University of Asia Pacific
Department of Civil Engineering
Term Examination Fall 2017
Program: B. Sc. Engineering (Civil)

Course Title: Professional Practices & Communication | Course Code: CE 403
Time: 2 hours | Full Marks: 100

[Assume Reasonable Values for Any Missing Data]

PART – A

Answer the following questions.

1. **(a)** In different contract documents different dates of completion of a project has been stated. If a dispute arises as to when the project has to be completed, mention in order of priority the documents you will consider to establish the actual date. **(5)**

(b) In a BOQ a tenderer has quoted the price of painting a building to be BDT 700,000. However the figure expressed in words reads 'Seven Hundred & Seventy Thousand taka only'. If you are the head of the Technical Evaluation Committee (TEC), which would you consider as the quoted price? **(5)**

OR

(c) Suppose one of your colleagues has prepared the technical specifications for a set of wooden tables. However he failed to mention the type of timber to be used. Anticipate the list of problems that may arise due to this and specify the qualities of a good specification. **(10)**

2. **(a)** Prepare the technical specifications of (i) a diesel generator to be used in a ten storied institutional building and of (ii) concrete for a reinforced concrete building. **(10)**

OR

(b) 'Litigation shall only be used as a last resort' – justify the following statement and criticize the effectiveness of Arbitration as a dispute resolution method. **(10)**

3. **(a)** Depict the tendering process using a flowchart. **(5)**

(b) Differentiate between 'Tender Security' and 'Performance Security'. **(5)**

4. Distinguish between Industrial Relations and Employee Relations. Point out the main aspects of Industrial Relations. **(10)**

5. Explain the process of mediation and mention the points to consider when selecting an arbitrator. **(10)**

PART– B

Answer the following questions.

6. **Answer 6(a) or 6(b)** **(20)**

(a) Read the following case report carefully, as you have to assess the situation with explanation from engineering ethical point of view.

Engineer A, a licensed civil engineer, is currently working on a major solicited project proposal. After the proposal has been prepared and ready to be submitted, the engineer goes to a closed room to print the document at a local high facility printing shop. As he walks in, he sees another proposal document prepared by a rival company (also bidding for the same project proposal) left over next to the automated printer. The engineer notices that he is alone in the room and he is not monitored. Moreover, knowing the budget prepared by the other bidders in order to be ahead of them in the competition is beneficial for his company.

Should the engineer take the proposal document and update the proposal of his company incorporating the knowledge gathered from other's proposal? Justify your position.

(b) 'A physician's personal ethics states that she should tell a woman if her future husband has a serious disease that can be transmitted. However, medical confidentiality may forbid her from doing so.'

In view of the statement, prepare a table demonstrating the conflicts between professional ethics and personal morality.

7. Read the following case study carefully: **(10)**

Two different meetings are being held in two different offices. In one meeting, Mr. A, the CEO of the company listens to all points of view of the participants, facilitates group discussion and helps the group to make the best decision possible. On the other hand, Mr. B, CEO of the other company generally issues order and commands, limits discussion and praises only who agrees with him in the meeting.

Considering the case study presented above, distinguish between two leadership styles followed in a meeting. Criticize the leadership style of both Mr. A and B.

8. Answer **any two questions** from the following. **(10×2=20)**

(a) In view of the case presented in **Question 6(a)**, establish the preamble of Code of Ethics for engineers.

(b) Read the following case carefully:

Mr. X is working as the team leader for preparing a proposal of constructing a six storied apartment building for retired government employees. In the final proposal, he commits to complete the construction work in eight months. However, no Gantt chart is attached in the proposal document.

In view of the case study presented above, justify whether the proposal has achieved a SMART objective. Explain how to make this proposal SMART with necessary examples.

(c) List different types of problems and barriers to communication. Illustrate how the 'convention of meaning' can be different with necessary examples.

(d) Evaluate this 'Term Final Question' and assess whether it satisfies the 7C's of effective communication.

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

Course Title: Environmental Engineering IV — Course Code: CE 433
Time- 2 hours — Full marks: 100

Answer all the questions from questions 1-5. (5 X 20 = 100)
(Assume any missing data)

1. (a) What are the major sources of air pollution? (6)

OR

Define "Emission Standard" and "Air Quality Standard".

(b) What is AQI? (10)

The following air quality data have been recorded at the Continuous Monitoring Stations/Systems (CAMS) in Dhaka on December 15, 2017.
$PM_{2.5}$ = 120 $\mu g/m^3$ (24 hr)
PM_{10} = 310 $\mu g/m^3$ (24 hr)
CO = 14.5 ppm (8 hr)
Prepare an AQI report for that particular day.

(c) Write a short note on "Radiation Inversion" **OR** "Subsidence Inversion". (4)

2. (a) With real life examples (personal perspective is preferred), discuss the effects of air pollution on **any two** of the following: (7)

i) Atmospheric properties ; ii) Materials ; iii) Vegetation ; iv) Human health

(b) What is "Photochemical Smog"? List down five major physical processes that are considered for air pollution dispersion modeling. (6)

OR

What is the goal of the diffusion models (such as Gaussian Plume model)? State any four assumptions of the "Point Source Gaussian Plume Model".

(c) Derive and determine the value of dry adiabatic lapse rate based on ideal gas law, hydrostatic equation and 1st law of Thermodynamics. (7)

OR

Suppose the ambient atmospheric temp profile of an area is given by the following equation: $\Lambda(°C) = 30 - 0.005z$, when, z = altitude in m.
If maximum surface temperature is 34°C and average wind speed is 4.9 m/s, estimate the ventilation coefficient and comment on the pollution potential.

3 (a) Compare the conditions in atmosphere (lapse rates) and show with schematic diagrams when you evaluate the following plumes from stacks in an industrial area: i) Lofting; ii) Fumigating; iii) Trapping. Which type of plume creates adverse effects for nearby community? (7)

(b) Enlist the names of control devices for particulate and gaseous contaminants. (6)

OR

Discuss any of the retrofit option/options that could be utilized in internal combustion engines to reduce CO (Carbon monoxide), HC (Hydrocarbons) and NO_x (nitrogen oxides) emissions.

(c) Cars are travelling with a speed of 65 mph at 80 m apart. Carbon monoxide (CO) is being emitted from the cars at a rate of 7.5 g/mile. The wind speed is 4.2 m/s perpendicular to the road. Estimate ground level concentration of CO at a distance 350 m downwind. Consider atmosphere to be adiabatic (Stability class D). (7)

4 (a) Classify lakes according to Eutrophication. (5)

OR

Discuss the impact of thermal stratification on Dissolved Oxygen in lakes.

(b) A sewage treatment plant (Q_w = 15000 m^3/d and T = 25°C) discharges 0.18 m^3/s of treated effluent having BOD_5 of 75 mg/L and DO of 2 mg/L into a stream (Q_T = 0.5 m^3/s and T = 22°C) that has a BOD_5 of 4 mg/L and DO of 8 mg/L. The deoxygenation constant for the mixture of river water and wastewater is k_d is 0.23/day. The stream has a depth of 2.6 m and the average stream velocity is 0.2 m/s. (15)

a. Estimate DO_{min}, x_c, t_c .
b. Sketch the DO Profile for a 100 km reach.

5 (a) What are the components that have to be considered to develop a simple phosphorus model in a lake (show in a figure)? Derive the equation for estimating phosphorus concentration in a lake using the model. (6)

OR

What are the limiting nutrients and when is each of them limiting? Based on limiting nutrients, how can you check if a lake is susceptible to eutrophication or not?

(b) For applying pollution control measures, what could be the strategies to reduce the concentration of pollutants (C_w) and the effluent flow (Q_w)? (5)

(c) A stack emitting 100 g/s of NO has an effective stack height of 150 m. The wind speed is 4 m/s at 10 m, and it is a clear summer day with Stability class B. Estimate ground level NO concentration: (9)

i) Directly downwind at a distance of 2 km

ii) At a point downwind where NO is maximum

Given Formula:

$$I_P = \frac{I_{Hi} - I_{Lo}}{BP_{Hi} - BP_{Lo}}(C_P - BP_{Lo}) + I_{Lo} \quad ;$$

Ventilation coefficient (m^2/s) = Maximum mixing depth * average wind speed within mixing depth

$$u = u_0(\frac{z}{z_0})^p$$

$$\sigma_y = a.x^{0.894} \quad ; \quad \sigma_z = c.x^d + f$$

$$c_{max} = \frac{Q}{u}(\frac{C_u}{Q})_{max}$$

$$C(x, 0) = \frac{2Q_L}{\sqrt{(2\Pi)u\sigma_z}}$$

$$C\ (x, 0, 0) = \frac{Q}{\pi u\sigma_y\sigma_z}\exp(\frac{-H^2}{2{\sigma_z}^2})$$

$$C\ (x, y, 0) = \frac{Q}{\pi u\sigma_y\sigma_z}\exp(\frac{-y^2}{2{\sigma_y}^2})\exp(\frac{-H^2}{2{\sigma_z}^2})$$

$$D = \frac{k_d L_0}{k_r - k_d}\left(e^{-k_d t} - e^{-k_r t}\right) + D_0 e^{-k_r t}$$

$$k_r = \frac{3.9u^{1/2}}{H^{3/2}} \qquad t_c = \frac{1}{k_r - k_d}\ln\left[\frac{k_r}{k_d}\left(1 - \frac{D_0[k_r - k_d]}{k_d \cdot L_0}\right)\right]$$

$$D_c = \frac{k_d}{k_r}L_0 e^{-k_r t_c}$$

$DO_{(sat)} = 14.62 – 0.39\ T + 0.007714\ T^2 – 0.0000646\ T^3$

$k_{d\ (at\ T°C)} = k_{20°C} \cdot (1.047)^{T-20}$, $k_{r\ (at\ T°C)} = k_{r20°C} \cdot (1.024)^{T-20}$

$DO_{min} = DO_{sat} – D_c$; $D_0 = DO_{sat} – DO_{mix}$; $DO\ (x) = DO_{sat} – D(x)$

$BOD_m \cdot V_m = BOD_w \cdot V_w + BOD_d \cdot V_d$ $BOD_t = L_0\ (1 - e^{-kt})$ $L_t = L_0\ e^{-kt}$

$$P = \frac{S}{Q + \upsilon_s \cdot A}$$

$k_{d\ (at\ T°C)} = k_{20°C} \cdot (1.047)^{T-20}$, $k_{r\ (at\ T°C)} = k_{r20°C} \cdot (1.024)^{T-20}$

Breakpoints							AQI	Category
O_3 (ppm) 8-hr	O_3 (ppm) 1-hr (i)	$PM_{2.5}$ ($\mu g/m^3$) 24-hr	PM_{10} ($\mu g/m^3$) 24-hr	CO (ppm) 8-hr	SO_2 (ppm) 24-hr	SO_2 (ppm) Annual		
0.000-0.064	---	0.0-15.4	0-54	0.0-4.4	0.000-0.034	(ii)	0-50	Good
0.065-0.084	---	15.5-40.4	55-54	4.5-9.4	0.035-0.144	(ii)	51-100	Moderate
0.085-0.104	0.125-0.164	40.5-65.4	155-254	9.5-12.4	0.145-0.224	(ii)	101-150	Unhealthy for sensitive group
0.105-0.124	0.165-0.204	65.5-150.4	255-354	12.5-15.4	0.225-0.304	(ii)	151-200	Unhealthy
0.125-0.374	0.205-0.404	150.5-250.4	355-424	15.5-30.4	0.305-0.604	0.65-1.24	201-300	Very unhealthy
(iii)	0.405-0.504	250.5-350.4	425-504	30.5-40.4	0.605-0.804	1.25-1.64	301-400	Hazardous
(iii)	0.505-0.604	350.5-500.4	505-604	40.5-50.4	0.805-1.004	1.65-2.04	401-500	Hazardous

(i) In some cases, in addition to calculating the 8-hr ozone index, the 1-hr ozone index may be calculated and the maximum of the two values is reported

(ii) NO_2 has no short term air quality standard and can generate an AQI only above 200

(iii) 8-hr O_3 values do not define higher AQI values (≥ 301). AQI values of 301or higher are calculated with 1-hr O_3 concentrations.

$$F = gr^2 v_s (1 - \frac{T_a}{T_s}) \quad ; \quad \Delta h = \frac{1.6 F^{1/3} x_f^{\ 2/3}}{u}$$

$x_f = 120\ F^{0.4}$ if $F \geq 55\ m^4/s^3$; $x_f = 50\ F^{5/8}$ if $F < 55\ m^4/s^3$

TABLE 7.7 WIND PROFILE EXPONENT p FOR ROUGH TERRAIN[a]

Stability class	Description	Exponent, p
A	Very unstable	0.15
B	Moderately unstable	0.15
C	Slightly unstable	0.20
D	Neutral	0.25
E	Slightly stable	0.40
F	Stable	0.60

[a] For smooth terrain, multiply p by 0.6; see Table 7.8 for further descriptions of the stability classifications used here.

Source: Peterson (1978).

From Stability Class and H:
- find x_{max}
- $(C_y/Q)_{max}$.

Then Calculate:
$C_{max} = \frac{Q}{u}\left(\frac{Cu}{Q}\right)_{max}$

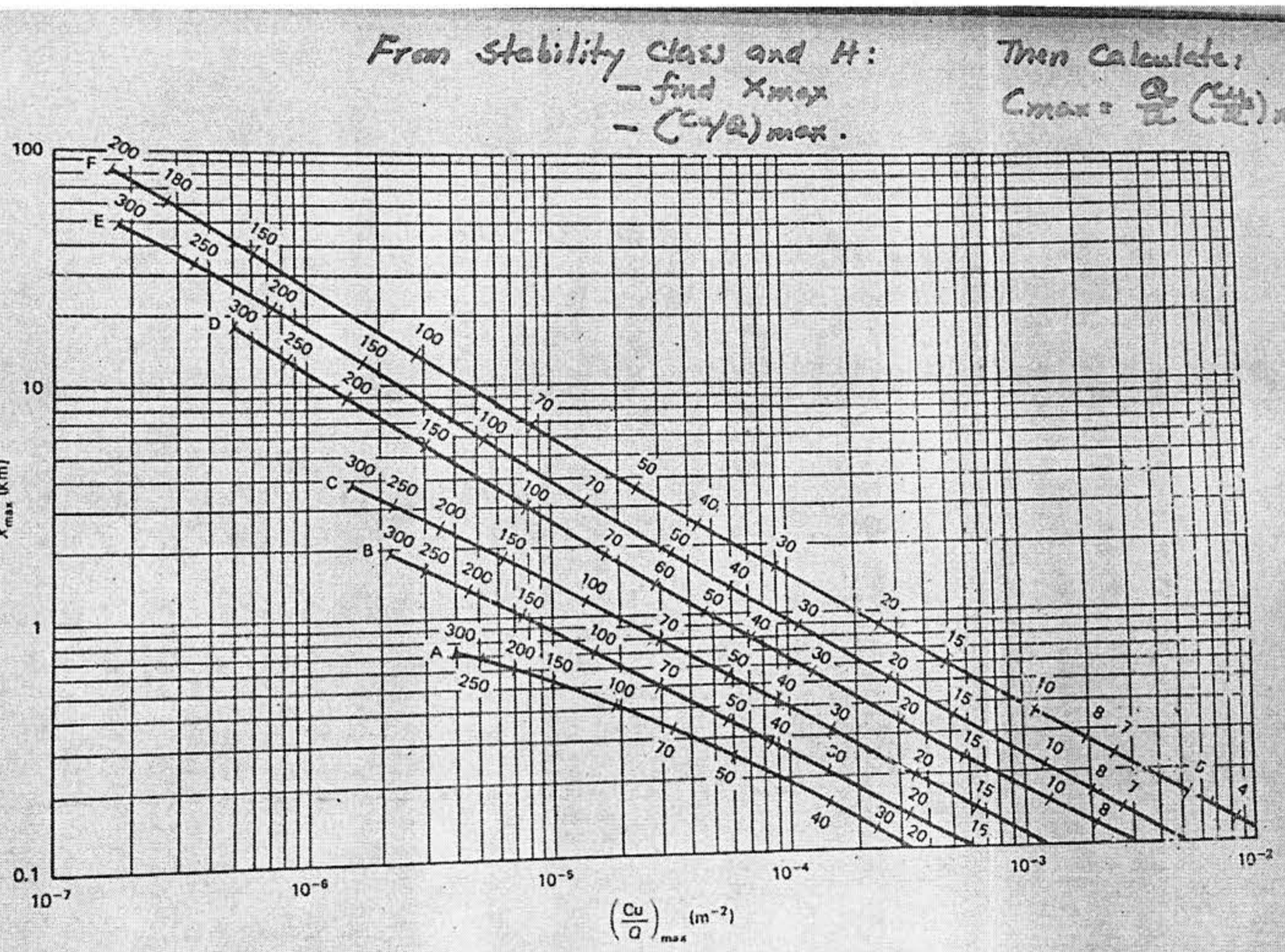


Figure 7.30 To determine the peak downwind plume concentration, enter the graph at the appropriate stability classification and effective stack height (numbers above the lines, in meters) and then move across to find the distance to the peak, and down, to find a parameter from which the peak concentration can be found (Turner, 1970).

Table 4. Constants in empirical relationships for σ_y and σ_z

Stability class	a	$x \leq 1$ km			$x \geq 1$ km		
		c	d	f	c	d	f
A	213	440.8	1.941	9.27	459.7	2.094	-9.6
B	156	106.6	1.149	3.3	108.2	1.098	2.0
C	104	61	0.911	0	61	0.911	0
D	68	33.2	0.725	-1.7	44.5	0.516	-13.0
E	50.5	22.8	0.678	-1.3	55.4	0.305	-34.0
F	34	14.35	0.740	0.35	62.6	0.180	-48.6

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

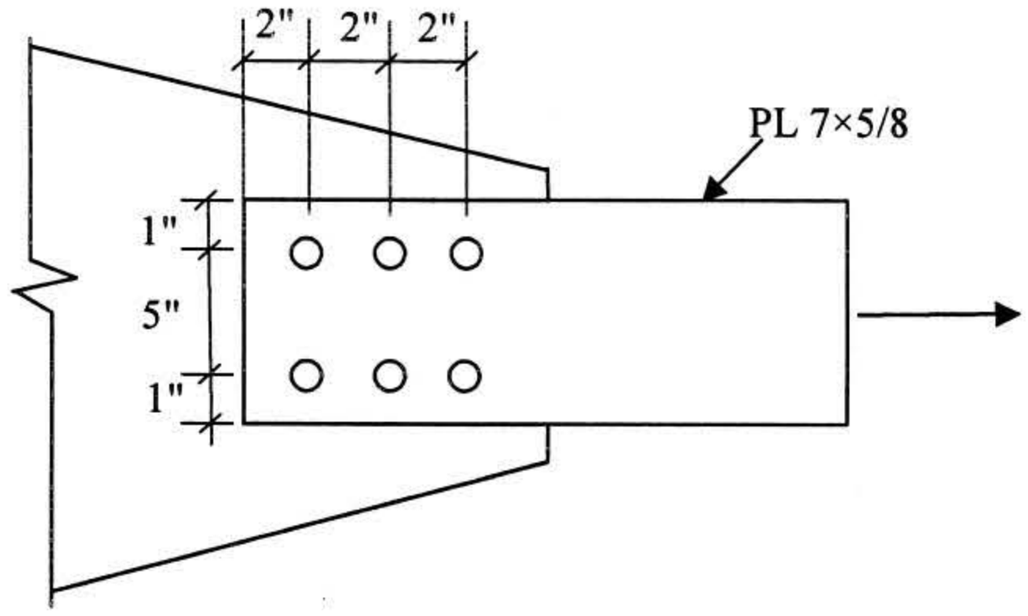
Course Title: Structural Engineering VI (Design of Steel Structures) Course Code: CE 417
Time: 2 hours Full Marks: 100

[Assume Reasonable Values for Any Missing Data]
Answer any **Five (05)** out of **Seven (07)** questions
Each question has equal mark

1. (a) Define residual stress. **(5)**

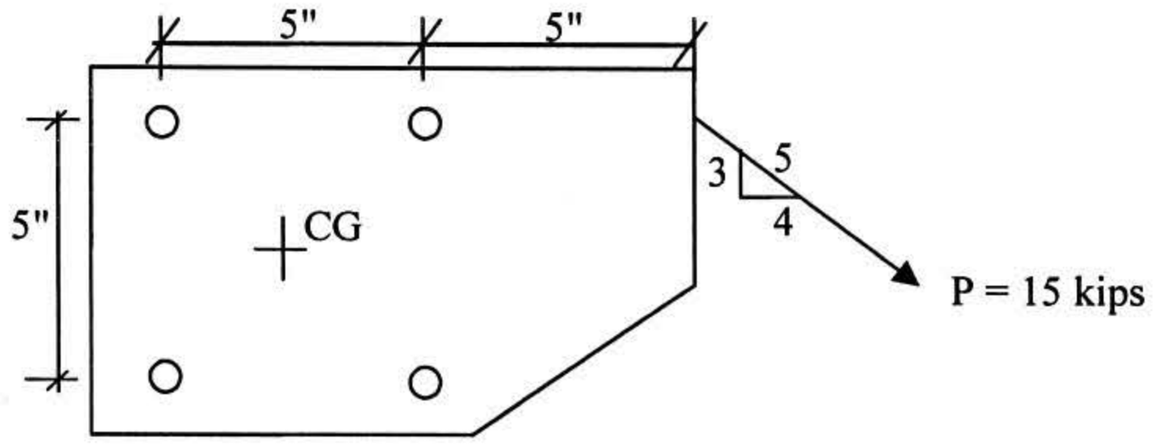
   What are the sources of residual stresses in steel members? Explain with neat sketches.

   (b) Investigate the tension capacity of the plate PL 7×5/8 attached to a gusset plate with six bolts as shown in the following figure. Consider **all the limit states** and assume uniform tension stress. The material is A36 (F_u= 58 ksi) and bolts are 3/4- in dia. with standard holes. Use both **AISC-ASD and LRFD** methods. **(15)**



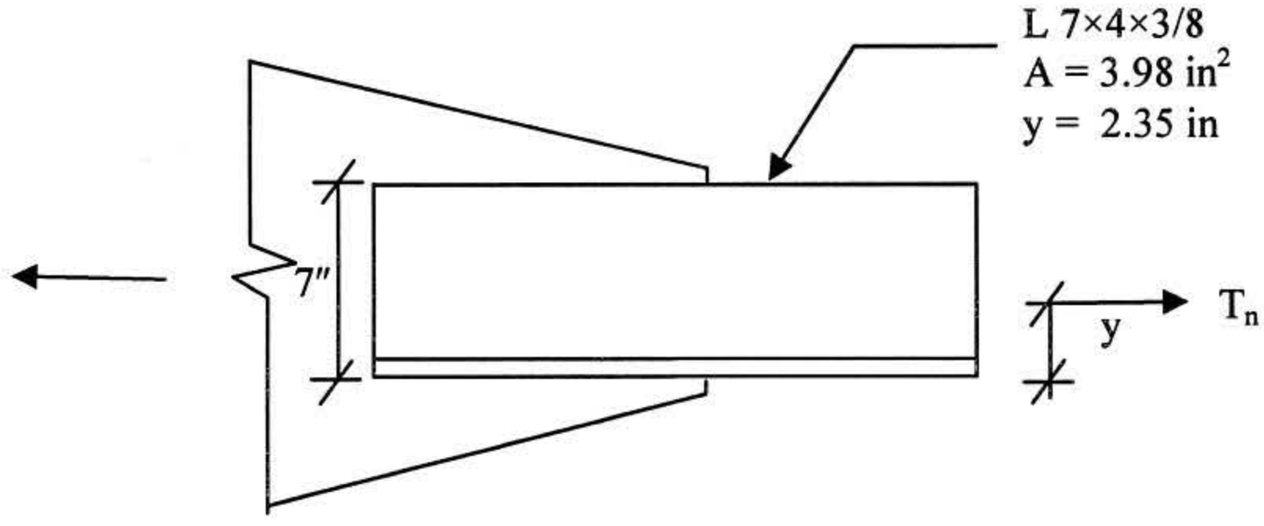
2. (a) State the types of structural fasteners. Explain why rivets are now obsolete. **(5)**

   (b) Use the elastic vector method to compute the resultant bolt shear forces at each bolt in the eccentrically loaded bolt group in the following figure. The bolts are all the same size. **(15)**



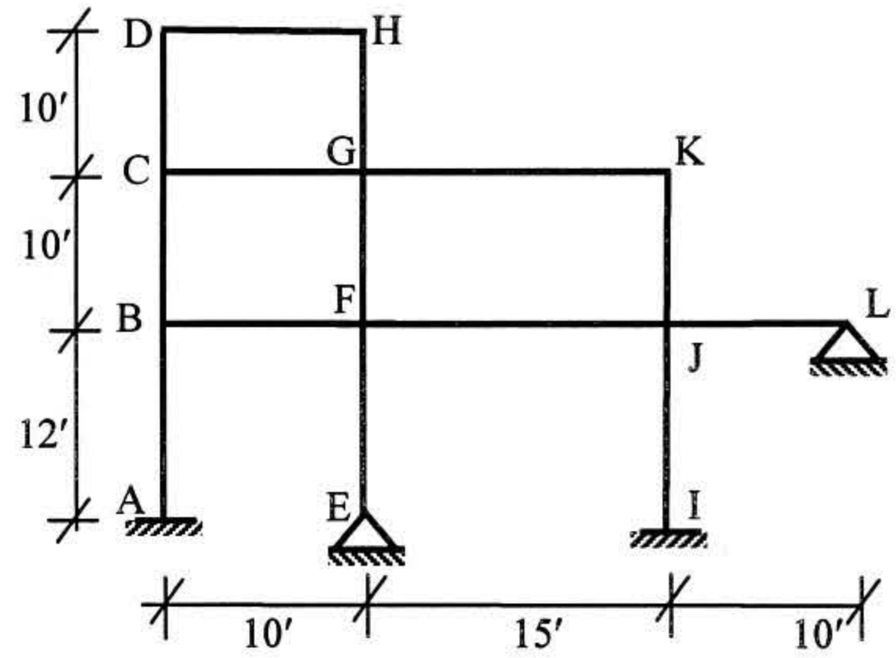
3. (a) Briefly discuss the possible defects of weld connections. **(6)**

(b) Use **AISC-ASD** approach to design the fillet welds to develop the full strength of the angle shown in the following figure so that the effects of eccentricity is minimized. Assume the gusset plate and base material of the angle do not govern the design. Use A572 Grade 50 steel (F_u = 65 ksi), a fillet weld size of ¼ in. and reduction coefficient U = 1. Neatly sketch the designed connection. **(14)**



4. (a) Draw a column strength curve and indicate regions of short, intermediate and long columns. **(8)**
Explain how the failure of a short column differs from that of a long column.

(b) Calculate effective length for members CD, KJ and IJ shown in the following figure. Given that, **(12)** I_{column} = 199 in^4 and I_{beam} = 291 in^4.



5. (a) Define local buckling (with free hand sketches). **(2)**

(b) Write short notes on: **(4)**

i. Stiffened element

ii. Unstiffened element

(c) Select the lightest W section (from the following table) of A992 steel (F_y = 50 ksi) to serve as a column of 15 ft length to carry an axial compression load of 65 kip dead load and 130 kip live load in a braced frame structure. The column is assumed to be pinned at top and fixed at bottom. Use **AISC-LRFD** approach. **(14)**

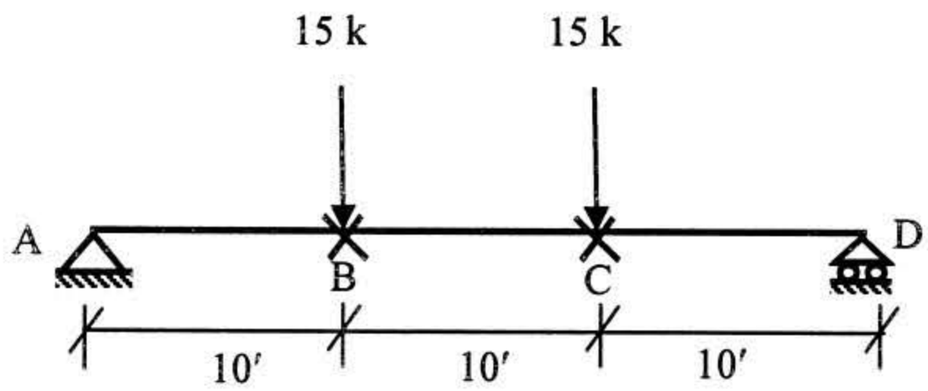
Shape	A_g (in^2)	r_x (in)	r_y (in)
W 10×45	13.3	4.32	2.01
W 12×35	10.3	5.25	1.54
W 12×40	11.7	5.13	1.94

6. (a) What is lateral torsional buckling? **(4)**

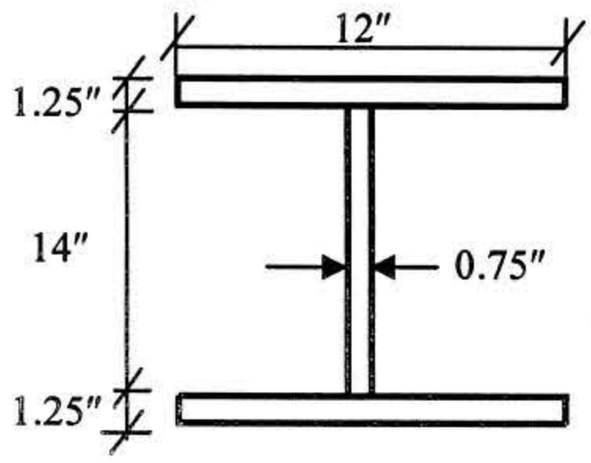
Distinguish between bending and lateral torsional buckling with neat sketches.

(b) Write a short note on moment gradient factor C_b. **(8)**

Compute C_b for segments AB, BC and CD of the beam in the following figure. The beam has lateral supports at points B and C; and its cross-section is doubly symmetric.



(c) Compute shape factor for the following W section about its strong axis. **(8)**



7. (a) Explain the following terms: **(5)**

i. Serviceability of beams

ii. Compact section

(b) Use **AISC-LRFD** approach to determine the maximum concentrated load W that can act at midspan on a simply supported span of 20 ft. Lateral supports exist only at the ends of the span. The service load is 65% live load and 35% dead load. The section is W21×62 of F_y = 50 ksi steel. **(15)**

Note: Beam self-weight is not negligible and hence it must be accounted for.

Annexure-1

Block shear capacity: Nominal strength

$R_n = 0.6F_yA_{gv} + U_{bs}F_uA_{nt}$ (shear yielding – tension rupture)

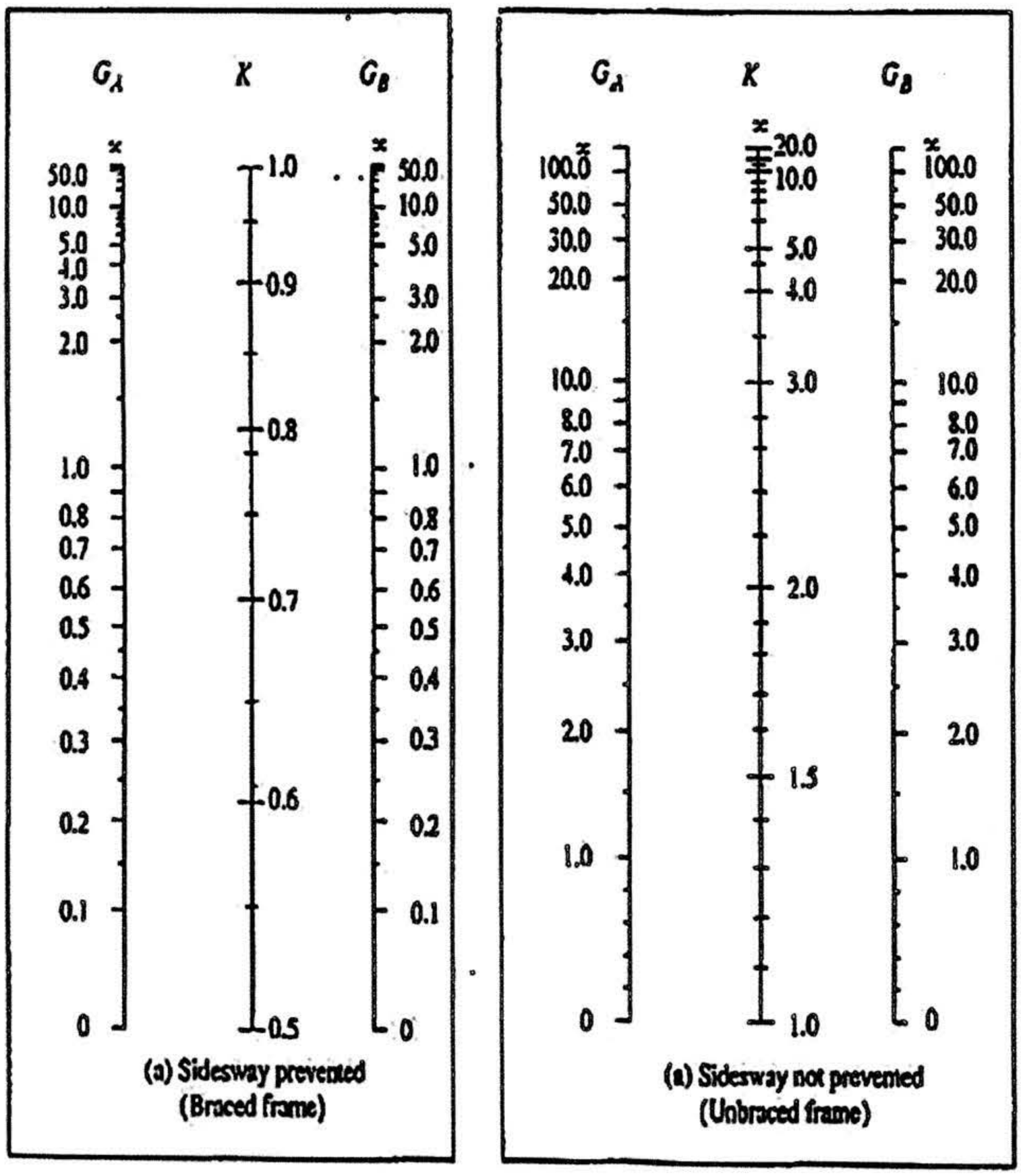
$R_n = 0.6F_uA_{nv} + U_{bs}F_uA_{nt}$ (shear fracture – tension rupture)

Annexure-2

$R_{nw} = 0.6t_eF_{EXX}$

Annexure-3

Alignment Chart



Annexure-4

$F_{cr} = [0.658^{F_y/F_e}]F_y$ for $\frac{kL}{r} \leq 4.71\sqrt{\frac{E}{F_y}}$

F_{cr}=0.877 F_e for $\frac{kL}{r} > 4.71\sqrt{\frac{E}{F_y}}$

Annexure-5

$$C_b = \frac{12.5M_{max}}{2.5M_{max} + 3M_A + 4M_B + 3M_C} R_m \leq 3.0$$

Annexure-6

Factored concentrated load $W_u = 1.2\times(0.35W) + 1.6\times(0.65W)$

Design moment, $\emptyset_b M_n = \frac{W_u L}{4} + \frac{w_{self\ weight} L^2}{8}$

For compactness of web; $\lambda_p \leq 3.76\sqrt{\frac{E}{F_y}}$

For compactness of flange; $\lambda_p \leq 0.38\sqrt{\frac{E}{F_y}}$

Beam LTB formulae:

$$\frac{L_p}{r_y} = 1.76\sqrt{\frac{E}{F_y}}$$

$$L_r = 1.95 r_{ts} \frac{E}{0.7F_y}\sqrt{\frac{Jc}{S_x h_0}}\sqrt{1+\sqrt{1+6.76\left(\frac{0.7F_y}{E}\frac{S_x h_0}{Jc}\right)^2}}$$ (c=1 for doubly symmetric section)

$$F_{cr} = \frac{C_b \pi^2 E}{\left(\frac{L_b}{r_{ts}}\right)^2}\sqrt{1+0.078\frac{Jc}{S_x h_0}\left(\frac{L_b}{r_{ts}}\right)^2}$$ (c=1 for this section)

Section properties of W21×62:

d (in)	t_w (in)	b_f (in)	t_f (in)	S_x (in^3)	Z_x (in^3)	r_y (in)	r_{ts} (in)	h_0 (in)	J (in^4)
21.0	0.400	8.24	0.615	127	144	1.77	2.15	20.4	1.83

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

Course Title: Structural Engineering X (Concrete Technology) Course Code: CE 425
Time: 2 hours Full Marks: 100 (10 x 10)

Answer any 10 (Ten) out of 12 (Twelve) questions

Question 1:

a. Using schematic diagram, apply the knowledge to explain the structure of hydrated silicates of cement. [4]
b. List the advantages of using blended cement? Describe how pozzolanic reaction occurs in Portland Composite Cement? [6]

Question 2:

a. Explain why is workability of concrete important? Based on your knowledge, what are the tests need to be carried out to measure the workability of concrete, illustrate one of them? [7]
b. Write what are the necessary precautions should be taken to avoid segregation of concrete? [3]

Question 3:

a. Using schematic diagram, discuss the mechanism for successful pumping concrete and how to improve the flow of fresh concrete. [7]
b. The ready-mixed concrete has recently gained popularity in the concrete industry of Dhaka city, explain why? [3]

Question 4:

a. What is superplasticizer? Discuss the effect of superplasticizer on the properties of fresh and hardened concrete. [7]
b. Give examples of the function of air entrained admixture. [3]

Question 5:

a. Describe the effect of incorporation of Fly Ash in cement on the fresh and hardened properties of concrete. [6]
b. "Partial replacement of Ordinary Portland Cement by Rice Husk Ash in cement can improve the performance of concrete", Do you agree or disagree with this statement? Justify your answer. [4]

Question 6:

a. Using schematic diagram, illustrate the interfacial transition zone of concrete. [4]
b. Apply the knowledge to explain the effect of microstructure on the strength and durability of concrete. [6]

Question 7:

a. "There is a growing trend toward the use of lightweight concrete all over the world", Do you agree or disagree with this statement? Justify your answer. [5]
b. "The steel fiber reinforced concrete is more durable than normal concrete" Do you agree or disagree with this statement? Give your opinion. [5]

Question 8:

a. What is Ultra-High Performance Concrete (UHPC)? "The absorption capacity of UHPC is much lower than the normal strength concrete, as a result, UHPC has higher resistance of freeze-thaw than normal strength concrete", Do you agree or disagree with this statement? Justify your answer. [5]
b. What is Shotcrete? List the advantages and application of Shotcrete? [5]

Question 9:

a. Write the purposes of Non-destructive test methods. [3]
b. Describe the test procedures to measure the compressive strength of the existing structures via rebound hammer. How smoothness of test surface influence the rebound number? [7]

Question 10:

a. What is autogenous healing of concrete? Apply the knowledge to illustrate the mechanism of autogenous healing of concrete. [5]
b. Discuss the degradation of the compressive strength of concrete due to high temperature. [5]

Question 11:

a. Explain the mechanisms of pore pressure spalling and thermal stress spalling of concrete. [7]
b. "An effective way for reducing concrete sensitivity to spalling is the addition of polypropylene fiber in concrete", Do you agree or disagree with this statement? Justify your answer. [3]

Question 12:

a. Describe the deterioration of concrete due to carbonation? Explain the measurement of carbonation depth of concrete. [7]
b. "Chloride is not so harmful for concrete", Do you agree or disagree with this statement? Justify your answer. [3]

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

Course Title: GIS and Remote Sensing
Time: 2.00 Hours

Course Code: CE 531
Full Marks: 60

Section A

Answer the following questions.
[Marks distribution: 3*5=15]

1. (a) Discuss briefly "People" as one component of GIS. **[1]**
   (b) Write down the Disciplines & Technologies connected to GIS? **[2]**
   (c) ArcGIS is the primary GIS software and used globally and designed by ESRI. List the three license levels of ArcGIS. **[2]**

2. (a) What do you understand by data Acquisition? Compare among different data acquisition methods. **[1+2]**
   (b) What is digitizing? Mention the names of few digitizing errors. **[1+1]**

3. (a) What is the way of obtaining un sampled points or areas using a limited number of sampled observations? **[2]**
   (b) Prepare a table which shows the choice of sampling methods according to their requirements. **[3]**

(OR)

4. (a) What are the input files for a terrain mapping analysis? **[2]**
   (b) From which point of view a DEM file is appropriate over a TIN file and why? **[3]**

Section B

Answer any 3 (three) from the following questions

[Marks distribution: 3*15=45]

5. (a) Geo-reference the image given in the exam folder and then convert the file as Google earth format. **[5]**

   (b) Digitize the image given in the attached exam folder. **[5]**

   (c) A shape file consisting of all the upazilla in Bangladesh. Prepare a map showing the population density. What is the name of this kind of mapping procedure? **[4+1]**

6. (a) Prepare a layer file of Gulshan drainage area. Shape files of Drainage network of Bangladesh and Gulshan thana are given. Find out the total drainage length of that particular area. Show the drainage line according to the field type L-poly in the map and do necessary labeling. **[4+1+2]**

   (b) Soil pattern of Bangladesh (shape file) is given. What are the common soil types of Dhaka District and Rajshahi District **[4]**

   (c) Thana bd shape file is given. Convert it to District bd shape file. **[4]**

7. (a) From the point shape file, select Parliament of Bangladesh. Select the places which are within 1500 m from Parliament of Bangladesh. Are there any schools situated in the selected area? If yes, then show then in the layout. **[1+3+2+1]**

   (b) Road map of ward 35 has been given. You are being asked to build a new city where there cannot be any high rising building and the distance of the building from the tertiary roads should be as near as possible (for example you can take those buildings which ate within 1m from the tertiary road) **[4+4]**

8. A study has been undertaken to evaluate the topography of the study area (Rajshahi, Naogaon and Chapai Nawabganj). [For conducting this study, shape file of the study area and shape file and topographic area is given.]

   (a) Prepare a DEM (Digital Elevation Model) map using inverse distance weighting (IDW) method. [8]

   (b) Prepare a contour map of the study area. [7]

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

Course Title: Environmental Engineering VIII — Course Code: CE 531
Time- 2 hr — Full marks: 60

Part A: There are TWO questions. Answer any ONE of them (15x1=15)

1. (a) Discuss overlay of raster data. What is partition of spatial data? (8+2)
   (b) Compare between continuous raster and discrete raster data model. (5)

2. (a) Briefly discuss IDW and Kriging methods of interpolation. What are the limitations of IDW? How does Kriging overcome those limitations? (8+2+2)

   (b) How are geographical features described in GIS? (3)

Part B: There are THREE questions. Answer ALL of them (15x3=45)

Use ArcGIS software to solve these problems. Use "Fall 2017_MS" data folder.

3. You have been provided with an image of Dhaka city.
   (a) Geo-reference the image. (3)
   (b) Digitize the following features. Create shp. Files and database of the features (10)
      i. Point feature – any Five Thanas (provide **Thana name** in the database)
      ii. Line feature – Rail Line (provide **Length** in the database)
      iii. Area feature – Banani lake (provide **Area** in the database)
   (c) Prepare a map in pdf with title and proper legends. (2)

4. (a) Bangladesh districts and river shp. Files are provided in the folder "BBS 2011 Admin_ Boundary".
      i. Find out the length of the river that falls within "Panchagarh" district. (4+3)
      ii. Create a divisional map for Bangladesh.

   (b) The coordinates of the University of Asia Pacific and residence location of CE 4-2 students are provided in a spreadsheet. (4+4)
      i. Insert the sheet into ArcGIS, and show the locational distribution of CE students' residence.
      ii. Create a shp. File of UAP and identify the list of students that live within 2 km from UAP, and show them in attribute table.

5. A new clinic is to be established in **Ward 36.** Identify the most suitable location for the new clinic by performing GIS Suitability analysis. (15)
Assume that the clinic will be:

i. Within 15 m distance from primary road
ii. Within 5 m distance from secondary road
iii. Within 100 m distance from banks
iv. The selected location is not covered by existing clinics/health services (consider 130 m as service area coverage for existing clinics)
v. Not within 120 m distance from dustbin
vi. Not within 20 m distance from commercial use buildings
vii. Not within 20 m distance from mixed use buildings

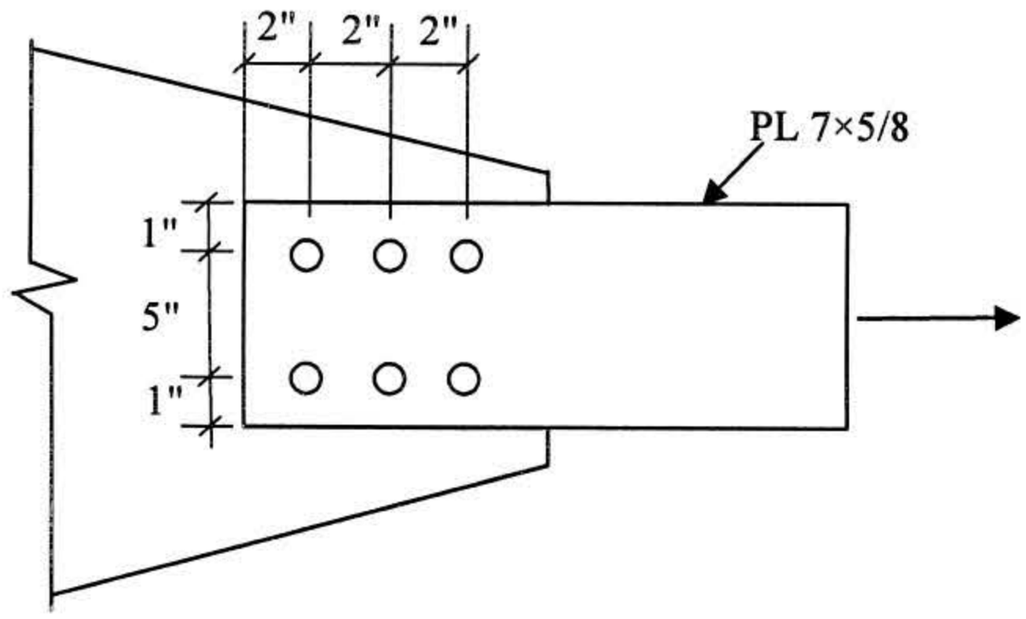
University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2017
Program: B.Sc. in Civil Engineering

Course Title: Structural Engineering VI (Design of Steel Structures) Course Code: CE 417
Time: 2 hours Full Marks: 100

[Assume Reasonable Values for Any Missing Data]
Answer any **Five (05)** out of **Seven (07)** questions
Each question has equal mark

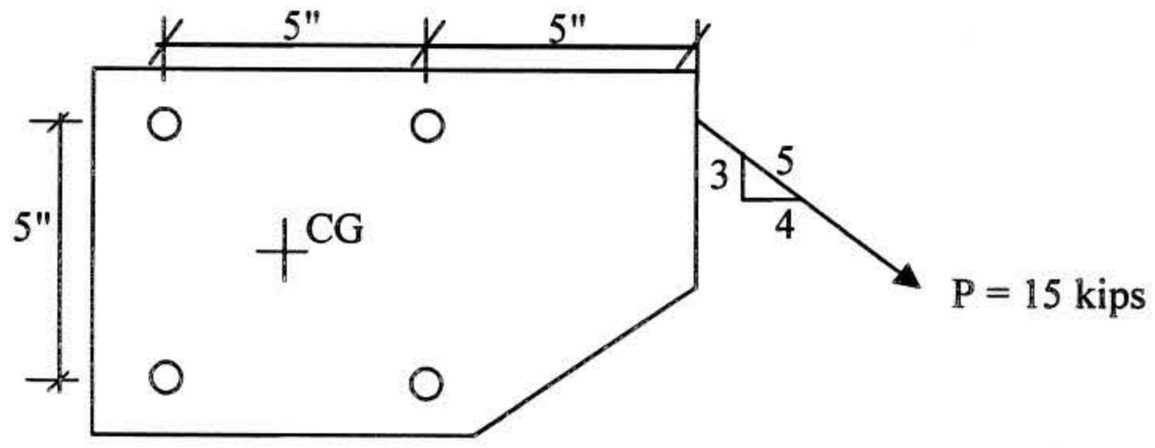
1. (a) Define residual stress. **(5)**
What are the sources of residual stresses in steel members? Explain with neat sketches.

(b) Investigate the tension capacity of the plate PL 7×5/8 attached to a gusset plate with six bolts as shown in the following figure. Consider **all the limit states** and assume uniform tension stress. The material is A36 (F_u= 58 ksi) and bolts are 3/4- in dia. with standard holes. Use both **AISC-ASD and LRFD** methods. **(15)**



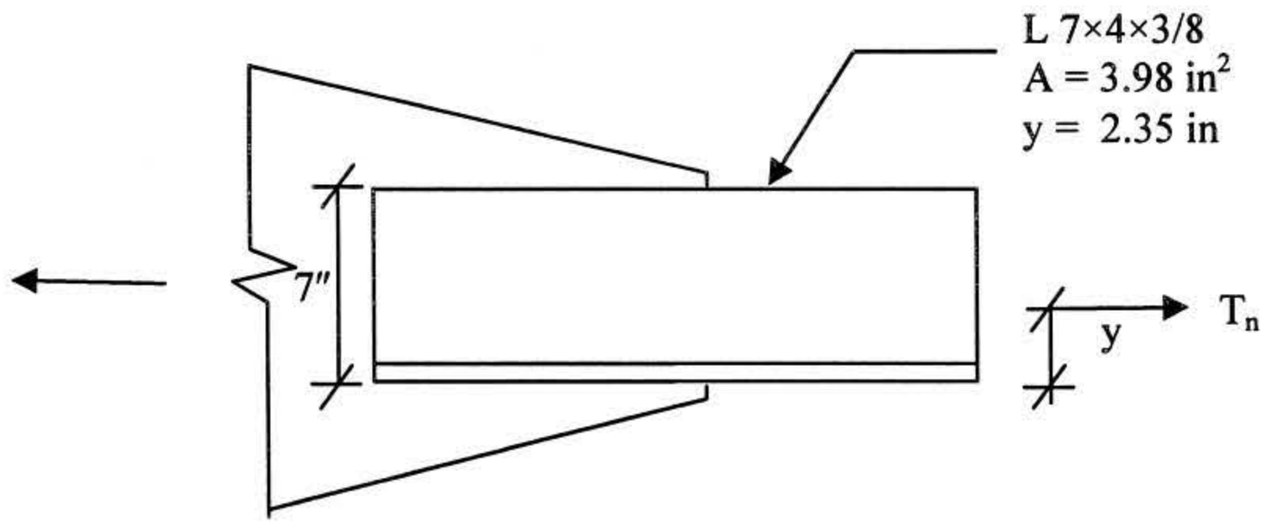
2. (a) State the types of structural fasteners. Explain why rivets are now obsolete. **(5)**

(b) Use the elastic vector method to compute the resultant bolt shear forces at each bolt in the eccentrically loaded bolt group in the following figure. The bolts are all the same size. **(15)**



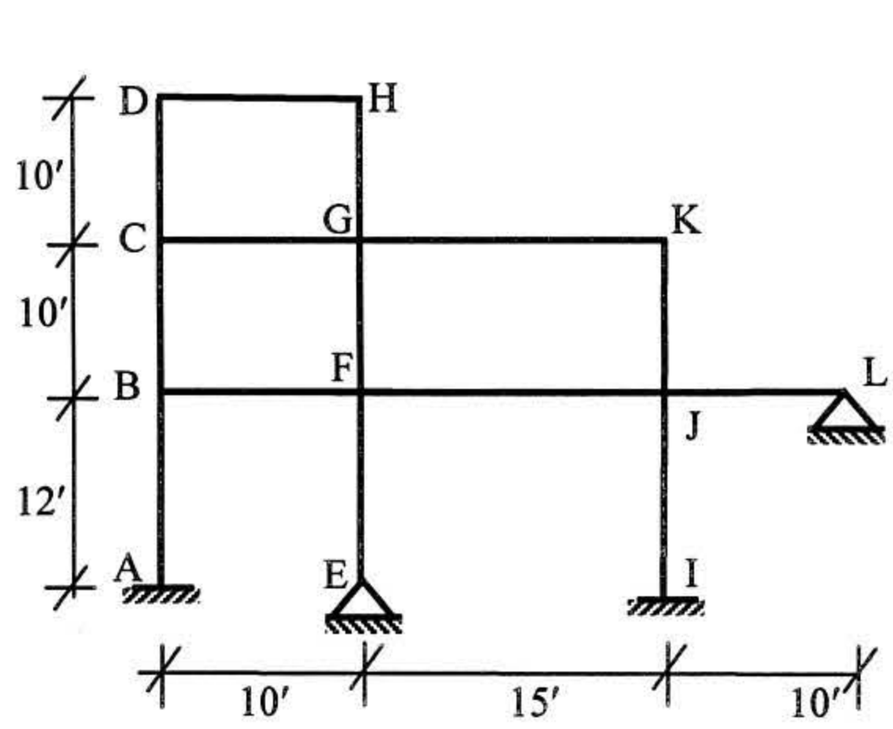
3. (a) Briefly discuss the possible defects of weld connections. **(6)**

(b) Use **AISC-ASD** approach to design the fillet welds to develop the full strength of the angle shown in the following figure so that the effects of eccentricity is minimized. Assume the gusset plate and base material of the angle do not govern the design. Use A572 Grade 50 steel (F_u = 65 ksi), a fillet weld size of ¼ in. and reduction coefficient U = 1. Neatly sketch the designed connection. **(14)**



4. (a) Draw a column strength curve and indicate regions of short, intermediate and long columns. **(8)**
Explain how the failure of a short column differs from that of a long column.

(b) Calculate effective length for members CD, KJ and IJ shown in the following figure. Given that, **(12)**
I_{column} = 199 in^4 and I_{beam} = 291 in^4.



5. (a) Define local buckling (with free hand sketches). **(2)**

(b) Write short notes on: **(4)**

i. Stiffened element

ii. Unstiffened element

(c) Select the lightest W section (from the following table) of A992 steel (F_y = 50 ksi) to serve as a column of 15 ft length to carry an axial compression load of 65 kip dead load and 130 kip live load in a braced frame structure. The column is assumed to be pinned at top and fixed at bottom. Use **AISC-LRFD** approach. **(14)**

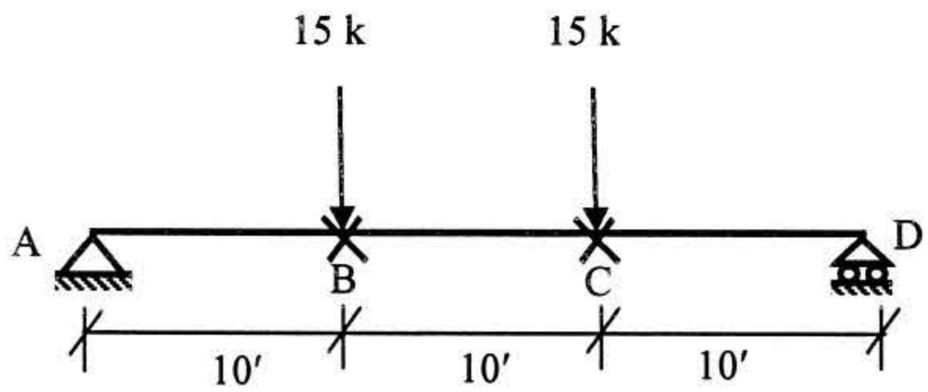
Shape	A_g (in^2)	r_x (in)	r_y (in)
W 10×45	13.3	4.32	2.01
W 12×35	10.3	5.25	1.54
W 12×40	11.7	5.13	1.94

6. (a) What is lateral torsional buckling? **(4)**

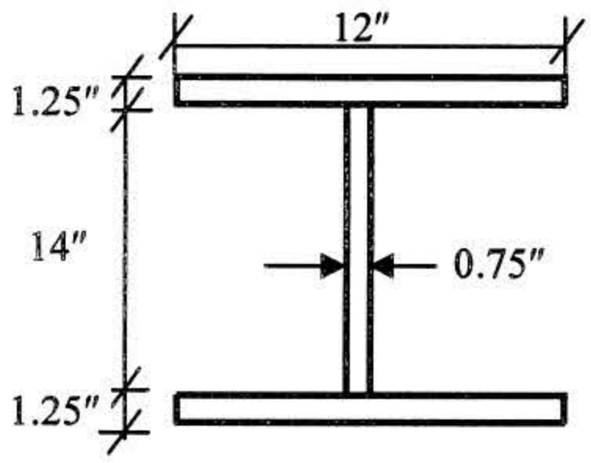
Distinguish between bending and lateral torsional buckling with neat sketches.

(b) Write a short note on moment gradient factor C_b. **(8)**

Compute C_b for segments AB, BC and CD of the beam in the following figure. The beam has lateral supports at points B and C; and its cross-section is doubly symmetric.



(c) Compute shape factor for the following W section about its strong axis. **(8)**



7. (a) Explain the following terms: **(5)**

i. Serviceability of beams

ii. Compact section

(b) Use **AISC-LRFD** approach to determine the maximum concentrated load W that can act at midspan on a simply supported span of 20 ft. Lateral supports exist only at the ends of the span. The service load is 65% live load and 35% dead load. The section is W21×62 of F_y = 50 ksi steel. **(15)**

Note: Beam self-weight is not negligible and hence it must be accounted for.

Annexure-1

Block shear capacity: Nominal strength

$R_n = 0.6F_yA_{gv} + U_{bs}F_uA_{nt}$ (shear yielding – tension rupture)

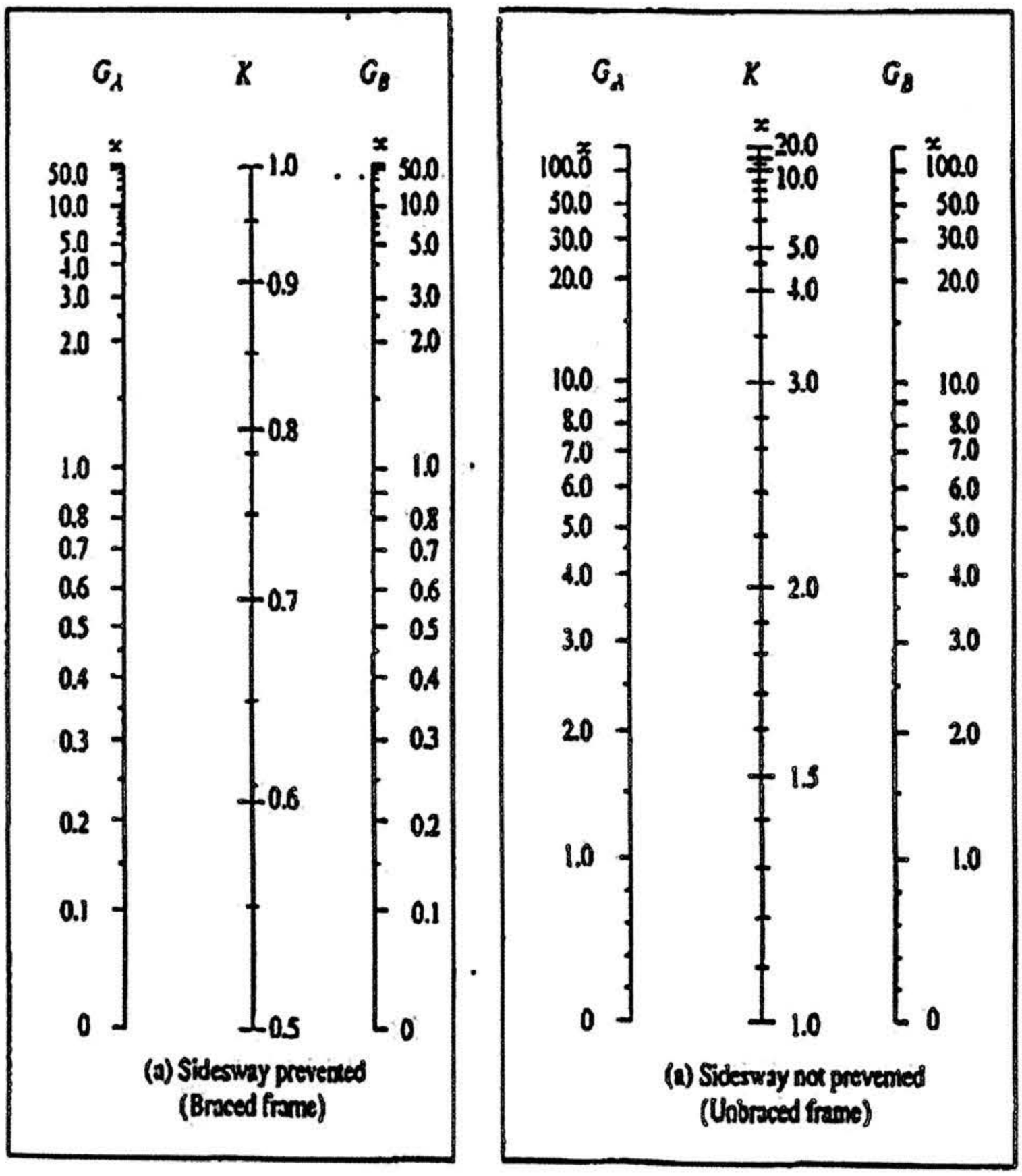
$R_n = 0.6F_uA_{nv} + U_{bs}F_uA_{nt}$ (shear fracture – tension rupture)

Annexure-2

$R_{nw} = 0.6t_eF_{EXX}$

Annexure-3

Alignment Chart



Annexure-4

$F_{cr} = [0.658^{F_y/F_e}]F_y$ for $\frac{kL}{r} \leq 4.71\sqrt{\frac{E}{F_y}}$

F_{cr}=0.877 F_e for $\frac{kL}{r} > 4.71\sqrt{\frac{E}{F_y}}$

Annexure-5

$$C_b = \frac{12.5M_{max}}{2.5M_{max} + 3M_A + 4M_B + 3M_C} R_m \leq 3.0$$

Annexure-6

Factored concentrated load $W_u = 1.2\times(0.35W) + 1.6\times(0.65W)$

Design moment, $\emptyset_b M_n = \frac{W_u L}{4} + \frac{w_{self\ weight} L^2}{8}$

For compactness of web; $\lambda_p \leq 3.76\sqrt{\frac{E}{F_y}}$

For compactness of flange; $\lambda_p \leq 0.38\sqrt{\frac{E}{F_y}}$

Beam LTB formulae:

$$\frac{L_p}{r_y} = 1.76\sqrt{\frac{E}{F_y}}$$

$$L_r = 1.95 r_{ts} \frac{E}{0.7F_y}\sqrt{\frac{Jc}{S_x h_0}}\sqrt{1+\sqrt{1+6.76\left(\frac{0.7F_y}{E}\frac{S_x h_0}{Jc}\right)^2}}$$ (c=1 for doubly symmetric section)

$$F_{cr} = \frac{C_b \pi^2 E}{\left(\frac{L_b}{r_{ts}}\right)^2}\sqrt{1+0.078\frac{Jc}{S_x h_0}\left(\frac{L_b}{r_{ts}}\right)^2}$$ (c=1 for this section)

Section properties of W21×62:

d (in)	t_w (in)	b_f (in)	t_f (in)	S_x (in^3)	Z_x (in^3)	r_y (in)	r_{ts} (in)	h_0 (in)	J (in^4)
21.0	0.400	8.24	0.615	127	144	1.77	2.15	20.4	1.83

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

Course Title: Environmental Engineering III | Course Code: CE 431
Time: 2 hours | Full Marks: 100

Answer all the questions (20*5=100). Assume data if not available.

1. (a) What is hazardous waste? List the categories of hazardous waste with example. Draw the hierarchy of priorities in hazardous waste management. **[9+6]**

Or

Compare the key characteristics of different methods of MSW landfill. Also describe their advantages and disadvantages. **[9+6]**

(b) Show the recycling pattern for urban solid waste in Bangladesh in figure. **[5]**

Or

Differentiate between "separation materials" and "conversion materials" in materials recycling processes.

2. (a) Justify why recycling and reuse is important in solid waste management. **[10]**

Or

If you want to recover resources from the waste stream during solid waste management in your locality, explain the risks that are involved in the process.

(b) Explain the functional elements of solid waste management system with figure. **[10]**

Or

Discuss the effects of poor management of solid waste from environmental view point.

3. (a) Discuss the physical properties or the chemical properties of solid waste. **[10]**

(b) Draw the figure of i) Batch digester ii) Anaerobic baffle reactor. Why pH control is necessary during anaerobic digestion of solid waste? **[6+4]**

Or

Calculate the oxygen requirement of organic waste for composting considering the structural formula $C_1H_{2.4}O_{0.9}N_{0.02}$. **[10]**

4. (a) Explain the mechanism of anaerobic digestion of solid waste with figure. **[10]**

Or

What is composting in solid waste management? What are its main objectives? Explain the factors that influence the marketing of compost.

(b) Estimate the total gas (theoretical) that could be produced from the organic fraction of MSW under anaerobic conditions having the given data:
Chemical formula without water= $C_{60}H_{94.3}O_{37.8}N$.
Total weight of organic material in 100 lb of solid wastes is equal to 58 lb including moisture. **[10]**

Or

Given that 2500 kg/h of municipal solid waste with 10 percent glass is applied to a rotary screen for the removal of glass prior to shredding. Weight of underflow is 500

kg/h and weight of glass in screen underflow = 200 kg/h, determine the recovery efficiency and effectiveness of the screen.

5. (a) Discuss different types of collection systems in solid waste management. What are the factors upon which the frequency of waste collection depends on? **[10]**

(b) Compare 'preventive maintenance' versus 'breakdown maintenance' of collection vehicles. **[4+6]**

Solid wastes from Farmgate, Dhaka (commercial area) are to be collected using a stationary container collection system. With the following data determine the truck capacity:

Container volume = 5 m^3
Container utilization factor = 0.7
Average number of containers at each location = 2
Collection-vehicle compaction ratio = 3.0
Average drive time between container location = 20 minutes
Container unloading time = 10 minutes
One-way haul distance = 2.5 km
Speed limit = 56 km/hr
Time from garage to 1st container location = 30 minutes
Time from last container location to garage = 15 minutes
Number of trips to disposal site per day = 2

$T_{scs} = (PT_{scs} + q + m + nx)$

$PT_{scs} = C_t uc + (S-1)(dbc)$

$$C_t = \frac{V_r z}{V_c f} \qquad M_{dc} = \frac{V_d}{V_r z}$$

$$L = \frac{(t_1 + t_2) + M_{dc}(PT_{scs} + q + m + nx)}{1 - W}$$

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

Course Title: Structural Engineering V | Credit Hours: 2.0 | Course Code: CE 415
Time: 2 hours | Full Marks: 100

1.a) A post tensioned bonded concrete beam has curved tendons which are tensioned from left end as shown in **Figure 1**. Calculate the percentage loss of pre-stress due to friction, from one end to other end (A to F) of the beam. The average length effect is 0.00061 per feet and coefficient of friction between the cable and the duct is 0.35. 10

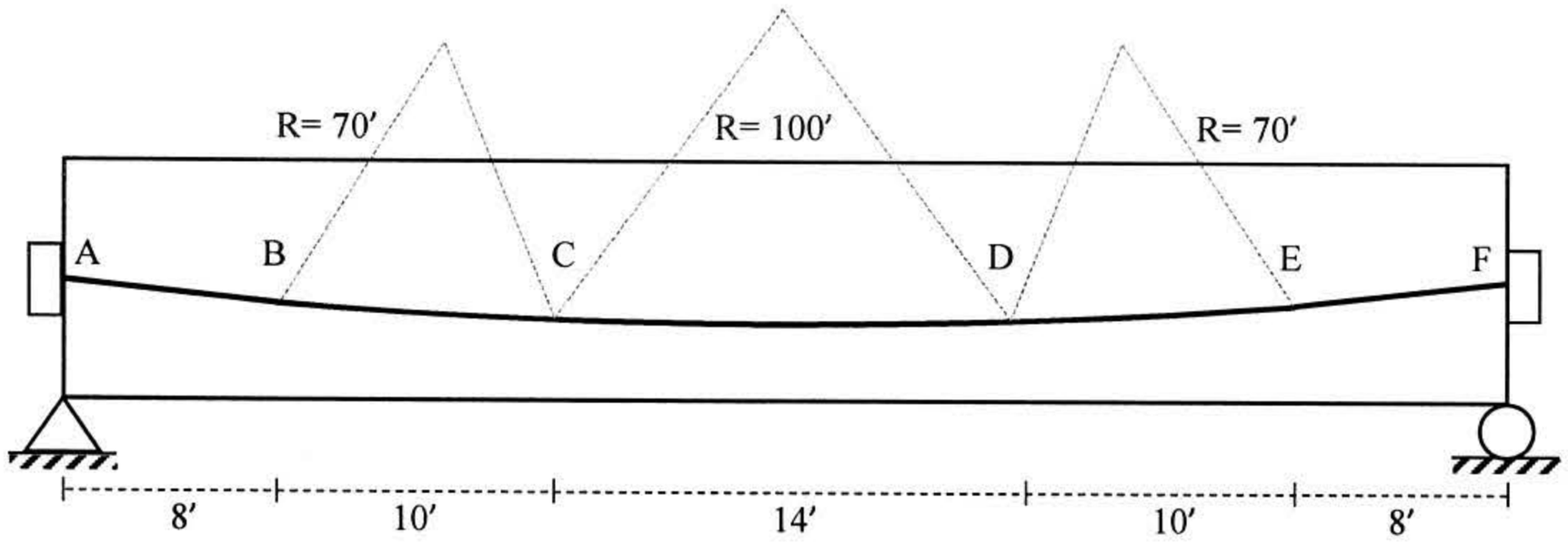
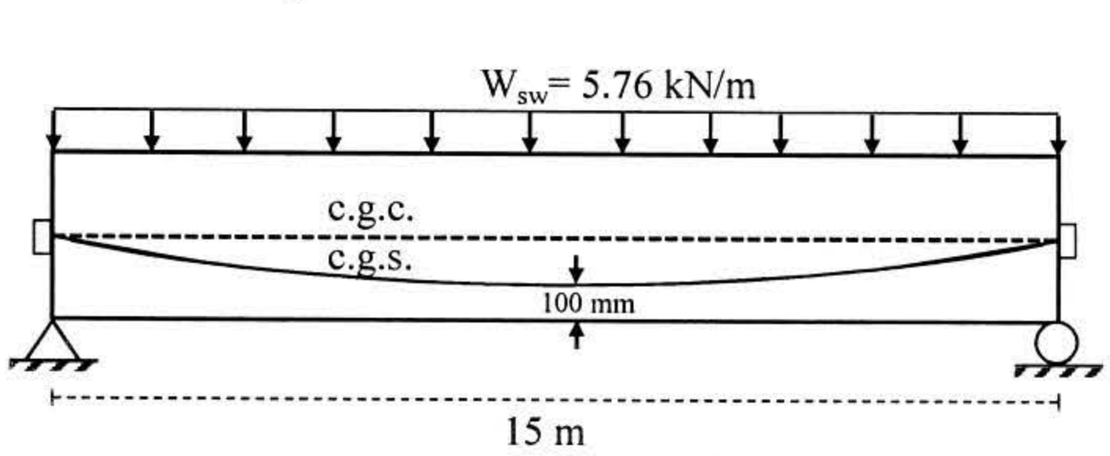


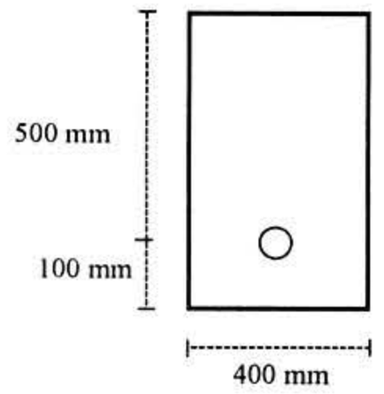
Figure 1

b) Write short notes on (any three): 15

i) Difference between reinforced concrete and prestressed concrete;
ii) Advantages of partial prestsressing over full prestressing
iii) Factors affecting transfer length for prestressing steel
iv) Ways of partial prestressing

2.a) A concrete beam, shown in **Figure 2**, is post-tensioned with high strength steel. The cross section of steel tendon is 920 mm^2 and initial pre-stressing is 1100MPa. 18
i) Calculate initial deflection at mid-span of the beam. [Given: E_c= 24000 MPa; w_{sw}= 5.76 kN/m]
ii) Estimate the deflection of the beam shown in **Fig 2** after 1.5 months, assuming creep coefficient is 1.80 and efective prestress is 960 MPa at that time.





Mid-section

Figure 2

b) Discuss the possible ways of reducing deflection and camber in prestressed concrete. 7

3.a) A pre-stressed concrete beam has been designed for the following loading and structural conditions as shown in **Figure 3**. While pre-stressing, two of the strands fail at site due to mechanical constraints. 10
Analyze the new beam section to calculate ultimate moment capacity and reduced allowable uniformly distributed load w.

3.b) Design the beam for shear at section a-a as shown in **Figure 3(b)** in accordance with ACI Code. [Given, pre-stressing steel 16 Φ10 mm; f'_c= 49 MPa; f_{se}=1100 MPa; f_{pu}=1860 MPa] 15

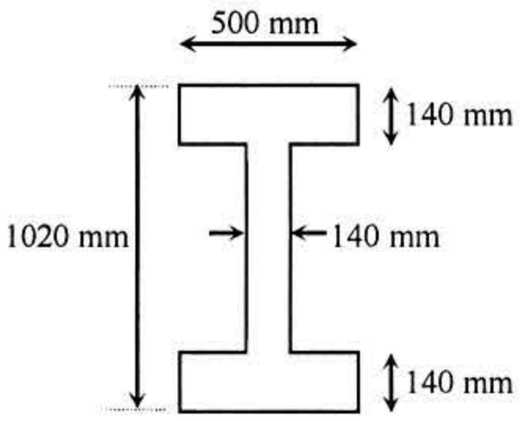


Figure 3(a)

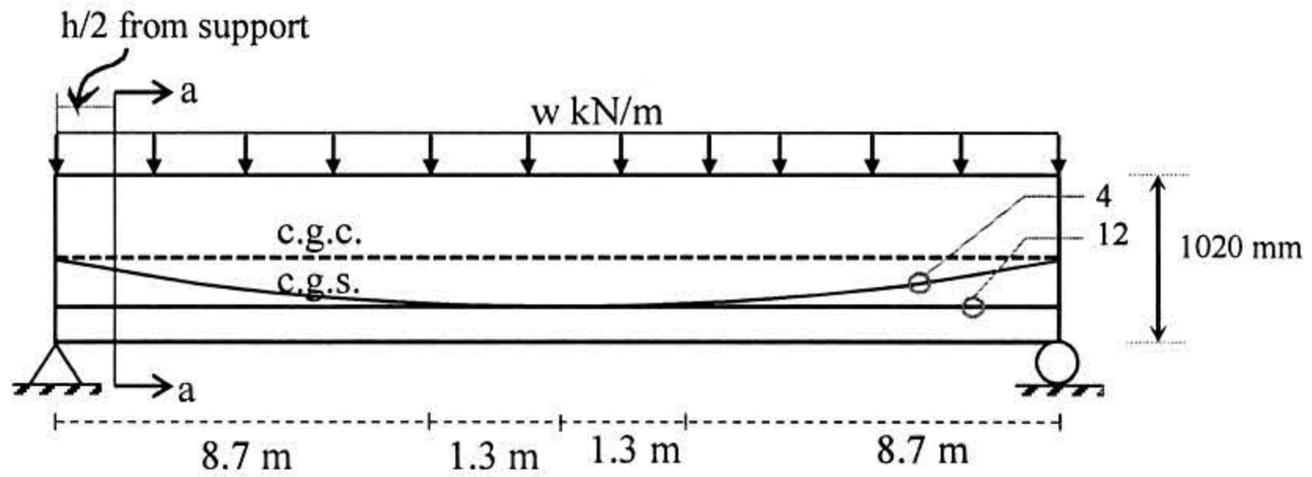


Figure 3(b)

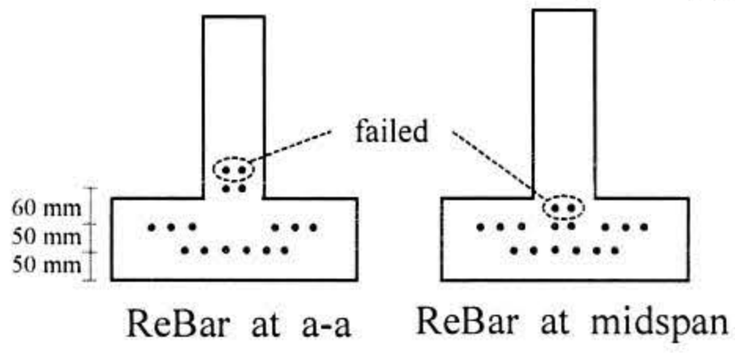


Figure 3(c)

4.a) The midspan section of a composite beam is shown in **Figure 4**. The precast stem is posttensioned with an initial force of 950 kN. The effective prestress after losses is taken as 890 kN. Moment due to weight of the precast section is 134 kN-m at midspan. After it is erected in place, the top slab is cast in place with induced of 84 kN-m moment on the beam. After the slab concrete has hardened, the composite section is to carry a maximum live load moment of 252 kN-m. Calculate stresses at various stages and show stress distributions for the section. [Given: c.g.s.= 75 mm from base] 15

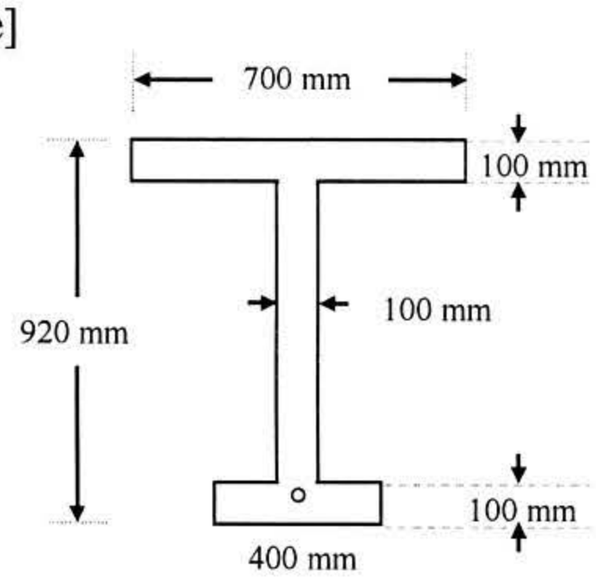


Figure 4

b) Sketch typical layout of pre-tensioned beams. 5

c) Explain briefly the graphical method of calculating principal tensile stress in pre-stressed concrete beams. 5

Or

5.a) Apply the concept of a preliminary design of a pre-stressed concrete beam to resist a total moment of 750 kN-m. Assume the depth of the section is 1020 mm. Initial prestress of steel is 1100 MPa and effective pre-stress is 910 MPa, allowable stress for concrete under working load is -13 MPa. [Given: M_G= 80 kN-m] 8

b) Design the beam section obtained from question 2(a) considering tension in concrete. [Given: f'_t= 2.2 Mpa; f'_b= 1.5 Mpa; f_t= -13 Mpa; f_b= -13.5 Mpa; F_o=968 kN] 17

List of formulae:

$$\#\ f_c = -\frac{F}{A} \pm \frac{Fey}{I} \pm \frac{My}{I} \qquad \#SH = 8.2 \times 10^{-6}\, K_{sh} E_s \left(1 - 0.06\frac{V}{S}\right)(100 - RH)$$

$$\#\ RE = [\, K_{re} - J(SH + CR + ES]C \qquad \#\ f_{ps} = f_{pu}\left\{1 - 0.5\rho_p\left(\frac{f_{pu}}{f'_c}\right)\right\} \qquad \#\ \rho_p = \frac{A_{ps}}{bd}$$

$$\#\ a = \frac{A_{ps}\, f_{ps}}{0.85 f'_c b} \qquad \#\ \omega_p = \frac{\rho_p f_{ps}}{f'_c} \le 0.30 \qquad \#\ M_u = \phi A_{ps}\, f_{ps}\left(d - \frac{a}{2}\right)$$

$$\#\ A_{pf} = \left\{0.85 f'_c (b - b_w) h_f\right\}\Big/_{f_{ps}} \qquad \#\ \omega_{pw} = \frac{\rho_w f_{ps}}{f'_c} \le 0.30$$

$$\#\ M_u = \phi\left[A_{pf}\, f_{ps}\left(d - \frac{h_f}{2}\right) + A_{pw}\, f_{ps}\left(d - \frac{a}{2}\right)\right]$$

$$\#\ \mathrm{F} = \frac{\mathrm{M_T}}{0.65\mathrm{h}}\ ;\ \text{if } \mathrm{M}_G \text{ is greater than 20\% of } \mathrm{M}_T$$

$$\#\ \mathrm{F} = \frac{\mathrm{M_L}}{0.5\mathrm{h}};\ \text{if } \mathrm{M}_G \text{ is less than 20\% of } \mathrm{M}_T, \mathrm{M}_L = \mathrm{M}_T - \mathrm{M}_G$$

$$\#\ \mathrm{A_c} = \frac{\mathrm{F_0 h}}{\mathrm{f_b c_t}} \qquad \#\ \mathrm{A_c} = \frac{\mathrm{Fh}}{\mathrm{f_t c_b}} \qquad \#\ \mathrm{A_c} = \frac{\mathrm{F_o}}{\mathrm{f_b}}\left(1 + \frac{\mathrm{e} - \left({}^{\mathrm{M_G}}/_{\mathrm{F_0}}\right)}{\mathrm{k_t}}\right) \qquad \#\ \mathrm{A_c} = \frac{\mathrm{F_o h}}{\mathrm{f_b c_t} - \mathrm{f'_t c_b}}$$

$$\#\ \mathrm{A_c} = \frac{\mathrm{Fh}}{\mathrm{f_t c_b} - \mathrm{f'_b c_t}} \qquad \#\ \mathrm{F} = \frac{\mathrm{M_T} - \mathrm{f'_b A k_t}}{\mathrm{e} + \mathrm{k_t}} \qquad \#\ \mathrm{k} = \frac{\mathrm{r}^2}{\mathrm{c}}$$

$$\#\ \mathrm{V}_{ci} = 0.05\sqrt{\mathrm{f'_c}}\mathrm{b}_w\mathrm{d} + \mathrm{V}_d + \mathrm{V}_i\frac{\mathrm{M}_{cr}}{\mathrm{M}_{max}}$$

$$\#\ \mathrm{M}_{cr} = ({}^{I}/_{y_b})(0.5\sqrt{\mathrm{f'_c}} + \mathrm{f}_{pe} - \mathrm{f}_d \qquad \#\ \mathrm{V}_{ci} = 0.05\mathrm{b}_w\mathrm{d}\sqrt{\mathrm{f'_c}} + \mathrm{V}_i\,\mathrm{M}_{cr}/\mathrm{M}_{max}$$

$$\#\ \mathrm{M}_{cr} = ({}^{I}/_{y_b})(0.5\sqrt{\mathrm{f'_c}} + \mathrm{f}_{pe} \qquad \#\ f_{pe} = \frac{F}{A} + \frac{Fey_b}{I}$$

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

Course title: Environmental Engineering VI | Course code: CE 437
Time: 2 hours | Full marks: 100

There are FIVE (5) questions. Answer all questions (28 + 4*18=100).

1. A) Explain the following: (6)
   - Environment management system
   - Ecosystem
   - Utilitarian justification of environmental value
   - Environmental unity
   - Natural environmental change
   - Biomass

   B) Explain savanna biome, tundra biome and temperate deciduous forest biome. (6)

   C) Assess the relationship between terrestrial ecosystem, aquatic ecosystem and wetland. (8)

   D) Justify the following statement with conceptual diagram: *Increasing diversity can stabilize ecosystem functioning.* (8)

2. A) Select three United Nations Sustainable Development Goals (UN SDGs) that you consider important for reducing waste of environmental resources at global level. Justify your selection. (2+8)

   B) Explain different indicators of global warming. (8)
   OR
   C) Demonstrate how environmental management in national level differs from environmental management in international level. (8)

3. A) Explain the key features of Kigali Amendment (2016) to the Montreal Protocol on Substances that deplete the Ozone Layer (1987). Analyze how major industries of least developed countries could be benefited from Kigali Amendment. (6+6)

   B) Summarize article 18A of the Constitution of Bangladesh that deals with protection of biodiversity. (6)
   OR
   C) Identify three transboundary environmental resources principles that are most relevant for solving transboudary environmental resources problems of Bangladesh. Justify your answer. (1+5)

4. A) Prepare a draft environmental policy for University of Asia Pacific. (10)

B) Summarize the benefits that ISO 14001 certification brings to an organization and environment. (8)

OR

C) Explain the different requirements of ISO 14001 certification and implementation (plan-do-check-act cycle). (8)

5. A) Assess four steps of pollution prevention hierarchy of waste management as stipulated by Environmental Protection Agency (EPA), USA. (10)

B) An industrialist is planning to open an automatic rice mill in a rural village located near a river. Explain the requirements that the proposed industrial unit must meet for obtaining environmental clearance certification according to Environmental Conservation Rules, 1997. (8)

OR (5+3)

C) Illustrate the pollution prevention hierarchy of waste management that is currently being practiced in Bangladesh. In your opinion, which step in pollution prevention hierarchy is most important but ignored in Bangladesh?

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2017 (Set 2)
Program: B.Sc. Engineering (Civil)

Course Title: Structural Engineering IX (Earthquake Resistant Design and Retrofitting) | Credit Hours: 2.0 | Course Code: CE 423

Time: 2 hours | Full Marks: 70 (= 7 × 10)

PART A

[Answer **any 2 (Two)** of the following 3 questions]

1. To evaluate seismic resistance of structures (in Bangladesh) shown in Figs. 1(a)~1(d), write briefly on
   (i) Most likely deficiency you should primarily investigate for each
   (ii) Most effective retrofit measure you would recommend if the structures are found deficient in (i).

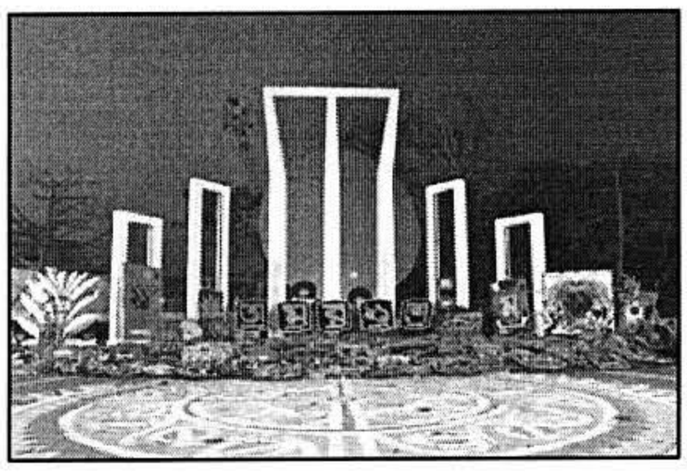


Fig. 1(a): Central Shaheed Minar

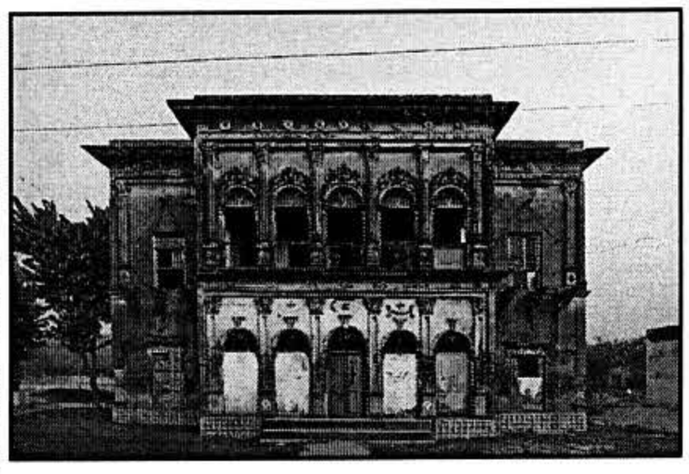


Fig. 1(b): Panamnagar Building (Historic Brick Masonry)

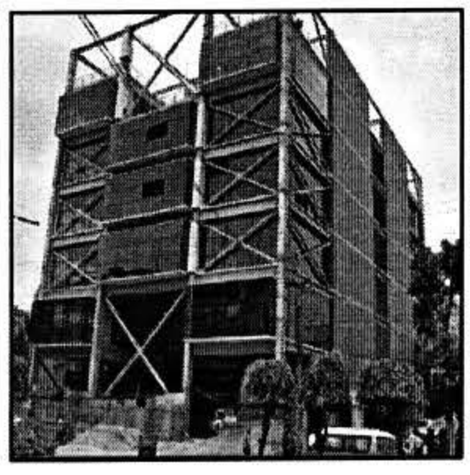


Fig. 1(c): MTB Center (Steel Bldg)

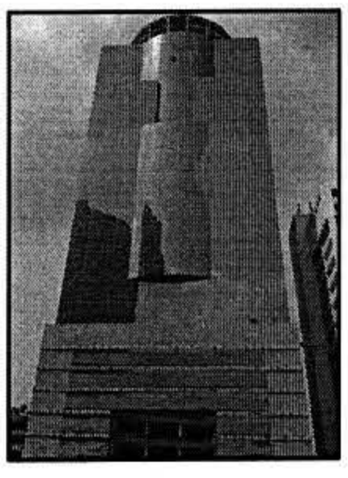


Fig. 1(d): City Center (Tallest RC Bldg)

2. For structures shown in Figs. 2(a)~2(d) damaged in earthquakes (outside Bangladesh), write briefly on
   (i) Most likely reason for their structural damage
   (ii) Most effective measure that could have prevented such damages.

Fig. 2(a): Flat slab Hotel (Mexico 1985)

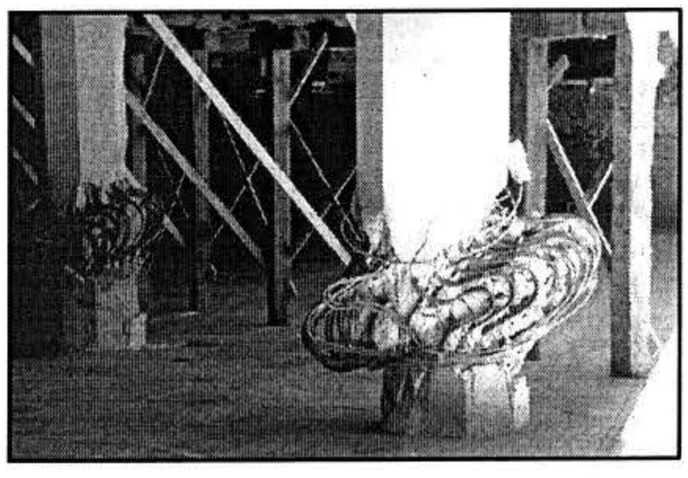


Fig. 2(b): Damage at Column-end (Northridge 1994)

Fig. 2(c): Tilted building (Taiwan 2018)

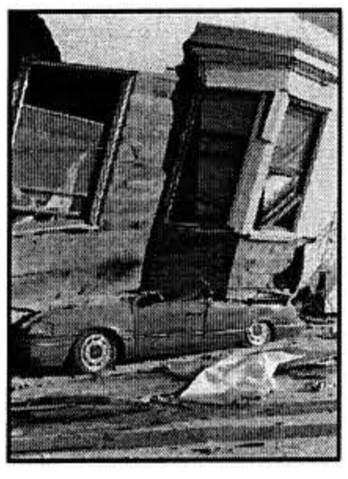


Fig. 2(d): Parking (Loma Prieta 1989)

3. Explain briefly OR draw appropriate sketches (with proper labels) to show
   (i) What you would do if an earthquake hits while you are at a classroom in UAP City Campus.
   (ii) Two possible reasons why a structure built on soft soil can be at greater risk during earthquake.
   (iii) Two possible seismic retrofit schemes you can apply to your own village home.
   (iv) Details of seismic safety measures for your 'Computer' and 'Book-shelf'.

PART B

[Answer **any 5 (Five)** of the following 7 questions]

[Given: $f_c' = 3.4$ ksi, $f_y = 45$ ksi, $E_c = 3400$ ksi for all questions]

4. For an earthquake that originates from rock with shear modulus 40 GPa, density 2200 kg/m^3 and causes an average displacement of 10 m of the fault plane over a rupture area of 50 km^2, calculate the

   (i) Seismic Moment and Moment Magnitude, (ii) PGA [Esteva-Villaverde (1974)]

   (iii) Arrival time of *s*-wave for an observer at hypocentral distance 50 km.

5. Figs. 3(a) and 3(b) show the super-structure and sub-structure of a bridge-span supported by 6 RC piles, each 200′ long, of 10′ diameter. The structural mass consists of a 100′ long RC pier (average section 15′×5′) and 500′ long bridge deck (weighing 20 k/ft).

   Calculate the

   (i) Time period, elastic base shear force and elastic deformation of each pile using the new BNBC in Zone 2 (for soil *SC*, $\xi = 5\%$).

   (ii) Inelastic base shear for a pile, assuming Ductility Ratio $\mu = \varepsilon_{50d}/\varepsilon_0$, using Kent-Park equations for confined concrete (with clear cover = 2″ and #4 ties @S_t = 10″).

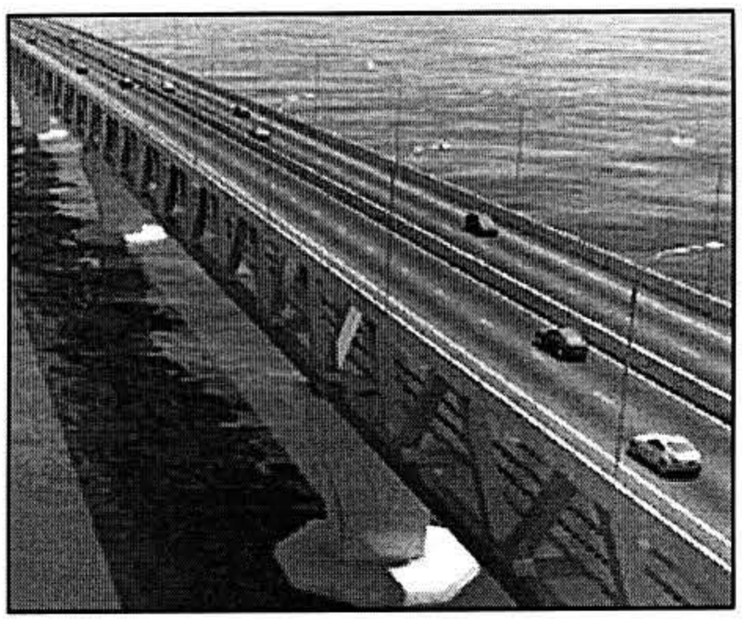


Fig. 3(a)

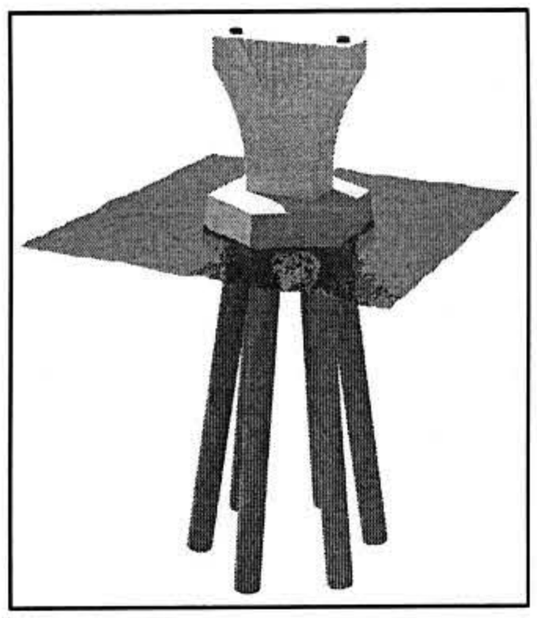


Fig. 3(b)

6. Figs. 4(a) and 4(b) show part of bridge super-structure mentioned in Question 5, supported on massless Base Isolation Spring with Shear Modulus = 150 psi, Bearing Area = 34 ft^2, Height = 12″.

   Here (M_D, M_P) represent mass of Bridge Deck and Pier, while (K_B, K_P) are stiffness of Base Isolator and Pier.

   (i) Calculate lateral stiffness of Base Isolation system

   (ii) Determine the 1st natural frequency and modal shape of the system shown in Fig. 4(b).

   (iii) Use BNBC 93 (for $S = 1.2$, $\xi = 5\%$) to calculate base shear (for design earthquake in Zone 2) and elastic peak deformations for 1st mode of vibration of the system.

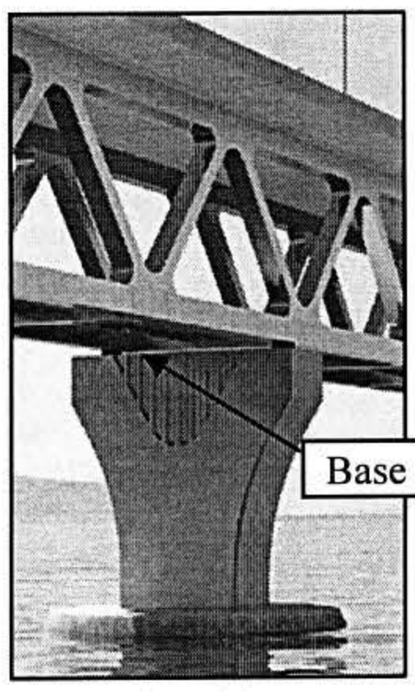


Fig. 4(a)

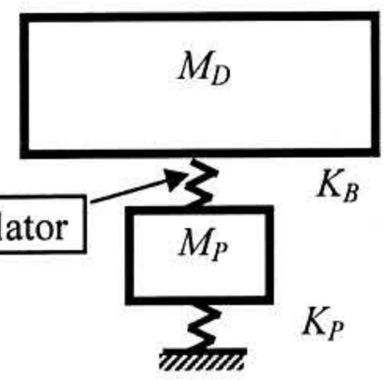


Fig. 4(b)

7. Fig. 5(a) shows test arrangement of a 7″ thick flat plate having an area of 5′ × 3.5′, supported on a 3′ high interior RC column of (7″ × 7″) section as shown in Fig. 5(b).

   Calculate the

   (i) Force *P* required to cause punching shear failure around the column
   - Without considering drift
   - Considering 1″ drift due to earthquake

   (ii) Bent-bar shear reinforcements required around the column to resist punching.

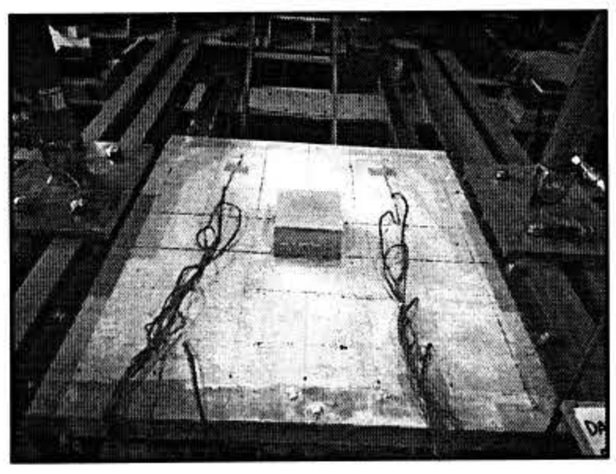


Fig. 5(a)

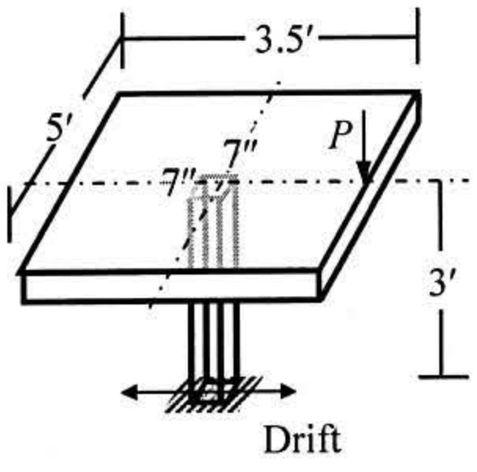


Fig. 5(b)

8. The floor plan of a 34-storied RC frame (with 10′ high columns) is shown in Fig. 6. All beams are uniformly loaded at $w_u = 3.4$ k/ft.

   Check adequacy of tie reinforcements of a ($h \times h$) RC column 'C_0' (with steel ratio = 0.034, clear cover = 1.5″ and #3 ties @S_t = 15″) for the following major seismic detailing provisions; i.e.

   (i) To provide adequate area of rectangular hoops

   (ii) To ensure the column yields in flexure before it fails in shear.

L = 34 + (Roll No/34) ft
h = 34 + (Roll No/34) in

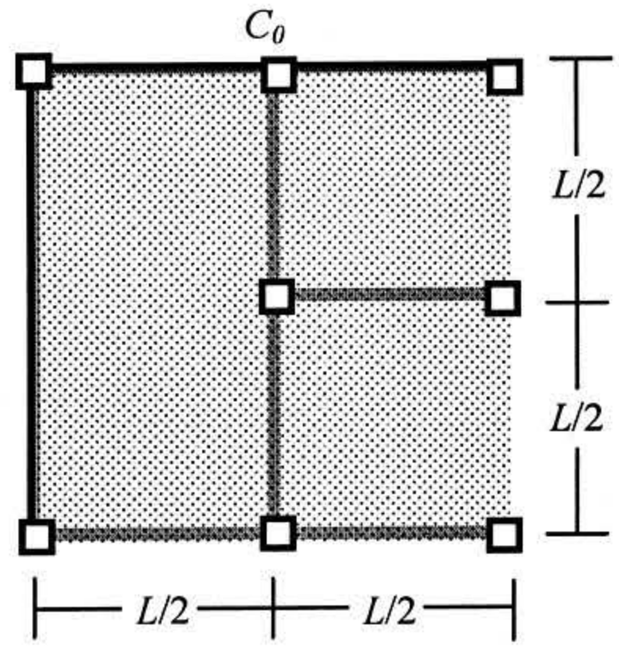


Fig. 6

9. Floor plan of a 3-storied steel frame (with 10′ high columns) is shown in Fig. 7(a), having member sections shown in Fig. 7(b) and beam load $w_u = 3.4$ k/ft.

   (i) Calculate shear force capacities V_{beam} and V_{col}

   (ii) Compare the moment capacities M_{pb}* and M_{pc}*.

L = 34 + (Roll No/34) ft

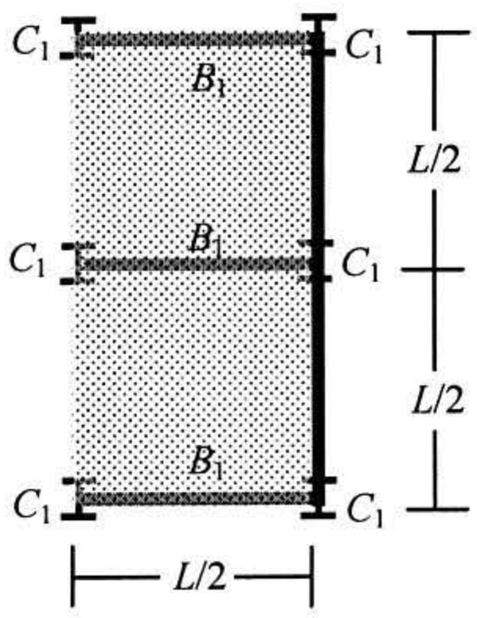


Fig. 7(a)

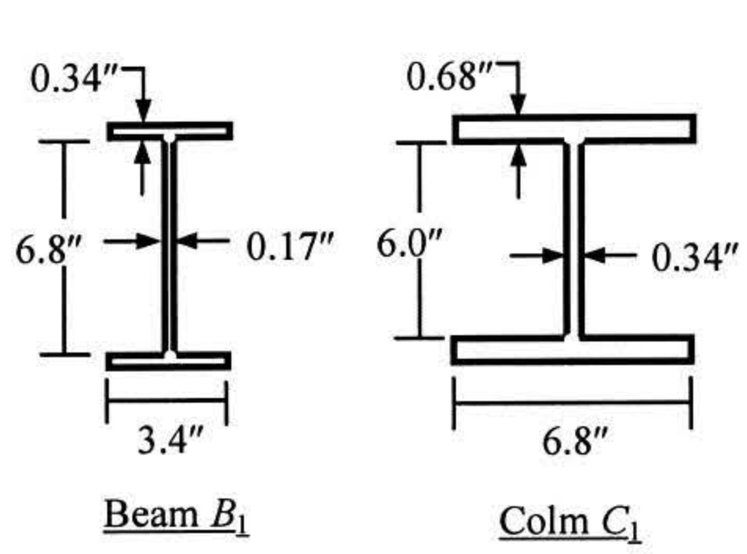


Fig. 7(b)

10. Floor plan of a 4-storied brick masonry building in Dhaka (with 10′ high stories and 6″-thick RC slabs) is shown in Fig. 8.

L = 34 + (Roll No/34) ft

(i) Determine the
- Lateral stiffness of in-plane solid walls
- Location ($\bar{x}$) of base shear V_b = (34+ Roll No/34) kips, considering weight of walls and slab
- Maximum shear stress in the solid walls, considering direct shear and torsional shear

[Given: $E_{Masonry}$ = 1700 ksi, t_{Wall} = 10″, t_{Slab} = 6″].

(ii) Check the adequacy of
- Wall opening width for in-plane loads
- Wall thickness for out-of-plane conditions.

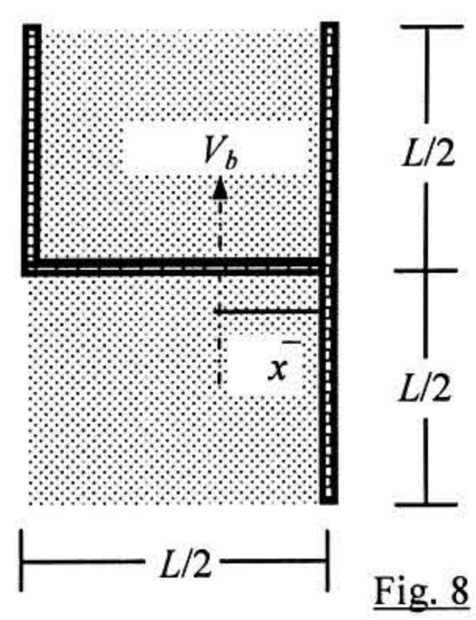


Fig. 8

List of Useful Formulae for CE 423

* $Z = 5.6\, e^{(0.8M)}/(R_h + 40)^2$ [Esteva and Villaverde (1974)]

* Governing equation of motion of SDOF system for ground motion $\Rightarrow m\, d^2u_r/dt^2 + c\, du_r/dt + k\, u_r = -m\, d^2u_g/dt^2$

* For lumped 2-DOF system

$$\begin{pmatrix} m_1 & 0 \\ 0 & m_2 \end{pmatrix} \begin{Bmatrix} d^2u_1/dt^2 \\ d^2u_2/dt^2 \end{Bmatrix} + \begin{pmatrix} c_1 + c_2 & -c_2 \\ -c_2 & c_2 \end{pmatrix} \begin{Bmatrix} du_1/dt \\ du_2/dt \end{Bmatrix} + \begin{pmatrix} k_1+k_2 & -k_2 \\ -k_2 & k_2 \end{pmatrix} \begin{Bmatrix} u_1 \\ u_2 \end{Bmatrix} = \begin{Bmatrix} f_1(t) \\ f_2(t) \end{Bmatrix}$$

* Eigenvalue problem (to calculate natural frequencies and modal vector)

$$|\mathbf{K} - \omega_{nr}^2\, \mathbf{M}| = 0 \qquad \text{and} \qquad [\mathbf{K} - \omega_{nr}^2\, \mathbf{M}]\, \boldsymbol{\phi}_r = \mathbf{0}$$

* <u>BNBC 93</u>

$V_b = ZICW/R$, where $C = 1.25S/T_n^{2/3} \le 2.75$

* $T_n = C_t\, (h_n)^{3/4}$

$C_t = 0.083$ for steel, 0.073 for RC frame, 0.049 for others

* <u>Proposed new BNBC</u>

$V_b = (2/3)\, ZICW/R$, where

$C = S\,[1 + (T_n/T_B)\,(2.5\eta - 1)]$ for $0 \le T_n \le T_B$

$= S\,(2.5\eta)$ for $T_B \le T_n \le T_C$

$= S\,[(2.5\eta)\,(T_C/T_n)]$ for $T_C \le T_n \le T_D$

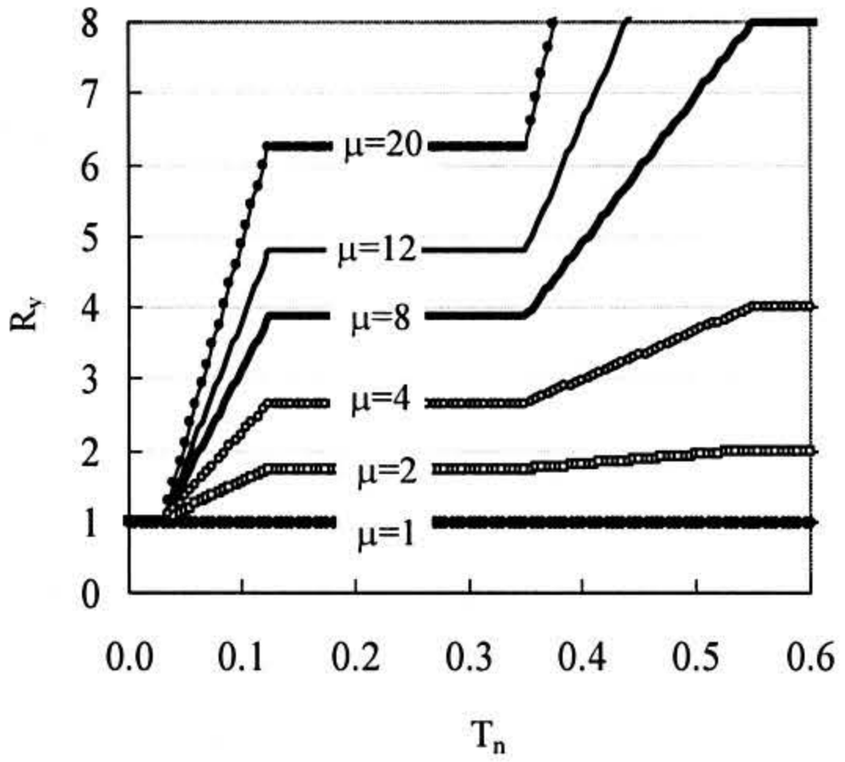
$= S\,[(2.5\eta)\,(T_C T_D/T^2)]$ for $T_D \le T_n$

* $T_n = 0.0466(h_n)^{0.90}$ for RC frames

$= 0.0724(h_n)^{0.80}$ for Steel frames

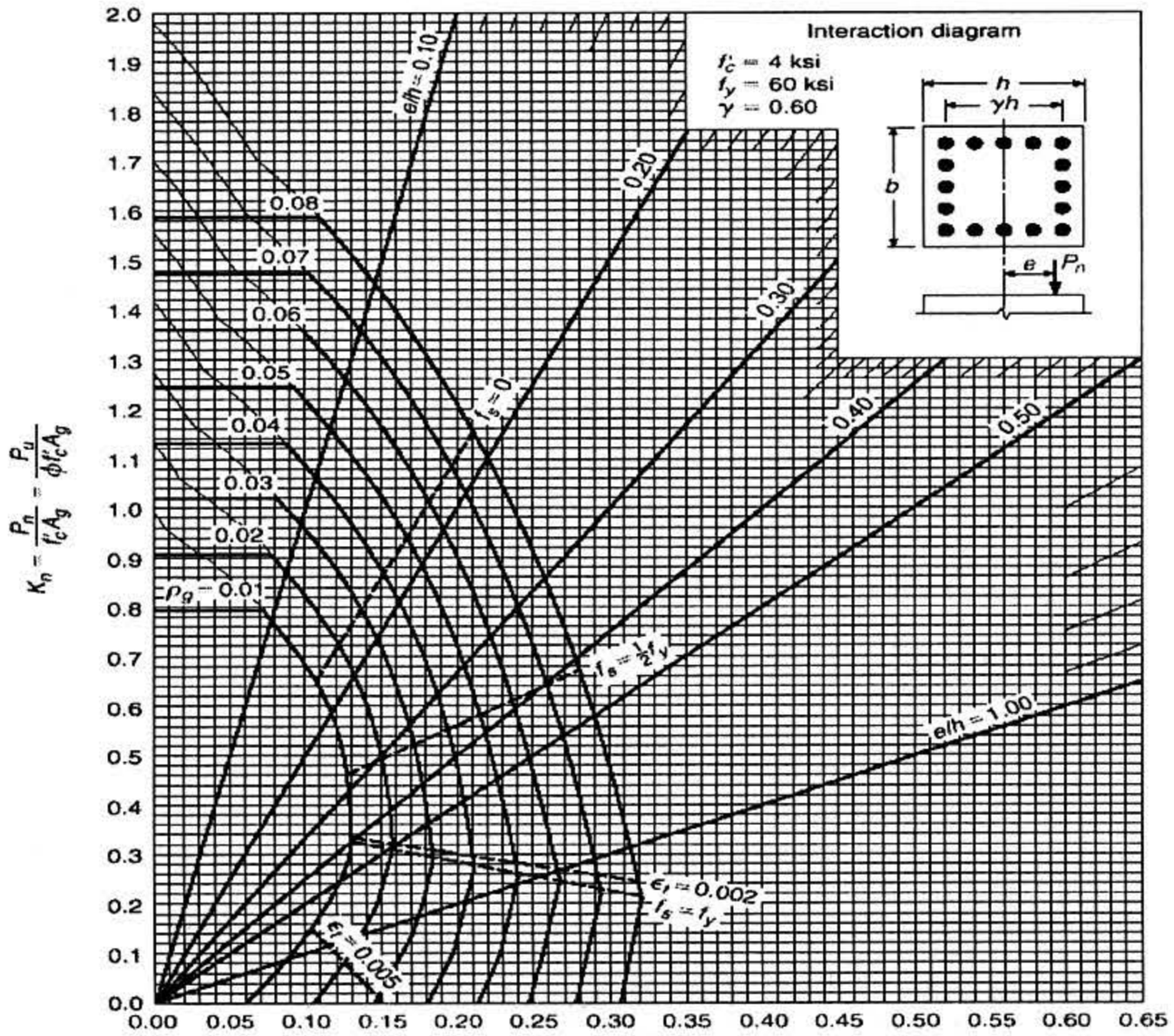
$\eta = \sqrt{\{10/(5+\xi)\}} \ge 0.55$

* $R_y = f_0/f_y \quad \mu = u_m/u_y$



Variation of R_y with T_n

Soil Type	S	T_B	T_C	T_D
SA ($V_s \ge 800$m/s)	1.00	0.15	0.40	2.00
SB	1.20	0.15	0.50	2.00
SC	1.15	0.20	0.60	2.00



* <u>Reinforced Concrete</u>

* $V_{Des} \ge 1.4\, (M_{ul} + M_{u2})/L_n + V_{Ext}$

* For Beam, $a = A_s f_y/0.85 f'_c b$

$M_{ult} = A_s f_y\, (d - a/2)$

* $V_c = 2\sqrt{f'_c}\, bd, \quad S_{max} = A_s f_y d/(V_n - V_c)$

* $\sum M_{c,ult} \ge 1.2 \sum M_{b,ult}$

Seismic Detailing of Web Reinforcement for Axial Members (Major Risk Zone)

Specification	Possible Explanation
Design shear force is the maximum of (a) shear force from analysis, (b) shear force required for flexural yielding of joints	It is desirable that the columns should yield in flexure before failure in shear
For special confinement, area of circular spirals $\geq 0.11\ S_t d\ (f_c'/f_y)(A_g/A_c - 1)$, rectangular hoops $\geq 0.3\ S_t d\ (f_c'/f_y)(A_g/A_c - 1)$	To ensure load carrying capacity upto concrete spalling, taking into consideration the greater effectiveness of circular spirals compared to rectangular hoops. It also ensures toughness and ductility of columns

* Kent & Park (1971) model

$\varepsilon_0 = 0.002$ $\quad \varepsilon_u = \varepsilon_{50u} + \varepsilon_{50h}$ with $\varepsilon_{50u} = (3 + 2f_c')/(f_c' - 1) \times 10^{-3}$

$\varepsilon_{50h} = 0.75\rho_{st}\sqrt{(b_c/S_t)}$ where ρ_{st} = Volumetric ratio of confining hoops to concrete core = Vol_{st}/Vol_{con}

* Flat slab

$M_{ub} = [1/\{1 + 2/3\sqrt{(c_1 + d)/(c_2 + d)}\}]\ M_u$ and $M_{uv} = M_u - M_{ub}$

$v_l = V_u/A_c - M_{uv}\ c_l/J_c$ and $v_r = V_u/A_c + M_{uv}\ c_r/J_c$

where A_c = Area of the critical section

c_l, c_r = Distances from centroid of critical section to the left and right face of section respectively

J_c = Property of critical section analogous to polar moment of inertia

For an interior column, $A_c = d\ [2(c_1 + d) + 2(c_2 + d)]$

$J_c = 2d(c_1+d)^3/12 + 2(c_1+d)d^3/12 + d(c_2+d)(c_1+d)^2/2$

Lateral Drift and Punching Shear

DR = 3.5 – 5.0 VR, if VR ≤ 0.6 and DR = 0.5, if VR > 0.6

where VR is the shear ratio, given by the relation, $VR = V_u/(\phi V_c)$

where V_u is the factored axial force of the column and V_c is the nominal capacity in the absence of unbalanced moment, calculated from

$V_c = (2 + 4/\beta_c)\ \sqrt{f'_c}\ b_o\ d \leq 4\sqrt{f'_c}\ b_o\ d$

Bent-Bar Reinforcement

Limit value of nominal shear strength V_n, calculated at the critical section d/2 from the support face = $6\sqrt{f_c'}\ b_0 d$.

The shear resistance of concrete, $V_c = 2\sqrt{f_c'}\ b_0 d$, and reinforcement must be provided for excess shear above ϕV_c.

The total bar area $A_v = (V_n - V_c)/(f_y \sin\alpha)$

* Brick Masonry

Stiffness of Cantilever and Fixed Wall or Pier (Wall height h, width d, thickness t, E_m = Modulus of elasticity)

$k_c = E_m t/[4(h/d)^3 + 3(h/d)]$ $\qquad k_f = E_m t/[(h/d)^3 + 3(h/d)]$

$X_m = \Sigma(W_i\ X_i)/\Sigma W_i$ and $Y_m = \Sigma(W_i\ Y_i)/\Sigma W_i$

$X_r = \Sigma R_{yi}\ x_i$ and $\bar{Y}_r = \Sigma R_{xi}\ y_i$

Torsional eccentricities are given by $e_x = \bar{X}_m - \bar{X}_r$ and $e_y = \bar{Y}_m - \bar{Y}_r$

$P_{xi} = P_x\ (R_{xi}) \pm P_x\ e_y\ (R_{xi}\ \bar{y}_i\ /J_r)$ $\qquad P_{yi} = P_y\ (R_{yi}) \pm P_y\ e_x\ (R_{yi}\ \bar{x}_i\ /J_r)$

where $\bar{x}$ or $\bar{y}$ are perpendicular distances from center of rigidity to the wall axis and $J_r = \Sigma(R_y\ \bar{x}^2 + R_x\ \bar{y}^2)$ is the polar moment of inertia.

-

	1 STOREY	2 STOREY	≥ 3 STOREY
Total Opening $B_1 + B_2 + B_3$	$\leq 0.5L_1$	$\leq 0.42L_1$	$\leq 0.33L_1$
Distance B_4 between Openings	$\geq 0.5H_2$ for Zone 3, or $0.25H_2$ for Zone 2 (but ≥ 60 cm)		
Distance B_5 of Opening from Corner	$\geq 0.25H_1$, or $0.125H_1$ for Zone 2 (but ≥ 60 cm)		

- Thickness (t) of wall ≥ h/14 for single-storied buildings, h/9 for top story of multistoried buildings, h/20 for other stories of multistoried buildings

* Column-Beam Moment Ratio

The following relationship must be satisfied for beam-column joint $\Sigma M_{pc}^* > \Sigma M_{pb}^*$

Also $M_{pb}^* = M_{pr} + V_{beam}\ (s_h + d_{col}/2)$, and $M_{pc}^* = M_{pc} + V_{col}\ (d_{beam}/2)$

with $M_{pr} = 1.1\ R_y\ M_p$

* Wave Velocity

$v_p = \sqrt{(M/\rho)}$ and $v_s = \sqrt{(G/\rho)}$,

where M = p-wave Modulus = $E(1-\nu)/[(1+\nu)\ (1-2\nu)]$, and G = Shear Modulus = $E/[2(1+\nu)]$