University of Asia Pacific
Department of Civil Engineering
Mid-Term Examination, Spring 2024
Program: B.Sc. in Civil Engineering

Course Title: Structural Engineering X	Course Code: CE 425
Time: 1 hour	Credit Hour: 2.0 Full Marks: 20

Question 1: [4]

Explain the hydration of four main compounds of cement and their effects on strength development of concrete.

Question 2: [4]

Discuss the working mechanism of Superplasticizer in fresh concrete.

Question 3: [4]

Distinguish the features between ready-mix concrete and site-mix concrete.

Question 4: [3+5]

A cement with a Silica ratio of 2.65, Alumina ratio of 1.55, Hydraulic modulus of 2.0 and Lime saturation factor of 0.95 is selected. Determine the missing oxide percentages and comment of the properties of cement in terms of strength, heat of hydration, setting time.

Oxides	Content (%)
Cao	?
SiO_2	22.0
Al_2O_3	7.25
Fe_2O_3	?
SO_3	?

Given:

$$\text{Silica ratio:} \quad \frac{\%\ SiO_2}{\%\ Al_2O_3 + \%\ Fe_2O_3}$$

$$\text{Alumina modulus:} \quad \frac{\%\ Al_2O_3}{\%\ Fe_2O_3}$$

$$\text{Hydraulic Modulus} = \frac{\%\ CaO}{\%\ SiO_2 + \%\ Al_2O_3 + \%\ Fe_2O_3}$$

$$\text{Lime Saturation Factor :} \quad \frac{\%CaO - 0.7\ (\%SO_3)}{2.8(\%SiO_2) + 1.2(\%\ Al_2O_3) + 0.65(\%Fe_2O_3)}$$

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Department of Civil Engineering
Mid-Term Examination, Spring 2024
Program: B.Sc. in Civil Engineering

Course Title: Environmental Engineering V   Course Code: CE 435
Time: 1 hour   Credit Hour: 2.0   Full Marks: 30

1   a.   What are the crucial factors for sustainable development?   [3]

    b.   Explain how political, social and environmental factors in different societies   [7]
and regions may slow down development.

2   a.   Explain how the Human Development Index (HDI) reflects the development   [6]
status of a country. What are its strengths and limitations in representing a
nation's development?

    b.   Given a country with a high HDI but significant environmental challenges,   [4]
analyze how well the HDI represents its development status. Apply your
understanding of HDI to suggest additional factors that should be considered?

3   a.   Identify the role of civil engineers in implementing the goals and targets of   [5]
SDG.

    b.   Explain the biggest challenges that the civil engineers face in Bangladesh   [5]
while working towards the SDGs.

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Fe_2O_3	?
SO_3	?

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$$\text{Hydraulic Modulus} = \frac{\% \, CaO}{\% \, SiO_2 + \% \, Al_2O_3 + \% \, Fe_2O_3}$$

$$\text{Lime Saturation Factor :} \frac{\% CaO - 0.7 \, (\% SO_3)}{2.8(\% SiO_2) + 1.2(\% \, Al_2O_3) + 0.65(\% Fe_2O_3)}$$

University of Asia Pacific
Department of Civil Engineering
Mid-Term Examination, Spring 2024
Program: B.Sc. in Civil Engineering

Course Title: Structural Engineering VI
Time: 1 hour

Credit Hour: 2

Course Code: CE 417
Full Marks: 40

QUESTION 1

(i) With neat sketches, explain the load transfer mechanism of snug-tight and slip-critical connections.　　[6]

(ii) With a neat sketch, explain the shear lag effect in a tension steel member. Explain the strategy taken by the AISC to incorporate the effect of shear lag in the design of tension member.　　[4+2]

QUESTION 2

A 25-ft-long A572 Grade 50 (F_u = 65 ksi) steel tension member needs to resist a service dead load of 60 kips and a service live load of 105 kips. The short leg of the tension member is connected to a gusset plate using 6 nos. 5/8 -in bolts with standard holes as shown in **Figure 1**. Select the lightest channel section from the following table to resist the loads. Assume that the gusset plate has adequate strength in tension, and U = 0.80 for preliminary calculation (revise this value after selecting the section). Neglect block shear failure mode and follow **AISC-ASD** method.　　[14]

Shape	A_g (in^2)	$\bar{x}$ (in)	$\bar{y}$ (in)	r_x (in)	r_y (in)	r_z (in)
L6x4x7/8	8.00	1.12	2.12	1.86	1.10	0.86
L8x6x3/4	9.99	1.56	2.55	2.52	1.75	1.29
L7x4x3/4	7.74	1.00	2.50	2.21	1.08	0.85
L8x4x3/4	8.49	0.95	2.94	2.55	1.05	0.85
L8x6x1/2	6.80	1.46	2.46	2.55	1.79	1.30

Figure 1

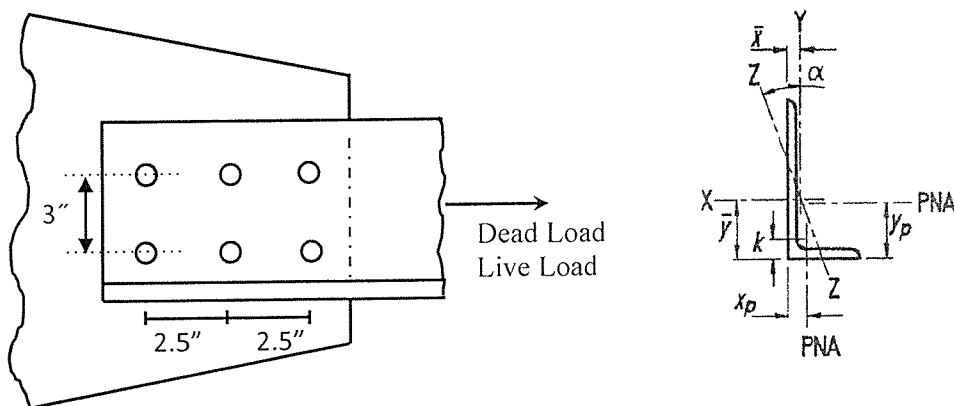## QUESTION 3

Figure 2 shows an eccentrically loaded bolt group where 7/8-inch-diameter A325 (F_{by} = 90 ksi, F_{bu} = 120 ksi) bolts are used. Calculate the shear forces on the bolts by using [14] elastic method, and check whether the bolts are adequate to resist the maximum shear. Assume single shear plane for the calculation, and follow **AISC-LRFD** approach.
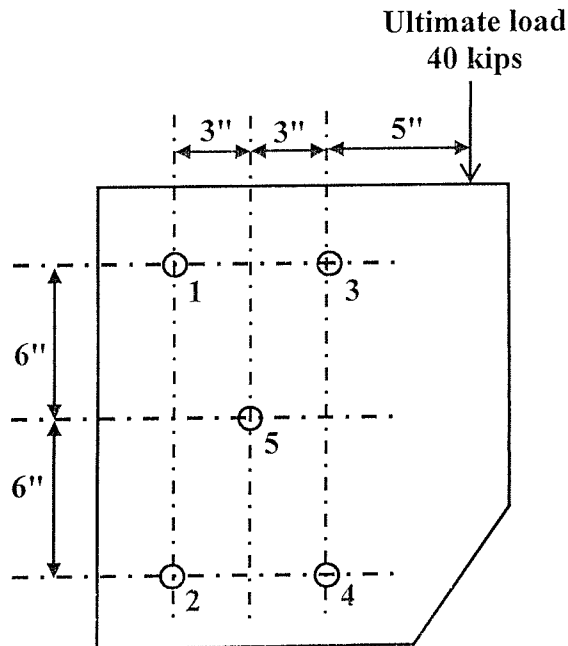

**Ultimate load
40 kips**

Figure 2

Formula

1. $R_n = mA_bF_{nv}$

2. $R_n = 0.6F_yA_{gv} + U_{bs}F_uA_{nt}$

3. $R_n = 0.6F_uA_{nv} + U_{bs}F_uA_{nt}$

4. $R_n = 1.5L_ctF_u \leq 3.0dtF_u$

5. $R_n = 1.2L_ctF_u \leq 2.4dtF_u$

6. $R_n = 1.0L_ctF_u \leq 2.0dtF_u$

7. $R_x = \dfrac{My}{\Sigma d^2}$ and $R_y = \dfrac{Mx}{\Sigma d^2}$

University of Asia Pacific
Department of Civil Engineering
Mid Semester Examination Spring 2024 (Set 2)

Course #: CE 423   Course Title: Structural Engineering IX
Full Marks: 40 (= 4 × 10)   Time: 1 hour

[Given: $\underline{R_0}$ = Last two digits of Reg. #, $E_c = (4000 + 10R_0)$ ksi, $f_c' = E_c/1000$, $f_y = 20f_c'$, $L = (18 + 0.1R_0)$ ft]
All beam and column sections are shown in Fig. 0

1. Fig. 1 shows frame *ASayed* with beams (*AS*, *ay*, *ed*) carrying loads $w_1 = w_2 = w_3 = (7 + 0.03R_0)$ k/ft.

   Use BNBC-1993 (for soil S_I at Dhaka) and BNBC-2020 (for soil S_A at Rangpur) to calculate the Elastic base shear (V_{be}) and seismic force (F_1, F_2 and F_3) at each storey level.

2. Fig. 2 shows frame *Mugdho* with beams (*Mu*, *gd*, *ho*) having masses $m_1 = m_2 = (2 + 0.01R_0)$ k-s^2/ft and $m_f = 0$, supported by column *Mg* and brick masonry wall *gh* (of width = $L/3$, thickness = $10''$, $E_m = 0.7E_c$).

   Determine the (a) First natural frequency and first modal shape of the frame
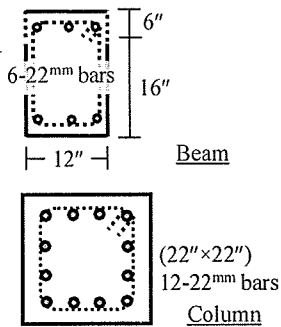   (b) Required tie spacing of column *Mg* to resist *Soft Storey failure*.
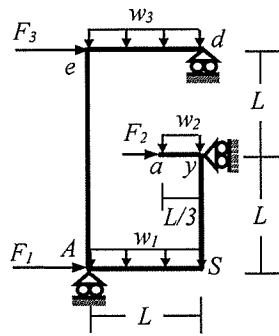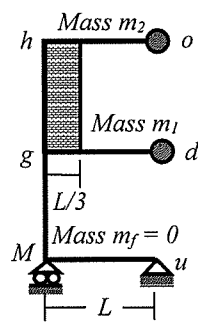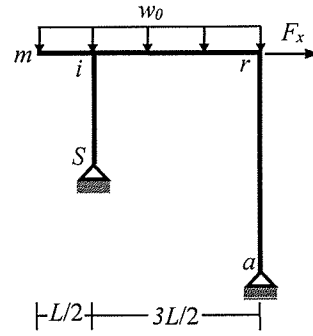
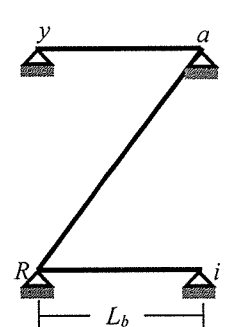

Fig. 0   Fig. 1   Fig. 2   Fig. 3   Fig. 4

3. Fig. 3 shows frame *Samir* with beam *mir* carrying load $w_0 = (7 + 0.03R_0)$ k/ft, supported by columns *Si* and *ar*.
   (a) Determine the lateral Stiffness and natural frequency of the frame
   (b) Calculate the Elastic base shear (equal to F_x) as well as shear force for each column of the frame
   (c) Design the column *Si* to survive *Short Column Effect*.

4. (i) Each 762 Bullet releases energy $(16 + 0.1R_0)$ kJoule. Assuming $[(10 + 0.1R_0) \times 10^3]$ such bullets were fired on the participants of *Anti-Discrimination Movement* (বৈষম্যবিরোধী আন্দোলন)
   (a) Calculate Moment Magnitude and Seismic Moment of an earthquake releasing the same energy.
   (b) Use Milne-Davenport equation to determine the PGA for this earthquake, assuming epicentral distance of $(80 + 0.1R_0)$ meters.

   (ii) (a) Determine the recommended minimum length L_b of the beams in frame *Riya* (Fig. 4).
   Explain why the beam length(s) should not be smaller than L_b.
   (b) For the beam length L_b determined in (a), calculate the length of column *Ra* as well as the length L_0 within the column. Explain why special confinement is required for the length L_0.

Course Title: Environmental Engineering IV   Course Code: CE 433

Time: 1 hour   Credit Hours: 2.00   Full Marks: 40

(There are FIVE questions. You must answer all the questions.)

1. A sample of sewage at 28°C is mixed with 260 mL dilution water to fill a 300 mL BOD bottle. Initial DO is 8.8 mg/L and DO after 5 days is 1.9 mg/L. For a BOD bottle filled with only dilution water, initial DO is 9.0 mg/L and after 5 days DO is 8.1 mg/L.   **[3+5]**

   i. Calculate BOD of sewage.
   ii. If the BOD rate constant at 20°C is 0.23 day^{-1}, calculate the ultimate CBOD of the sewage at 28°C.

2. Consider a lake of an area which has been used for water supply and recreation. After conducting water quality tests on the lake water samples, high values of nitrogen and phosphorus have been detected. Besides, the BOD and COD values of the sample water were found as 240 mg/L and 310 mg/L respectively.   **[5+2]**

   i. Explain the problems caused by the water quality of the lake.
   ii. Decide on the possible treatment method that can be applied on the lake water by considering BOD/COD ratio.

3. Explain "Aerobic" and "Anaerobic" decomposition with necessary equations.   **[5]**

4. A 1,500 MW coal-fired plant converts 40% of the coal's energy into electrical energy. The other 60% of the energy content of the fuel is rejected to the environment as waste heat. About 20% of the waste heat goes to the atmosphere, up the smokestack, and cooling water is required to remove the remaining 80% of the waste heat to prevent the power plant from overheating. The cooling water is drawn from a nearby river with an upstream flow of 150 m³/s and a temperature of 18°C. If the heated cooling water is discharged into the same river, determine the river temperature just after the discharge point.   **[5]**

5. A lake with a surface area of 100 x 106 m² is fed by a stream having a flow rate of 20 m³/s with 0.01 mg/L phosphorus. Effluent from a wastewater treatment plant also discharges into the lake. The effluent flow rate is 0.5 m³/s, and its phosphorus concentration is 8 mg/L Furthermore, agricultural runoff adds on average 0.2 g/s phosphorus into the lake.

   a) If the phosphorus settling rate is 10 m/yr, calculate the average phosphorus concentration in the lake and comment on the occurrence of "Algal Bloom".   **[4+1]**

   b) Estimate the amount of additional phosphorus removal required at the treatment plant to keep the lake's phosphorus concentration in the lake below 0.010 mg/L.   **[5]**

   c) Discuss the pollution control measures you will take to manage the water quality in the lake.   **[5]**

Course Title: Project Planning and Management	Course Code: CE 401
Time: 1 hour	Credit Hour: 3.00	Full Marks: 20

1. A construction project has an initial cost of $500,000, and the annual operating costs for the next 5 years are expected to be $40,000 (discount each year's operating costs using the 8% discount rate). The project is expected to generate the following benefits over 5 years:

   - Year 1: $150,000
   - Year 2: $160,000
   - Year 3: $170,000
   - Year 4: $180,000
   - Year 5: $190,000

The discount rate is 8%. Calculate the Benefit-Cost Ratio (BCR) for this project and decide whether the project should be accepted or rejected. [4]

2. A project requires an initial investment of $400,000 and has the following cash inflows:

   - Year 1: $120,000
   - Year 2: $150,000
   - Year 3: $180,000
   - Year 4: $220,000

The discount rate is 10%. Calculate the Payback Period (PBP), accounting for the time value of money (i.e., discount each year's cash flow using the discount rate). How long does it take for the project to break even when considering the discounted cash flows? [4]

3. Two mutually exclusive projects, A and B, are being considered by a company:
   - **Project A:**
     Initial investment: $200,000
     Cash inflows for the next 4 years: $70,000 annually
     Discount rate: 12%
   - **Project B:**
     Initial investment: $250,000
     Cash inflows for the next 4 years:
     - Year 1: $50,000
     - Year 2: $80,000
     - Year 3: $90,000
     - Year 4: $120,000
       Discount rate: 12%

(a) Calculate the Net Present Value (NPV) for both Project A and Project B. [3]
(b) Determine which project has the higher Internal Rate of Return (IRR). [2]
(c) Based on your findings, which project should be selected? Explain the rationale. [1]

4. (a) Write down characteritics of a project? [2]
   (b) What are the key differences between project and operation? [2]
   (c) What is project life cycle? Provide an example of a construction project life cycle with multiple phases. [2]

or

5. Enterprise Environmental Factors and Organizational Process Assets are key influencing factors for a project. You are managing a construction project.
   (a) Based on PESTLE identify six influencing factors for your construction project. [2]
   (b) What is triple bottom line? [2]
   (c) Write some characteristics of Agile Life Cycle. [2]