University of Asia Pacific
Department of Civil Engineering
Final Examination, Spring 2025
Program: MSc in Civil Engineering

Course Title: Earthquake Damage Repair and Retrofitting | Course Code: CE 6714
Time: 3 hours | Credit Hour: 3.00 | Full Marks: 100

Answer all the questions

QUESTION 1 [20 MARKS]

a. State the debonding mechanisms of externally bonded CFRP laminate for flexural and shear strengthening of RC beam. Select the appropriate anchor system and method to elimante the debonding failures, justify the selection through analysis of debonding mechanisms of laminate. [10]

b. A multi-storeyed RC frame structure need to be evaluated for seismic load. A particular beam of that structure having 5-20 mm flexural reinforcement at support (top bar) with the dimension of 300 mm x 700 mm and 2-legs 10 mm shear link of 150 mm spacing, designed based on the provision of previous code without consideration of seismic load. After seismic evaluation of the structure as per BNBC 2020, the total design moment at support and shear force of that beam is 600 kN.m and 400 kN respectively, evaluate whether the beam could sustain the new moment and shear force. The concrete strength of the existing beam is 24 MPa, the steel grade is 420 MPa. [10]

QUESTION 2 [20 MARKS]

Design flexural and shear retrofitting of the beam stated in **Question 1 (b)** for the new design moment and shear force using externally bonded CFRP laminate (for flexure) and CFRP wrap (for shear).

QUESTION 3 [20 MARKS]

The floor slab layout plan of an existing 9-storeyed residential apartment (live load is 2 kN/m^2) is shown in **Figure 1**. The building is located at city centre of Dhaka; has been constructed with frame structure and it carries 3 kN/m^2 dead load due to random wall and floor finishes.

Analyze the frame (grid-2, short direction) of the structure using portal method for seismic load only in accordance to BNBC 2020 to obtain the **moment and shear force** of column "C1" at ground floor; **hogging (negative) moment and shear** force of the beam "B1" in beam-column joint at 8th floor (roof floor) of the structure as shown in **Figure 1**. The slab thickness could be assumed as 175 mm. Shallow foundation has been provided on topsoil (SPT value is 10). The information related to seismic analysis of structure in Accordance to BNBC 2020 are provided in **Appendix**, assume required data to calculate the seismic load and analyse the structure.

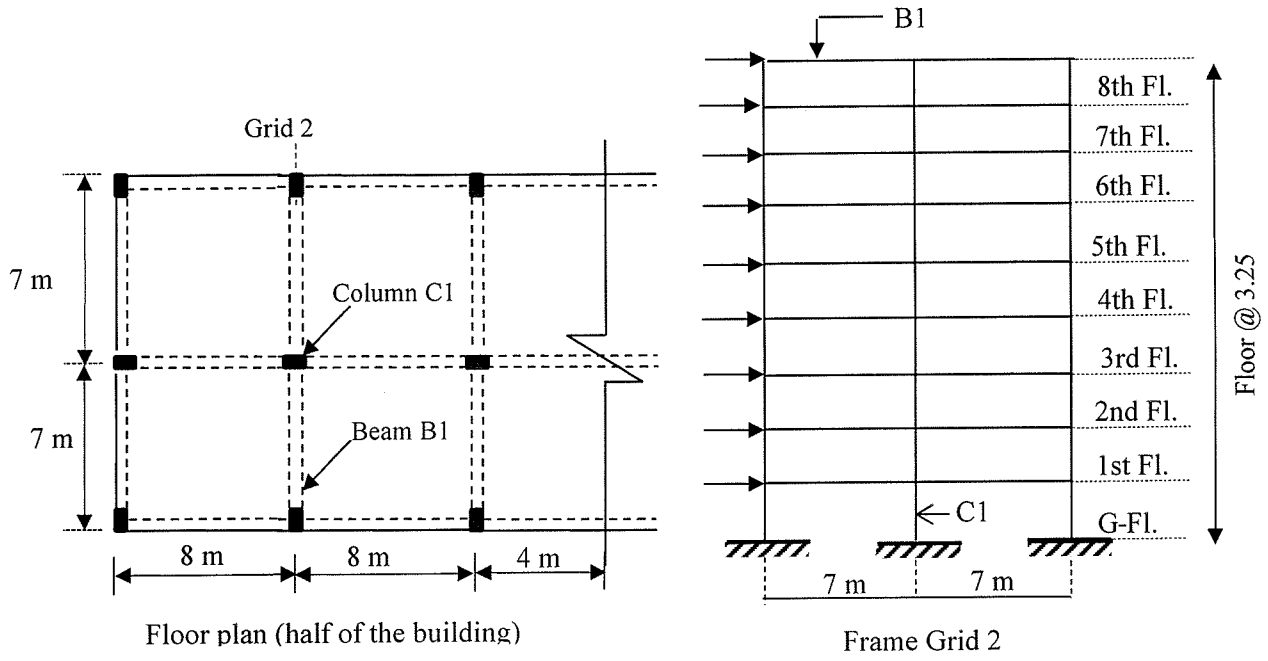

Figure 1: Floor Layout Plan and elevation of 9 Storeyed Apartment

QUESTION 4 [20 MARKS]

The ground floor column (C1) of the existing structure of **Question 3** as shown in **Figure 1** has been designed for axial compression and bending moment with the dimension of 500 mm x 750 mm and 16-20 mm steel reinforcement. 4-legs 10 mm tie bar with the spacing of 200 mm c/c has been used for detailing requirements of column. The yield strength of 10 mm tie bar is 275 N/mm^2. Smaller dimension of column (500 mm) along the short direction of the structure as shown in **Figure 1** is critical for shear design. Evaluate whether the column could sustain the shear force (depth of column is 500 mm) due to seismic load. Design the column for shear retrofitting (Jacketing) using externally bonded steel plate. Concrete strength of the existing column is 24 N/mm^2. Assume required data for retrofit design. [20]

QUESTION 5 [20 MARKS]

The beam "B1" at 9th floor (roof floor) of the structure stated in **Question 3** has been designed as 300 mm x 600 mm with 5-20 mm flexural top reinforcement for hogging moment at support due to gravity load. The support moment of the beam could be considered as 300 kN.m due to gravity load. After seismic evaluation, the total design support moment of the beam would be increased. Evaluate whether the beam could sustain the increased moment due to seismic and gravity loads. Design the beam for flexural retrofitting using externally bonded steel plate for the increased moment. As per the non-destructive test, the concrete strength of the existing beam is 25 N/mm^2.

APPENDIX

$$V = S_a W$$

$$S_a = \frac{2}{3}\frac{ZI}{R}C_s$$

$$F_x = V\frac{w_x h_x^{\,k}}{\sum_{i=1}^{n} w_i h_i^{\,k}}$$

Dhaka, Z is 0.2

$$T = C_t(h_n)^m$$

$$C_s = S\left(1+\frac{T}{T_B}(2.5\eta - 1)\right) \text{ for } 0 \le T \le T_B$$

$$C_s = 2.5S\eta \quad \text{for } T_B \le T \le T_C$$

$$C_s = 2.5S\eta\left(\frac{T_C}{T}\right) \text{ for } T_C \le T \le T_D$$

$$C_s = 2.5S\eta\left(\frac{T_C T_D}{T^2}\right) \text{ for } T_D \le T \le 4\text{sec}$$

	R
5. Intermediate reinforced concrete moment frames	5

SD Deposits of loose-to-medium cohesionless soil (with or without some soft cohesive layers), or of predominantly soft-to-firm cohesive soil. < 180 < 15

Table 6.2.16: Site Dependent Soil Factor and Other Parameters Defining Elastic Response Spectrum

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

Table 6.2.20: Values for Coefficients to Estimate Approximate Period

Structure type	C_t	m
Concrete moment-resisting frames	0.0466	0.9
Steel moment-resisting frames	0.0724	0.8
Eccentrically braced steel frame	0.0731	0.75
All other structural systems	0.0488	0.75

All buildings and other structures except those listed in Occupancy Categories I, III and IV	II

Table 6.2.17: Importance Factors for Buildings and Structures for Earthquake design

Occupancy Category	Importance factor I
I, II	1.00
III	1.25
IV	1.50

University of Asia Pacific
Department of Civil Engineering
Final Semester Examination, Spring 2025
Program: M.Sc. in Civil Engineering

Course Title: River Engineering | Course Code: CE 6609
Time: 3 hours | Credit Hour: 3.00 | Full Marks: 150

SECTION 'A'
Answer Any THREE questions

QUESTION 1 [25 MARKS]

a. Write down all the bed form names with sketches and classify those bedforms according to Flow regime. [8]

b. Write down the characteristics of 'Ripple' bed form. Describe the effect of bedforms on roughness, discharge and depth relationship. [8]

c. Write down the six unit processes related to Bar dynamics. Describe the process of Bar form development with sketches. [9]

QUESTION 2 [25 MARKS]

a. What are point bars? Describe the causes of meandering of a river with neat sketches if needed. [8]

b. What are the main causes of failure of an earthen levee. Write down the design criteria for an earthen levee. [8]

c. Write down the characteristics of the following river types: i) Anastomosing rivers ii) Braided rivers iii) Glacial rivers. [9]

QUESTION 3 [25 MARKS]

a. What is Tidal River Management (TRM). How TRM can help to reduce water logging issue in Southern part of Bangladesh? [8]

b. What does it mean by regime channel? Distinguish between "Bankful discharge" and "Design discharge". [8]

c. Answer the following questions: i) Briefly explain what will happen to the river bed if at a section river *sediment size* is increased ii) Briefly explain what will happen to the river bed if at a section river *channel slope* is increased. [9]

QUESTION 4 [25 MARKS]

a. Classify river training works based on the purposes. Briefly describe temporary river improvement methods. [8]

b. Briefly describe methods to control sediment in a reservoir. Distinguish between Riprap and Pitched Stone. [8]

c. Calculate the thickness and length of a launching apron in a guide bank protection at the nose section for the following given data of a river. i) Maximum discharge is 7,500 m^3/sec ii) Elevation of River Bed level: 100 m iii) Highest Water Level: 104.5 m iv) d_{50} of the sediment particle is 0.15 mm. Assume any missing data if needed. [9]

SECTION 'B'
Answer Any THREE questions

QUESTION 5 [25 MARKS]

a. What are the main causes of floods in Bangladesh? Write down the names of all structural measures to control flood. [8]

b. How Reservoir and Channel Improvement help to reduce flood? Explain. [8]

c. What are the objectives of Seepage analysis and slope stability analysis in designing an earthen levee? [9]

QUESTION 6 [25 MARKS]

a. What are the challenges in flood forecasting? What are the different methods for flood proofing? [8]

b. What is flood resilience? What does it mean by living with the flood? [8]

c. What are the factors affecting flood hazard? Distinguish between flood risk and vulnerability. [9]

QUESTION 7 [25 MARKS]

a. What does Ecoregion or Habitat mean? What are the bio-indicators for a good habitat? [8]

b. Describe the importance of wetlands of Bangladesh in context of bio-diversity and river basin management. [8]

c. What is instream flow? What are the different methods to estimate instream flow of a river? [9]

QUESTION 8 [25 MARKS]

a. Distinguish between policy of first order and policy of second order. What are the processes for dispute settlement? [8]

b. What are the different sources of International Water laws? Write down the Five principles of International Water Laws. [8]

c. Write down the salient features of Ganges Treaty. Explain the strengths and limitations of the Ganges Treaty. [9]

University of Asia Pacific
Department of Civil Engineering
Final Examination, Spring 2025
Program: M.Sc. in Civil Engineering

Course Title: GIS and Remote Sensing in Transportation | Course Code: CE6513

Time: 3 hours | Credit Hour: 3 | Full Marks: 100

All questions are mandatory. Numbers in parentheses indicate marks assigned to each.

1. Environmental modeling
   a. Name the broad areas of environmental modeling where GIS can be used. (5)
   b. Write the full name of the following: (5)
      i. NDVI
      ii. NDWI
      iii. NDMI
      iv. NDSI
   c. What does EIA stand for? Draw a flow chart to describe the process of EIA, showing the following activities in proper sequence (10)
      i. Impact modeling
      ii. Informed decision making
      iii. Analyzing alternatives
      iv. Human intervention
      v. Establishing baseline condition

2. Transportation planning
   a. Name the broad areas of urban and transportation planning where GIS can help. (5)
   b. Draw a flow chart of how GIS can help in efficient urban waste collection. (10)
   c. Draw a diagram to explain the method of service area delineation of an urban facility (such as a hospital) (5)

3. Urban and land use planning
   a. How does GIS help in urban growth modeling? Write 5 points only (no need to explain) (5)
   b. List 5 areas where GIS can be used for land use planning (bullet points only) (5)
   c. Suppose I want to find out the change in land use of an area over the last 30 years. However, no land use survey was conducted in that area. How can I determine the land use changes over time? (10)

4. Public health
   a. List 5 areas of public health management where GIS can help (bullet points only, no need to write details). (5)
   b. Write 5 points to explain how GIS combines public health with epidemiology. (5)
   c. Draw a diagram to explain how GIS helps in identifying gaps in healthcare facilities in an urban area (10)

5. Disease management
   a. List 5 broad areas where GIS can help in disease outbreak management. (5)
   b. Draw a flow chart showing an outbreak investigation and monitoring policy (10)
   c. Draw a flow chart showing the use of GIS in health intervention planning (5)

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Course Title: Soil Dynamics | Course Code: CE 6407
Time: 3 hours | Credit Hour: 3.0 | Full Marks: 100

(Answer all questions)

1. Explain the importance of studying *Soil Dynamics* with examples. [5]

2. Define: *Time period, Amplitude, Natural frequency.* [5]

3. In an SDOF system, the damping coefficient 'c' is given as 1265 N.s/m. If the damping force 'F_d' is 600 N, what is the velocity 'v' of the mass? [5]

4. The natural frequency of a 500 kN structure is 200 rpm. An external vibratory force is applied to this structure with a frequency of 250 rpm. What should be the damping ratio of the structure to ensure the *transmissibility*, T value of 1? [5]

Note: $T = \dfrac{\sqrt{1+\left(2\zeta\left(\frac{\omega}{\omega_n}\right)\right)^2}}{\sqrt{\left(1-\left(\frac{\omega}{\omega_n}\right)^2\right)^2+\left(2\zeta\left(\frac{\omega}{\omega_n}\right)\right)^2}}$

5. Free vibration of a particle is represented by the *simple harmonic motion*. For that particle, if the maximum velocity is 100 mm/s and maximum acceleration is 2 m/s^2, compute the amplitude of displacement, natural frequency and natural period of the vibration. [5]

6. A 10 kg mass is attached to a spring with a stiffness of 4000 N/m and allowed to vibrate on a frictionless surface. Determine the natural frequency in rad/s, and the natural period of the vibration. [5]

7. A 5 kg mass is attached to a spring with stiffness 2000 N/m and a damper with damping coefficient 'c'. The mass is displaced and released from rest. (a) If c = 50 Ns/m, calculate the damping ratio and determine whether the system is underdamped, critically damped, or overdamped. (b) Find the value of 'c' that makes the system critically damped, (c) If c = 300 Ns/m, calculate the damping ratio and determine the type of damping. [10]

8. A mass–spring system consists of a mass m = 5 kg attached to a spring with stiffness k = 2000 N/m. The mass is displaced 0.05 m downward from its equilibrium position and then released from rest. Determine: (a) The natural frequency of vibration in rad/s and Hz, (b) The equation of motion for the system, (c) The maximum velocity and maximum acceleration of the mass during vibration. [10]

Note: $u(t) = u_o\, cos(\omega_n t) + \dfrac{\dot{u_o}}{\omega_n} sin\,(\omega_n t)$

9. What are the laboratory and field tests that are performed to determine dynamic soil properties? Briefly describe the SASW test. [10]

10. What is liquefaction? Which factors influence liquefaction susceptibility? How do we calculate the factor of safety against liquefaction? [10]

11. How can we improve the strength of liquefiable soil? Discuss the vibro-compaction method and its effect to mitigate liquefaction. [10]

12. What is vibration isolation using wave barrier? Briefly discuss active and passive isolation methods. [10]

13. What are the different types of earthquake waves? Briefly describe *Rayleigh* wave. [10]