	17 7/8	0.315	5/16	3/16	6.02	6	0.525	1/2	0.927	1 3/16	13/16		
×35[c]	10.3	17.7	17 3/4	0.300	5/16	3/16	6.00	6	0.425	7/16	0.827	1 1/8	3/4	↓	↓

[c] Shape is slender for compression with $F_y = 50$ ksi.
[f] Shape exceeds compact limit for flexure with $F_y = 50$ ksi.
[g] The actual size, combination, and orientation of fastener components should be compared with the geometry of the cross-section to ensure compatibility.
[h] Flange thickness greater than 2 in. Special requirements may apply per AISC Specification Section A3.1c.

ANNEXURE

Table 1-1 (continued)
W Shapes
Properties

W21 – W18

Nominal Wt.	Compact Section Criteria		Axis X-X				Axis Y-Y				r_{ts}	h_o	Torsional Properties	
	$\frac{b_f}{2t_f}$	$\frac{h}{t_w}$	I	S	r	Z	I	S	r	Z			J	C_w
lb/ft			in.^{4}	in.^{3}	in.	in.^{3}	in.^{4}	in.^{3}	in.	in.^{3}	in.	in.	in.^{4}	in.^{6}
93	4.53	32.3	2070	192	8.70	221	92.9	22.1	1.84	34.7	2.24	20.7	6.03	9940
83	5.00	36.4	1830	171	8.67	196	81.4	19.5	1.83	30.5	2.21	20.6	4.34	8630
73	5.60	41.2	1600	151	8.64	172	70.6	17.0	1.81	26.6	2.19	20.5	3.02	7410
68	6.04	43.6	1480	140	8.60	160	64.7	15.7	1.80	24.4	2.17	20.4	2.45	6760
62	6.70	46.9	1330	127	8.54	144	57.5	14.0	1.77	21.7	2.15	20.4	1.83	5960
55	7.87	50.0	1140	110	8.40	126	48.4	11.8	1.73	18.4	2.11	20.3	1.24	4980
48	9.47	53.6	959	93.0	8.24	107	38.7	9.52	1.66	14.9	2.05	20.2	0.803	3950
57	5.04	46.3	1170	111	8.36	129	30.6	9.35	1.35	14.8	1.68	20.4	1.77	3190
50	6.10	49.4	984	94.5	8.18	110	24.9	7.64	1.30	12.2	1.64	20.3	1.14	2570
44	7.22	53.6	843	81.6	8.06	95.4	20.7	6.37	1.26	10.2	1.60	20.2	0.770	2110
311	2.19	10.4	6970	624	8.72	754	795	132	2.95	207	3.53	19.6	176	76200
283	2.38	11.3	6170	565	8.61	676	704	118	2.91	185	3.47	19.4	134	65900
258	2.58	12.5	5510	514	8.53	611	628	107	2.88	166	3.42	19.2	103	57600
234	2.76	13.8	4900	466	8.44	549	558	95.8	2.85	149	3.37	19.0	78.7	50100
211	3.02	15.1	4330	419	8.35	490	483	85.3	2.82	132	3.32	18.8	58.6	43400
192	3.27	16.7	3870	380	8.28	442	440	76.8	2.79	119	3.28	18.6	44.7	38000
175	3.58	18.0	3450	344	8.20	398	391	68.8	2.76	106	3.24	18.5	33.8	33300
158	3.92	19.8	3060	310	8.12	356	347	61.4	2.74	94.8	3.20	18.3	25.2	29000
143	4.25	22.0	2750	282	8.09	322	311	55.5	2.72	85.4	3.17	18.2	19.2	25700
130	4.65	23.9	2460	256	8.03	290	278	49.9	2.70	76.7	3.13	18.1	14.5	22700
119	5.31	24.5	2190	231	7.90	262	253	44.9	2.69	69.1	3.13	17.9	10.6	20300
106	5.86	27.2	1910	204	7.84	230	220	39.4	2.66	60.5	3.10	17.8	7.48	17400
97	6.41	30.0	1750	188	7.82	211	201	36.1	2.65	55.3	3.08	17.7	5.86	15800
86	7.20	33.4	1530	166	7.77	186	175	31.6	2.63	48.4	3.05	17.6	4.10	13800
76	8.11	37.8	1330	146	7.73	163	152	27.6	2.61	42.2	3.02	17.5	2.83	11700
71	4.71	32.4	1170	127	7.50	146	60.3	15.8	1.70	24.7	2.05	17.7	3.49	4700
65	5.06	35.7	1070	117	7.49	133	54.8	14.4	1.69	22.5	2.03	17.6	2.73	4240
60	5.44	38.7	984	108	7.47	123	50.1	13.3	1.68	20.6	2.02	17.5	2.17	3850
55	5.98	41.1	890	98.3	7.41	112	44.9	11.9	1.67	18.5	2.00	17.5	1.66	3430
50	6.57	45.2	800	88.9	7.38	101	40.1	10.7	1.65	16.6	1.98	17.4	1.24	3040
46	5.01	44.6	712	78.8	7.25	90.7	22.5	7.43	1.29	11.7	1.58	17.5	1.22	1720
40	5.73	50.9	612	68.4	7.21	78.4	19.1	6.35	1.27	10.0	1.56	17.4	0.810	1440
35	7.06	53.5	510	57.6	7.04	66.5	15.3	5.12	1.22	8.06	1.52	17.3	0.506	1140

ANNEXURE

Design Specifications According to AISC 2010

For CFT Columns:

TABLE I1.1A
Limiting Width-to-Thickness Ratios for Compression Steel Elements in Composite Members Subject to Axial Compression
For Use with Section I2.2

Description of Element	Width-to-Thickness Ratio	λ_p Compact/ Noncompact	λ_r Noncompact/ Slender	Maximum Permitted
Walls of Rectangular HSS and Boxes of Uniform Thickness	b/t	$2.26\sqrt{\frac{E}{F_y}}$	$3.00\sqrt{\frac{E}{F_y}}$	$5.00\sqrt{\frac{E}{F_y}}$
Round HSS	D/t	$\frac{0.15E}{F_y}$	$\frac{0.19E}{F_y}$	$\frac{0.31E}{F_y}$

TABLE I1.1B
Limiting Width-to-Thickness Ratios for Compression Steel Elements in Composite Members Subject to Flexure
For Use with Section I3.4

Description of Element	Width-to-Thickness Ratio	λ_p Compact/ Noncompact	λ_r Noncompact/ Slender	Maximum Permitted
Flanges of Rectangular HSS and Boxes of Uniform Thickness	b/t	$2.26\sqrt{\frac{E}{F_y}}$	$3.00\sqrt{\frac{E}{F_y}}$	$5.00\sqrt{\frac{E}{F_y}}$
Webs of Rectangular HSS and Boxes of Uniform Thickness	h/t	$3.00\sqrt{\frac{E}{F_y}}$	$5.70\sqrt{\frac{E}{F_y}}$	$5.70\sqrt{\frac{E}{F_y}}$
Round HSS	D/t	$\frac{0.09E}{F_y}$	$\frac{0.31E}{F_y}$	$\frac{0.31E}{F_y}$

(a) For *compact sections*

$$P_{no} = P_p$$

where

$$P_p = F_y A_s + C_2 f_c' \left(A_c + A_{sr} \frac{E_s}{E_c} \right)$$

$C_2 = 0.85$ for rectangular sections and 0.95 for round sections

(b) For *noncompact sections*

$$P_{no} = P_p - \frac{P_p - P_y}{\left(\lambda_r - \lambda_p\right)^2}\left(\lambda - \lambda_p\right)^2$$

where

λ, λ_p and λ_r are slenderness ratios determined from Table I1.1a

P_p is determined from Equation I2-9b

$$P_y = F_y A_s + 0.7 f_c' \left(A_c + A_{sr} \frac{E_s}{E_c} \right)$$

ANNEXURE

(c) For slender sections

$$P_{no} = F_{cr} A_s + 0.7 f_c' \left(A_c + A_{sr} \frac{E_s}{E_c} \right)$$

where

(i) For rectangular filled sections

$$F_{cr} = \frac{9E_s}{\left(\frac{b}{t}\right)^2}$$

(ii) For round filled sections

$$F_{cr} = \frac{0.72 F_y}{\left(\left(\frac{D}{t}\right)\frac{F_y}{E_s}\right)^{0.2}}$$

$$EI_{eff} = E_s I_s + E_s I_{sr} + C_1 E_c I_c$$

$$C_1 = 0.6 + 2\left(\frac{A_s}{A_c + A_s}\right) \le 0.9$$

$$If \ldots \frac{P_{no}}{P_e} \le 2.25 \quad P_n = P_{no}\left[0.658^{\left(\frac{P_{no}}{P_e}\right)}\right]$$

$$Else \ldots \frac{P_{no}}{P_e} > 2.25 \quad P_n = 0.877 P_e$$

For FEC Columns:

$$P_o = A_s F_y + A_{sr} F_{yr} + 0.85 A_c f_c'$$

$$EI_{eff} = E_s I_s + 0.5 E_s I_{sr} + C_1 E_c I_c$$

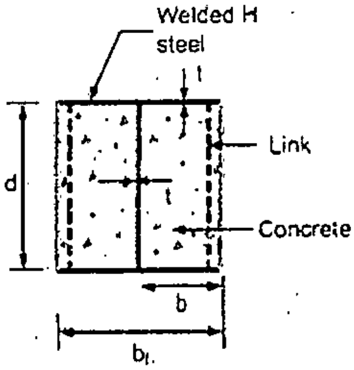
$$C_1 = 0.1 + 2\left(\frac{A_s}{A_c + A_s}\right) \le 0.3$$

$$If \ldots \frac{P_o}{P_e} \le 2.25 \quad P_n = P_o\left[0.658^{\left(\frac{P_o}{P_e}\right)}\right]$$

$$Else \ldots \frac{P_o}{P_e} > 2.25 \quad P_n = 0.877 P_e$$

ANNEXURE

For PEC columns with Non-compact section:



$C_r = A_{sc}\,F_y + 0.85\,A_c\,f_c'$

$A_{sc} = (d - 2t + 2b_e)t$

$b_e = \dfrac{b_f}{\left(1+\lambda_p^{\,2n}\right)^{1/n}} \le b_f$ where, $n = 1.5$

$\lambda_p = \dfrac{b}{t}\sqrt{\dfrac{12\left(1-\nu_s^{\,2}\right)F_y}{\pi^2 E_s k}}$

$k = \dfrac{0.9}{(s/b_f)^2} + 0.2(s/b_f)^2 + 0.75,$ $(0.5 \le s/b_f \le 1)$ where, s = link spacing

AISC Interaction Equations:

(a) When $\dfrac{P_r}{P_c} \ge 0.2$

$$\frac{P_r}{P_c} + \frac{8}{9}\left(\frac{M_{rx}}{M_{cx}} + \frac{M_{ry}}{M_{cy}}\right) \le 1.0$$

(b) When $\dfrac{P_r}{P_c} < 0.2$

$$\frac{P_r}{2P_c} + \left(\frac{M_{rx}}{M_{cx}} + \frac{M_{ry}}{M_{cy}}\right) \le 1.0$$

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-II B.Sc. Engineering Examinations, Session: January 2020

Sub: **CE 415** (Prestressed Concrete)

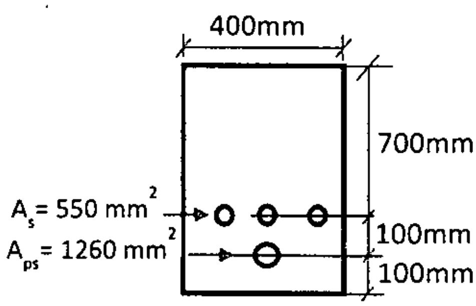
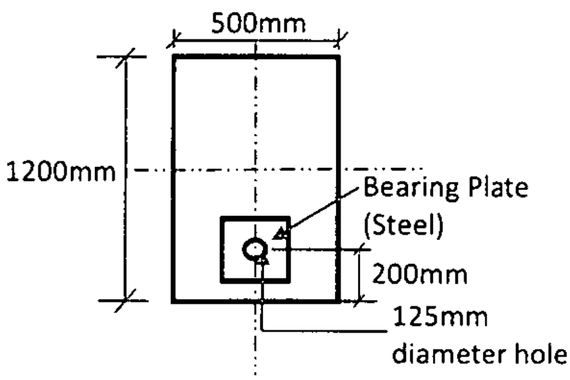
Full Marks: 120 Time: 2 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

USE Reasonable values for any missing data.

No.	Questions	Marks
1.	Determine the ultimate moment capacity of the rectangular section shown in Fig. 1. It contains mild steel rebars in addition to prestressing steel. Use $f_c^{'}$= 40 MPa, $E_s = E_p$ = $2X10^5$ MPa,E_c= $3X10^4$ MPa, f_{pu} = 1860 MPa, f_y = 415 MPa, ϵ_{cu}= 0.003 and effective prestress, f_{se}=1100 MPa. Follow any method of calculation. Fig. 1 	20
2.	Determine the bearing plate area required for a tendon consisting of 14-12.7 mm dia 7-wire strands anchored at the end of a beam as shown in Fig.2. The tendon forces for design are 2100 kN due to maximum Jacking force and 1500 kN at service load. Use $f_{ci}^{'}$= 35 MPa, $f_c^{'}$= 45 MPa. Follow the specification of Post-Tensioning Institute (PTI) for allowable bearing stresses of the concrete. At service load: $f_{cp} = 0.6 f_c^{'} \sqrt{\frac{A_b^{'}}{A_b}}$ but not greater than $f_c^{'}$. At transfer load: $f_{cp} = 0.8 f_{ci}^{'} \sqrt{(\frac{A_b^{'}}{A_b} - 0.2)}$ but not greater than $1.25f_{ci}^{'}$. All symbols carry their usual meanings. Fig. 2 	20

3.	Check shear strength for the beam shown in Fig. 3 at section 1-1. Given that the section is adequate for w_u= 60 kN/m on the basis of flexural strength. Given Effective prestress = 110 MPa, Initial prestress=1400 MPa, f'_c= 40 MPa. Use ACI Equations attached herewith.	20

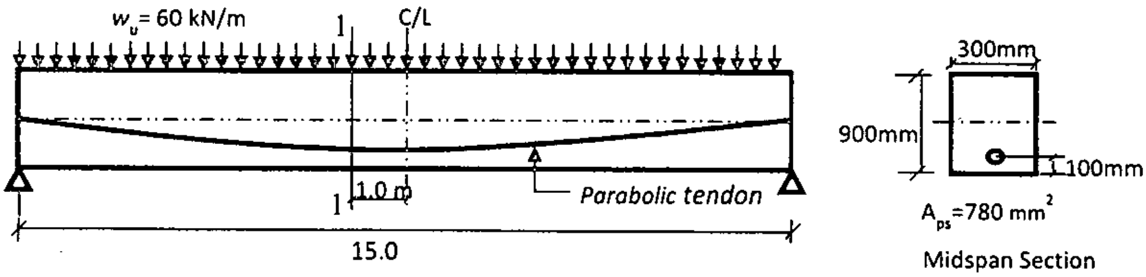


Fig. 3

Table 7-1 ACI Equations for shear strength evaluation: Shear stress = $\frac{\text{shear force}}{b_w d}$

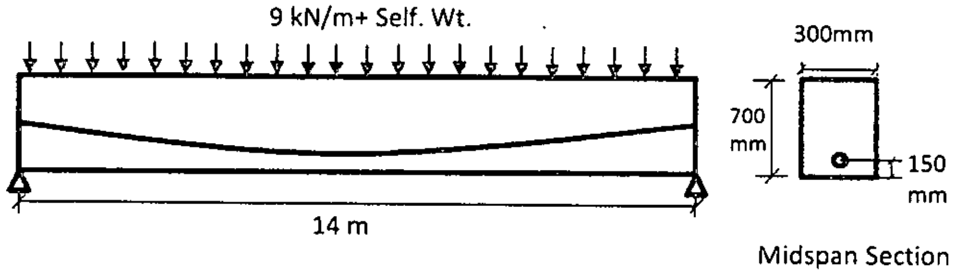
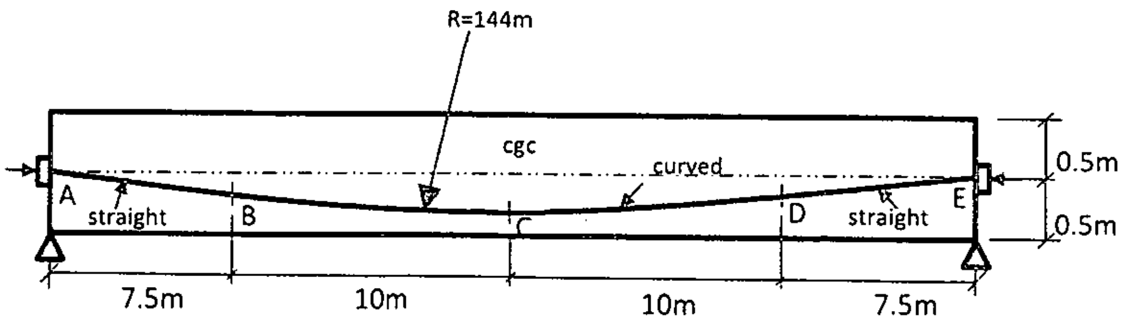
Shear Stress Equations (following 1971 ACI Code)		Shear Force Equations (following 1977 ACI Code)	
$v_u = \frac{V_u}{\phi b_w d}$	(7-3)	V_u = Factored shear force at section $V_u \leq \phi V_n$	(7-6)
where V_u in design is factored shear force at section. Use $\phi = 0.85$ for shear.		Design for V_u/ϕ as the nominal shear strength, V_n. Use $\phi = 0.85$ for shear.	
$v_{ci} = 0.05\sqrt{f'_c} + \frac{V_d + \left(\frac{V_i M_{cr}}{M_{max}}\right)}{b_w d} \geq 0.14\sqrt{f'_c}$	(7-4)	$V_{ci} = 0.05\sqrt{f'_c}\, b_w d + V_d + \frac{V_i M_{cr}}{M_{max}} \geq 0.14\sqrt{f'_c}\, b_w d$	(7-7)
where $M_{cr} = (I/y_t)(0.5\sqrt{f'_c} + f_{pe} - f_d)$	(7-9)	where $M_{cr} = (I/y_t)(0.5\sqrt{f'_c} + f_{pe} - f_d)$	(7-9)
$v_{cw} = 0.29\sqrt{f'_c} + 0.3 f_{pc} + \frac{V_p}{b_w d}$	(7-5)	$V_{cw} = (0.29\sqrt{f'_c} + 0.3 f_{pc}) b_w d + V_p$	(7-8)

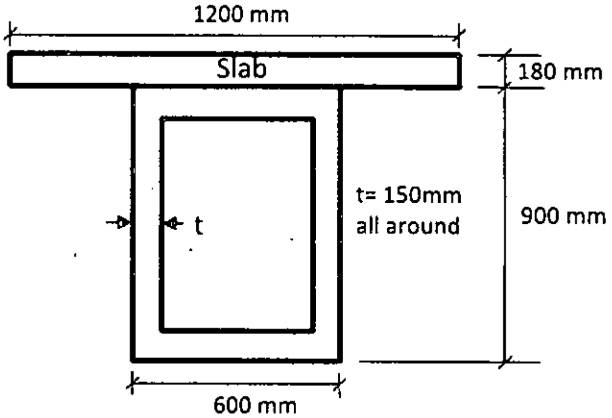
4.	Make an initial design for section of a prestressed concrete beam to resist a total moment of 580 kN-m which includes girder self weight moment of 85 kN-m. Given: Effective prestress in steel, f_{se}= 920 MPa and f_c=12 MPa. Start with a trial depth of about $42\sqrt{M_T}$ where M_T in kN-m. Make a final design for the preliminary section obtained above for the following prescribed material properties and allowing no tension in the beam at any stage: f_b = -14 MPa, f_t = -12 MPa, f_{se} = 1040 MPa.	(20)

SECTION-B: CE 415

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

Assume reasonable values for missing data

No.	Questions	Marks
5.	A post tensioned simple beam on a span of 14 m is shown in Fig. 4. It carries a superimposed load of 9.0 *kN/m* in addition to its own weight. The initial prestress in the steel is 980 MPa reducing to 840 MPa after deducting all losses but assuming no bending of the beam. Compute the stress in the steel at midspan, assuming steel to be bonded by grouting. Assume n=6, $A_{ps} = 1400\ mm^2$ and $\gamma_{con} = 25\ kN/m^3$.  Fig. 4	20
6.	A simple beam with cable layout is shown in Fig.5. Compute the percentage loss of prestress due to friction at midspan if it is tensioned from both ends. Solve using segment wise exact friction formula. Given: K= 0.003 per meter, friction co-efficient, μ= 0.36.  AB, DE: Straight; BCD: Curved Fig. 5	20

7.	The mid-section of a composite beam is shown in Fig. 6. It is post-tensioned with an initial force of 3300 kN which eventually reduces by 15% to get down to effective value. After erection of the precast box section, the 180 mm thick slab is cast in place. Compute stresses in the precast and composite section at various stage of loading. Given Moments are: - Due to Wt. of precast section= 276 kN-m - Due to top slab= 166 kN-m - Due to live load= 500 kN-m Estimate the beam span if $\gamma_{con} = 24\ kN/m^3$.  Fig. 6	20

8.	Compute the initial deflection at midspan of a simply supported beam of width 400mm and depth 800mm due to prestress and uniformly distributed load of 40 kN/m (self wt. included). Estimate the deflection after six months assuming a creep coefficient, C_c=2.5, Use f_0= 1200 MPa, f_{se}=1000 MPa, span of beam= 12.0 m and $A_{ps} = 820\ mm^2$. The c.g.s with constant eccentricity is at 100 mm from the bottom surface of the beam. All symbols carry their usual meaning.	20

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

Subject: CE 419 (Introduction to Finite Element Method)

Full Marks: 120 Time: 2 Hours

Figures in the margin indicate full marks. Symbols carry their usual meaning. Assume reasonable values for missing data, if any.

UPLOAD SEPARATE FILES FOR EACH SECTION

SECTION-A

There are **Four Questions** in this section. Answer **ALL** questions.

1. a. Clearly point out the situations in which FEM is preferred over other methods. **8**

   b. What are the advantages of FEM in solving a system of equations that describe a phenomenon? **7**

2. Answer either (a) or (b) **15**

   a. What is a constitutive relation? What is its purpose in a FEM program?

   OR

   b. Explain the following terms and write down constitutive laws for each of the cases: (i) Plane Stress Problem. (ii) Plain strain problem

3. Answer either (a) or (b) **15**

   a. For the spring system with arbitrarily defined nodes and elements as shown in Figure 1, find the global stiffness matrix.

Figure 1

OR

   b. For the spring system with arbitrarily defined nodes and elements as shown in Figure 2, find the global stiffness matrix.

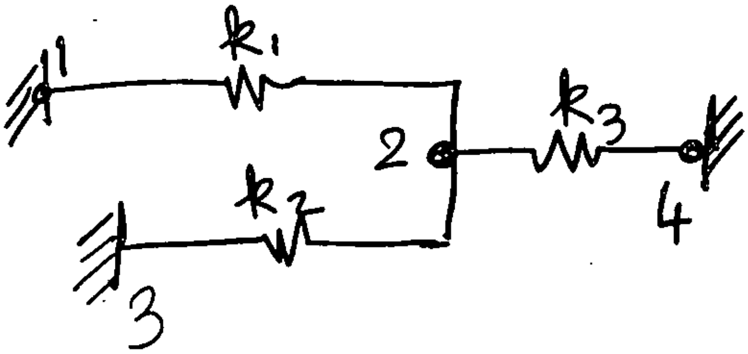


Figure 2

4. Answer either (a) or (b) **15**

a. Introduce reasonable shape functions for a two noded beam element (Figure 3) and derive the element stiffness matrix.

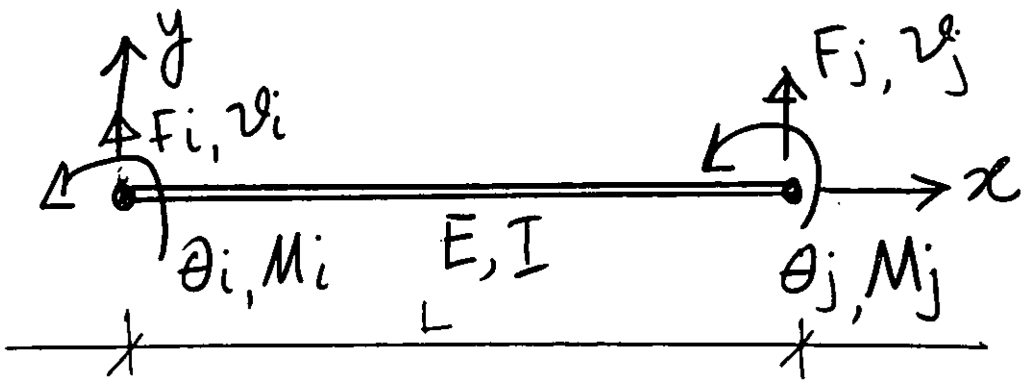


Figure 3

OR

b. A cantilever beam shown in Figure 4 is subjected to a distributed load. Write down global FE equation for the beam. Find out (i) deflection and rotation at the right end and (ii) Reaction force at and moment at the left end.

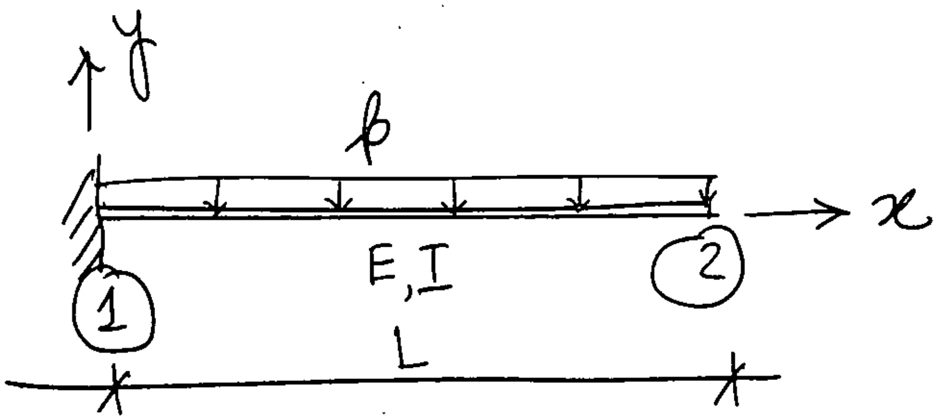


Figure 4

SECTION B: CE 419

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

No.	Questions	Marks
5.	a. Introduce and explain isoparametric concept in finite element analysis. b. Explain the following terms: (i) Subparametric element; (ii) Superparametric element	(7) (8)
6.	Answer either (a) or (b) a. List and explain four major discontinuities that may exist in a real structure and the necessity of considering those in discretizing a structure. Draw necessary sketches. **OR** b. "In a displacement based finite element formulation with inadequately defined mesh, a lower bound solution is expected"- Explain.	(15)
7.	Answer either (a) or (b) a. Give illustrative examples to compare frontal solution technique with band and skyline techniques. Explain the advantages and disadvantages in terms of memory requirements. **OR** b. A triangular element is better than a quadrilateral element and a tetrahedron element is better than cube element. Justify the statement giving four examples indicating the storage requirement and computation time.	(15)
8.	Answer either (a) or (b) (a) What is a numerical error? Give strategy to reduce the numerical error in a real-life problem showing the skills in modeling. **OR** (b) In civil engineering problems, the derived global stiffness matrix is usually "symmetric" and "banded". Explain the implications of these characteristic features in solving global FE equation by employing band solution technique.	(15)

L-3/T-2/CE

Date: 24/01/2021

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY

~~L-3/T-2 B.Sc. Engineering Examinations January 2020~~(online)

Sub: **WRE-311** (Open Channel Flow)

Full Marks: 240 Time: 2 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

The symbols and notations have their usual meanings.

Assume reasonable value of any data, if required.

SECTION – A

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

1(a) A sluice gate in 3.0 m wide rectangular horizontal channel releases a discharge of 18 m^3/s. the gate opening is 0.67 m and the coefficient of contraction can be taken as 0.6. Examine the type of hydraulic jump formed with sketches when the tailwater is (i) 3.60 m (ii) 5.00 m (iii) 4.09 m (20)

1(b) The velocity distribution in the plane of a vertical sluice gate discharging free in shown in figure 1. Calculate the discharge per unit width of the gate. (20)

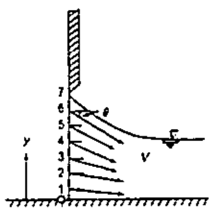


Figure 1 for question 1(b)

location	1	2	3	4	5	6	7
Velocity(m/s)	2.3	2.5	2.6	2.6	2.5	2.1	0.0
θ (degrees)	5	10	15	20	25	30	-
y(m)	0.05	0.10	0.15	0.20	0.25	0.30	0.35

2(a) A rectangular channel 6 m wide and inclined at an angle of 5^0 with the horizontal carries a discharge of 20 m^3/s. Determine the type of jump with neat sketch if the upstream depth normal to the direction of flow is 0.40 m and the tailwater depth is 3.20 m. Also compute the energy loss in the jump if the length of the jump is 2.5 m. (20)

2(b) A 3.5 m rectangular channel carries a discharge of 15 m^3/s at a depth of 2.0 m. It is proposed to reduce the width of the channel at the vicinity of a hydraulic structure. Assuming the transition to be horizontal and the flow to be frictionless determine the water surface elevation upstream and downstream of the constriction when the constricted width is 2.50 m. (20)

3(a) A vertical sluice gate with an opening of 0.67 m produces a downstream jet with a depth of 0.40 m when installed in a 5.0 m wide long rectangular channel carrying a discharge of 20 m^3/s. It is assumed that the flow downstream of the gate returns to a uniform flow of depth 2.5 m. (20)

(i) Verify that a hydraulic jump occurs.

(ii) Calculate the energy head loss in the jump.

(iii) If the energy lead loss through the gate is 5% of the velocity head at vena contracta calculate the depth upstream of the gate.

Show necessary sketch for the sluice gate.

3(b) Water flows in a rectangular channel at a depth of 1.5 m. A 30 cm smooth hump produces a drop of 15 cm in water surface elevation. Neglect energy losses and estimate the discharge per unit width of the channel. (20)

4(a) Proportion a USBR stilling Basin type II with neat sketch for the following data: (use necessary graphs for any missing data) (20)
Design discharge: 15870 m^3/s
TW level: 17.26 m
Basin width: 227.1 m
Elevation of ground: 0.00 m
Velocity at the foot of the spillway: 24.70 m/s

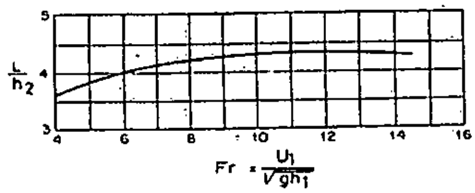
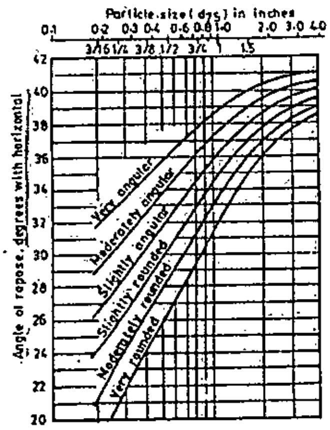


Figure 2 for question 4(a)

4(b) A trapezoidal channel is to be laid on a slope of 1in 1000 and carry a discharge of 20 m^3/s. it is to be excavated in earth containing moderately rounded coarse non-cohesive particles with d_{50}=2 cm, d_{75}=2.5 cm and n=0.025. Determine the section dimensions with neat sketch of the channel. Necessary graphs have been provided. (20)



Angle of repose for non-cohesive materials
Figure 3 for question 4(b)

SECTION – B

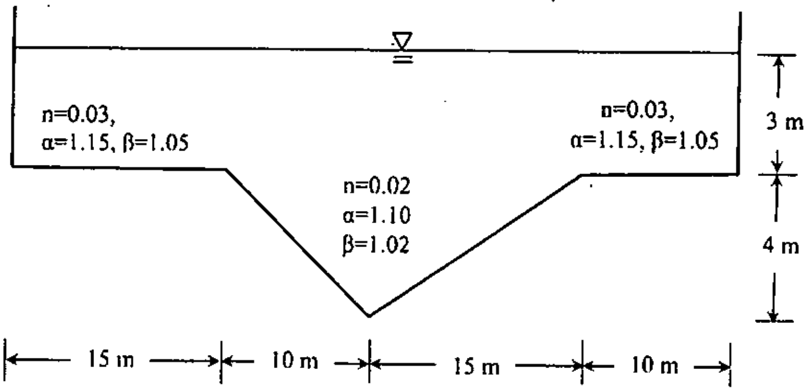
There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) What are the basic equations needed to describe the movement of water and describe salient features as well as applications of these equations in open channel flow? Briefly explain how the surface roughness affects the velocity distribution in turbulent flow. **(20)**

(b) Compute the normal depth and normal velocity in a trapezoidal channel whose bottom width is 6 m, side slope=2 and discharge is 30 m^3/s. Given, n=0.025, S_0=0.0025. Apply 'Bisection' method. Also, determine the cross-sectional mean velocity if k_s=0.03 cm and h=2 m. **(20)**

6. (a) Derive the expression for hydraulic exponent for uniform flow computation, N for rectangular channel using Chezy formula. Hence, compute the numerical value of N for a wide channel. Comment on the numerical value of N for a wide channel computed using Manning formula. **(20)**

(b) A channel consists of a main section and two side sections with respective roughness, energy and momentum coefficients as shown in the following figure. Compute the total discharge and the mean velocity of flow for the entire section if the bed slope is S_0=0.0002. Also compute the numerical values of n, α and β for the entire section. **(20)**



7. (a) Make a comparison among different methods for computing gradually varied flow. Which method is preferable to compute flow profile in non-prismatic channel and why? **(20)**

(b) A rectangular channel with b=6 m, α=1.10 and n=0.02 has three reaches arranged serially. The bottom slopes of these reaches are 0.0090, 0.0052 and 0.0020, respectively. For a discharge of $(20+\sin\theta)$ m^3/s in this channel, name and sketch qualitatively the resulting flow profiles. Consider θ *(in degrees)* is the last three digit of your student number. Suppose, at section 1 of this channel (assume bottom slope is constant), the elevation head and depth of flow is 10 m and 5 m, respectively. At section 2 (10 km downstream from section 1), the elevation head and depth of flow is 6 m and 3 m, respectively. Compute the friction slope (S_f) between these two sections. **(20)**

8. A trapezoidal channel having bottom width of 6.10 m, side slope = 1V:2H, longitudinal slope = 0.00016 and n = 0.025 carries a discharge of 11.33 m^3/s. The backwater profile (M1) created by a dam, backs up the water to a depth of 3.50 m immediately behind the dam. The elevation of the channel bottom at the dam site is 500 m Mean Sea Level (MSL). Compute the stage at a distance of 330 m upstream of the dam site by standard step method. The energy coefficient is 1.15 and momentum coefficient is 1.05. Draw a neat sketch of the resulting flow profile. **(40)**