

University of Asia Pacific
Department of Civil Engineering
Final Examination Spring 2023
Program: MSc in Civil Engineering

Course Title: Earthquake Damage Repair and Retrofitting
Time: 3 hours

Credit Hour: 3.00

Course Code: CE 6714
Full Marks: 100

QUESTION 1 [20 MARKS]

- a. A multi-storeyed reinforced concrete frame structure of an office building is located at city centre of Dhaka. The structure is required to be retrofitted for seismic load because of upgradation of BNBC. Propose the most effective strengthening / retrofitting methods of beam (flexural, shear) and column (shear) of the structure, justify the effectiveness of those methods through analysis the drawback of the system. [10 Marks]
- b. A particular beam of the structure having 5-20 mm flexural reinforcement at support (top bar) with the dimension of 300 mm x 750 mm and 2-legs 10 mm shear link of 125 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 650 kN.m and 450 kN respectively, evaluate whether the beam could sustain the new moment and shear force. The concrete strength of the existing beam is 20 MPa, the steel grade is 420 MPa. [10 Marks]

QUESTION 2 [20 MARKS]

Design flexural and shear retrofitting of the beam stated in **Question 1 (b)** for the new design moment (or recommended moment capacity) and shear force using externally bonded steel plate. [20 Marks]

QUESTION 3 [20 MARKS]

The floor slab layout plan (symmetric half) of an existing 9-storeyed office (live load 2.4 kN/m²) building 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/m² dead load due to random wall and floor finishes.

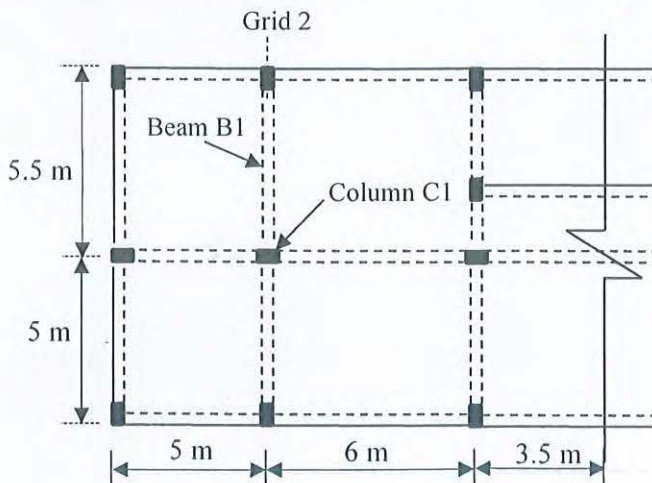


Figure 1: Floor Layout Plan of 9 Storeyed Medical Institute (Half of the floor plan)

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 at ground floor roof) as shown in **Figure 1**. The slab thickness is 175 mm. Shallow foundation has been provided on topsoil (SPT value is 10). Assume required information to calculate seismic load and analyse the structure. The required information of seismic load (BNBC) as shown in the attachment. [20 Marks]

QUESTION 4 [20 MARKS]

The **beam B1** of the structure stated in **Question 3** has been designed as 300 mm x 750 mm with 5-20 mm flexural top reinforcement for hogging moment at support due to gravity load. The support moment could be considered as 370 kN.m at gravity load. After seismic evaluation, the total design support moment 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 CFRP laminate for the increased moment (or recommended maximum design moment). As per the non-destructive test, the concrete strength of the existing beam is 24 N/mm². [20 Marks]

QUESTION 5 [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 900 mm and 16-25 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/mm². Smaller dimension of column (500 mm) is along the critical direction of the structure as shown in Figure 1. 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 CFRP wrap. Concrete strength of the existing column is 24 N/mm². Assume required data for retrofit design. [20 Marks]

Spring 2023

Final Exam

CE 6315: Faecal Sludge Management

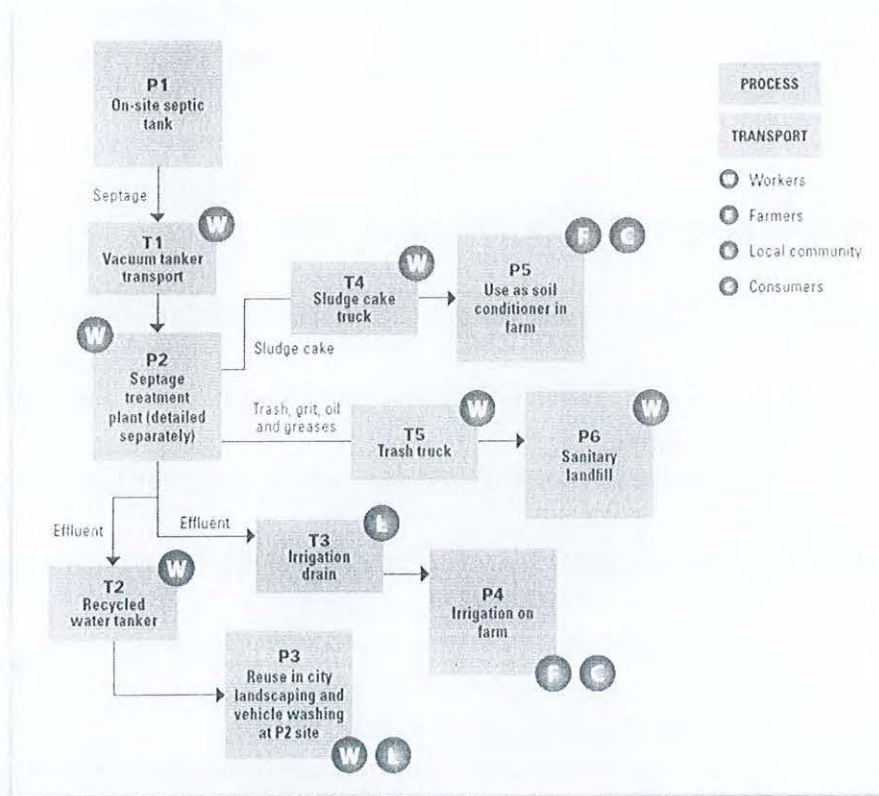
Marks: 50

Time: 3:00 hour

(The index mentioned in the parenthesis indicates marks)

Instruction: Please assume any data/information, if missing.

1. A municipality treats faecal sludge and septage through different solid and liquid treatment units of FSM. The municipal authority wants to develop a sanitation safety plan (SSP) to secure public health. They have identified all the actors for developing the SSP with a boundary of the Faecal Sludge Treatment Plant and finally produces the process flow diagram of SSP at below:



Prepare the risk assessment table mentioning hazard, hazardous event, route of exposure, exposure groups with the analyzed risks as high (H), Medium (M) and Low (L) to prepare the SSP

of the municipality with the stated process flow diagram. Assume any relevant data for analyzing the risks, if missing here. (10)

2. 200 m³/day faecal sludge needs to be discharged into a faecal sludge treatment plant with planned operation of 5 days a week. The treatment plant will be open 8 hours a day, and has a peak flow of 20 m³/h. The faecal sludge is discharged into the settling-thickening tank during one working week (5 days). The incoming faecal sludge has an average TSS of 6 g TSS/L, and thickened TSS concentration of 60 g TSS/L. The Sludge Volume Index (SVI) is calculated as 35.1 mL/g. Given the condition of the settling efficiency of 85% and a settling velocity of 0.5 m/h. Calculate the required surface area and tank dimensions for the settling-thickening tank. [The design scum layer is 0.4m. Assume any data, if missing] (8)

3. Calculate the area of land requirement for drying the sludge from digestion tank for 50,000 population designed. Sludge content/capita/day is 0.075 kg. Moisture content is 90%, specific gravity is 1.02, 355 of digester volume is daily filled with fresh sludge. Based on the available information, design the Unplanted Drying Bed to treat Faecal Sludge. Assume any data, if missing. (8)

4. Answer any six questions from the followings questions. (4X6=24)

- a) What do you understand by Faecal Sludge Management (FSM)? Enumerate the different options of FSM?
- b) What is Settling Thickening Tank to treat Faecal Sludge? What are the advantages and limitations of Settling Thickening Tank?
- c) What is Citywide Inclusive Sanitation (CWIS) approach? Describe the functions and outcome of CWIS approach?
- d) What is Shit Flow Diagram (SFD)? States the objectives of SFD. What are the advantages and limitations of SFDs?
- e) Mention the advantages and limitations of deep row trench method of FSM.
- f) What is decentralized wastewater treatment system? Briefly enumerate the functions of each components of decentralized wastewater treatment system
- g) Enumerate the advantages and limitations of Unplanted Drying Bed to treat faecal sludge.
- h) Difference between Horizontal Flow and Vertical Flow in designing constructed wetland to treat faecal sludge.

University of Asia Pacific
Department of Civil Engineering
Final Examination, Spring 2023 Semester
Program: Master of Science in Civil Engineering

Course code: CE 6615

Course title: Development of water resources project

Time: 3 hours

Total marks: 50

Answer all questions

1. Government is planning to fill an existing wetland located in Farmgate (Dhaka) area to build a hospital to ensure health services to the local people. However, there are concerns that the project will have many negative effects as well including increase of waterlogging in the area, lowering of the groundwater table and reducing biodiversity in the area etc. as this is the only remaining wetland in the area.

Prepare a brief feasibility report for this project (maximum 3 pages). (10)

2. To conduct *scoping* of the project mentioned in question number 01, prepare the following: a. long list of concerns; b. a short list of key issues and problem areas based on their potential significance and likely importance for decision-making on the proposal; and c. classify and order the key issues into impact categories by reference to policy objectives and scientific concepts, such as emission levels that may exceed health or environmental standards. (15)
 3. Government is planning to provide domestic water services to a municipality area located in Kushtia, Bangladesh, with a population of 25000 through private companies. Explain the relevant indicators and their implications for the following five variables the project above: a. legal framework; b. fiscal space; c. institutional capacity; d. willingness of users to pay for water and sanitation services; and e. size and location of the project. (15)
 4. A private company is proposing to construct a new export processing zone (EPZ) in an area covering 267 Acres. After completion, the EPZ will have 250 industrial plots. The area proposed for the new EPZ is located in a rural area mainly used for agriculture and there is a river nearby. The project might contribute to increase the pollution of the water bodies, decrease agricultural production, change the existing social structures, increase alternative employment opportunities etc.
- For this project, write the benefits of public participation during EIA process for the following stakeholder groups (write five benefits for each stakeholder group): (10)
- The proponent/supporter
 - The decision-maker
 - Affected communities

University of Asia Pacific
Department of Civil Engineering
Final Examination – Spring 2023
Program: M.Sc. Engineering (Civil)

Course Title: Structural Design of Pavement
 Time: 3 hours

Credit Hour: 3:00

Course Code: CE 6505
 Full Marks: 100

1. a) Explain the pavement design steps as per Road Note No. 31. (6)
- b) Describe different types of Joints in rigid pavements. (6)
- c) Explain with a figure the deflections for different pavement thicknesses. (6)
- d) Write short notes on (i) Warping and (ii) Curling (6)
- e) Describe the pavement life cycle. (6)
2. A 6-lane divided Highway is to be designed to replace an existing one. The present AADT (both directions) is 7000 vehicles. Determine the design ESAL if the design life is 18 years. The vehicle composition and growth rate of different vehicles are as follows: (10)
 - Passenger Car (1000 lb/axle) = 50% (Growth rate 8%)
 - 2 axle single unit truck (5000 lb/axle) = 25% (Growth rate 5%)
 - 3 axle single unit truck (12000 lb/axle) = 15% (Growth rate 4%)
 - 2 axle single unit truck (16000 lb/axle) = 10% (Growth rate 3%)
 - The percentage of trucks in the Design Lane is 45% and SN is 4.
3. Design a suitable pavement of an asphalt mixture surface using the AASHTO method for a minor highway with a structural coefficient of 0.3 for the surface course. The CBR-value of the base, sub-base, and subgrade is 25, 35, and 2.5 respectively. The drainage quality of the base and sub-base layers is good with 5% saturation and quick draining occurs in the surface course. Use a reliability level of 75%. Consider the value of design ESAL as calculated in Q2. The resilient modulus of the base course and sub-base course is 25000 lb/in² and 5000 lb/in² respectively. (20)
4. Design a rigid pavement for a two-lane residential street using the PCA method in such a way that the assumed pavement thickness is adequate for fatigue analysis. Assume subbase-subgrade K value 250 lb/in³ and concrete modulus of rupture 735 lb/in². The pavement has asphalt shoulder on both sides of the road with doveled joints. The traffic data are as follows: (20)

Single axle	Expected Repetitions
25	21,320
42.5	42,870
45	2,000
Tandem axle	Expected Repetitions
55	930,700
102	15,000
110	1500

5. Figure 1 shows a pavement structure consisting of two layers. Two circular loads of 24-inch diameter are applied on the top layer. The pressure on the circular area is 50 psi. The elastic modulus of the different layers is shown in the figure. Determine the vertical stress, at point A which is located 25 inches below the center of both circles. Also, find out (a) the thickness of the full-depth pavement when the elastic modulus of the layer is 1,20,000 psi. If a surface treatment is applied on a granular base with an elastic modulus of 30,000 psi, (b) what is the thickness of the base course required? (12)

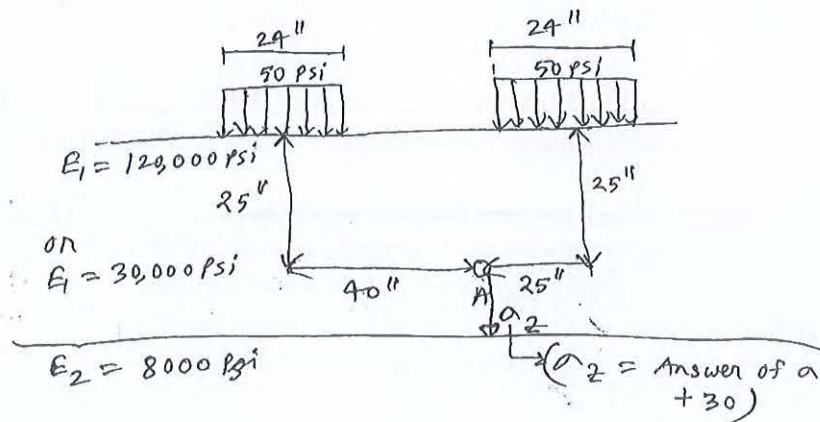


Figure 1

6. The monthly degree-day data are September, 550; October, -140; November, -460; December, -750; January, -550; February, -440; March, -280; April, -80; May, 170; and June 210. Calculate the freezing index. (8)

University of Asia Pacific
Department of Civil Engineering
Final Examination Spring 2023
Program: Masters in Engineering (Civil)

Course Title: Construction Planning and Management
Time: 3 Hour

Course Code: CE6005
Full Marks: 100

There are 7 (seven) questions. Answer all. Programmable calculators are not allowed. Do not write on this question paper. The figures in the right margin indicate full marks. The Symbols have their usual meaning.

1. (a) Describe the advantages of Network diagram. 5
- (b) A company has estimated the following time for its project. The company has fixed 30 months to complete the project. What is the probability of success that the project will complete on time (times are in months)? 20

Activity	Predecessor	Optimistic Time	Most likely Time	Pessimistic Time
a	-	8	10	12
b	-	6	8	10
c	a,b	8	9	10
d	b	3	5	7
e	b	6	8	10
f	c,d	2	3	4
g	c,d	6	8	10
h	c,d,e	3	4	5

Determine the total duration of the project, free float, total float of each activity and identify critical path of the project.

2. Suppose you are an assistant project manager of that company (Ques-1). Total costs of the project is \$200 million. The company provides all kinds of support to the site operations regarding materials, labor and equipment supply. Your responsibility is to smooth operations of the site as well as on-time completion of the project with desired quality.

At 19 months, you have found that, the work estimated was \$100 million, work completed was \$90 million although \$75 million have been spent for the work.

In the schedule, you have found that three activities (f, g and h) will be started soon (i.e. after 19 months). Activity f = boundary wall, g = interior and exterior walls plastering, painting, cleaning and finishing all works, and h = lime tracing at roof slab respectively. But, there will be heavy rainfall for next three months and sub-contractors want to slow the operation.

In such case,

- (a) What will be your role for completing the jobs within specified time frame (30 months)?

- (b) Draw the Bar Diagram and S-Curve, and justify your opinion to the management. 10
- (c) Identify the areas that need to monitor in this project. 5

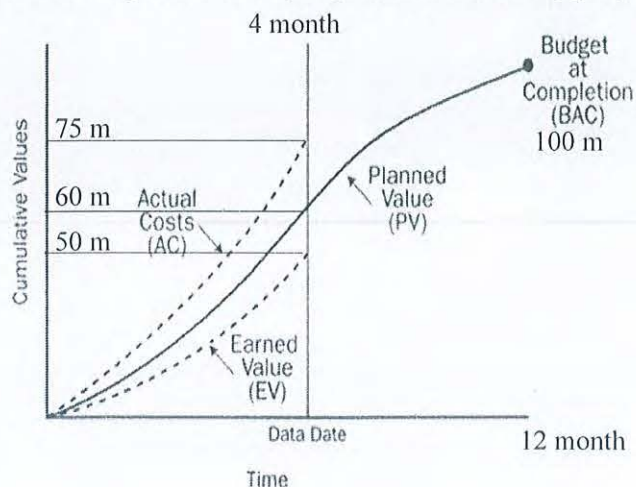
3. (a) What do you understand by Opportunity Cost? 2
- (b) A factory has a current market value of \$60,000 and can be kept in service for 4 more years. With a MARR of 12% per year and annual operation and maintenance cost \$5000 per year, when should it be abandoned? The following data are projected for future years: 8

	Year 1	Year 2	Year 3	Year 4
Net revenue	\$50,000	\$50,000	\$15,000	\$10,000
Market value	\$35,000	\$20,000	\$15,000	\$5,000

- 4.(a) Describe briefly the benefits of EVM. 4
- (b) A project was originally planned to be completed with an investment of \$300 millions and was planned to be completed in 30 months. After reviewing the project after 10 months, it was found that work worth \$95 millions have been completed instead of \$90 millions as per plan though the expenses incurred till date was found \$100 million. Determine the cost and schedule variance. Also determine the expected cost and time of completion with same performance. Also suggest your strategy to the management. 6

- 5.(a) Explain the economic life of an asset. 4
- (b) Dr. Chowdhury purchased a car 10 years back at a cost of \$5.10 million whose market value is \$6.00 million now. It can be used for 3 more years at which time its value will be \$3.5 million. Operation and maintenance expenses are \$1.80 million per year. Dr. Chowdhury can purchase a reconditioned car with the same functionality for \$25.0 million In 5 years the value of this car is estimated to be \$15.0 million. Operation and maintenance expenses will be \$48000 per year. Should Dr. Chowdhury replace the old car using before Tax MARR of 12%? 6

6. (a) The following S-curve represents the progress of a building project in Bogura. 7



Give your comments of project status on Data date. Find out SV, CV, SPI, CPI, EAC (without modification of performance) and EAC (with modification of performance).

- (b) What corrective actions to be taken in order to bring the building project of Bogura [Ques. 7(a)] to its master schedule? 3
7. (a) When is meant by resource leveling? Write down its benefits. 5
- (b) Why do we need project crashing? State the important considerations for crashing a project. 5

MARR 12%

Interest Rate	12.00%								
n	F/P	P/F	A/F	A/P	F/A	P/A	A/G	P/G	N
1	1.120	0.8929	1.0000	1.1200	1.000	0.893	0.000	0.000	1
2	1.254	0.7972	0.4717	0.5917	2.120	1.690	0.472	0.797	2
3	1.405	0.7118	0.2963	0.4163	3.374	2.402	0.925	2.221	3
4	1.574	0.6355	0.2092	0.3292	4.779	3.037	1.359	4.127	4
5	1.762	0.5674	0.1574	0.2774	6.353	3.605	1.775	6.397	5
6	1.974	0.5066	0.1232	0.2432	8.115	4.111	2.172	8.930	6
7	2.211	0.4523	0.0991	0.2191	10.089	4.564	2.551	11.644	7
8	2.476	0.4039	0.0813	0.2013	12.300	4.968	2.913	14.471	8
9	2.773	0.3606	0.0677	0.1877	14.776	5.328	3.257	17.356	9
10	3.106	0.3220	0.0570	0.1770	17.549	5.650	3.585	20.254	10
11	3.479	0.2875	0.0484	0.1684	20.655	5.938	3.895	23.129	11
12	3.896	0.2567	0.0414	0.1614	24.133	6.194	4.190	25.952	12
13	4.363	0.2292	0.0357	0.1557	28.029	6.424	4.468	28.702	13
14	4.887	0.2046	0.0309	0.1509	32.393	6.628	4.732	31.362	14
15	5.474	0.1827	0.0268	0.1468	37.280	6.811	4.980	33.920	15