

৩। (ক) সংক্ষেপে নোট লিখুন :

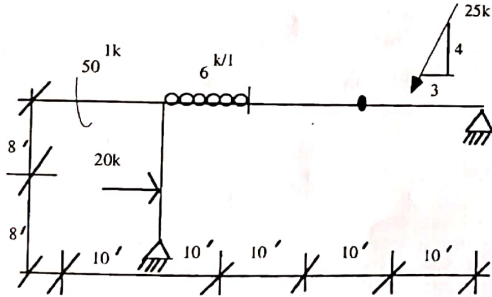
- (i) Average daily traffic; (ii) Design hourly volume; (iii) Highway capacity; (iv) At grade separation.
(খ) Sight distance কি? কিভাবে Minimum stopping sight distance calculate করা যায়?

২৪তম বিসিএস
পুরকৌশল (ঐচ্ছিক)

[দ্রষ্টব্য : ইংরেজি অথবা বাংলা যে-কোন একটি ভাষায় প্রশ্নের উত্তর দিতে হবে। তবে টেকনিক্যাল শব্দগুলো ইংরেজিতে লেখা চলবে। প্রত্যেক প্রশ্নের মান প্রশ্নের শেষে প্রান্তে দেখানো হয়েছে।]

ফর্ম-১ (যেকোন দুইটি প্রশ্নের উত্তর দিন)

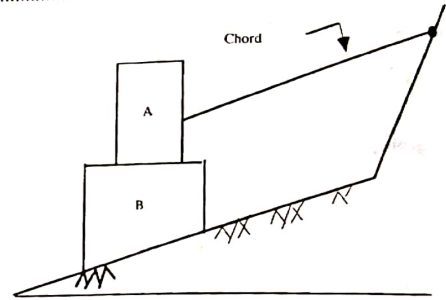
- ১। (ক) Influence line কি? Influence line-এর প্রধান উদ্দেশ্যসমূহ বর্ণনা করুন। ১+২=৩
(খ) Bending Moment-এর জন্য influence line এবং bending moment diagram-এর মধ্যে পার্থক্য কি? ২
(গ) চিত্র নং ১-এ প্রদর্শিত beam-এর জন্য influence line আঁকুন এইগুলির জন্য (i) A-এর বাম পার্শ্বে cross section এ shear (ii) C তে shear (iii) A তে bending moment (iv) C তে bending moment এবং (v) B তে reaction.



২। নিচের বিমের Shear এবং Moment-এর চিত্র অংকন করুন :

২০

১০



- ৩। (ক) ছয়তলা বিল্ডিং এর Ground floor এ একটি Interior কলাম ৪০০ (চারশত) kips load বহন করতে হবে। কলামটি একটি Tied কলাম হিসাবে ডিজাইন করুন, তার footing হবে আয়তাকার। সঙ্গে স্কেচ দিবেন। ২০
দেওয়া আছে :
 $f'c = 3\text{ksi}$; $f_y = 45\text{ksi}$; $n = 9$ এবং Safe bearing capacity of soil = 2.5 kips/sq. ft.

ফর্ম-২

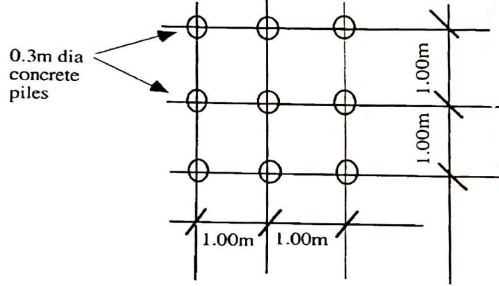
(এই ফর্ম হইতে যেকোন দুইটি সেকশনের প্রশ্নের উত্তর দিতে হবে।
প্রত্যেক সেকশন হ'তে যেকোন দুইটি প্রশ্নের উত্তর দিন)

ক সেকশন

- ১। মাটির mass density (p) এর অন্য Parameters-এর term-এ প্রকাশ করুন যখন মাটি (soil) (ক) Partially saturated (SL ১০০%); (খ) Fully saturated (S=১০০%); (গ) Fully dry S=০%) এবং (ঘ) Submerged। ১৫
২। (ক) যেকোন তিনটির উপর টীকা লিখুন : ৬
(i) Plastic limit; (ii) Liquid limit; (iii) Plasticity Index; (iv) Shrinkage limit; (v) SPT.
(খ) নিম্নলিখিত term গুলি দ্বারা soil-এর কি বুঝায়? ৯
(i) Moisture content; (ii) Porosity এবং (iii) Void ratio.
উপরের term গুলি সূত্রের সাহায্যে দেখান যখন—
 $M = \text{Weight of Water}$
 $W = \text{Weight of Solids}$ } some unit

V_s = Volume of Solid
 V_m = volume of water } some unit
 V_a = volume of Air
 e = Void ratio.

- ৩। (ক) Pile foundation সম্পর্কিত term negative skin friction ব্যাখ্যা করুন। ৩
 (খ) চিত্র-৩ এ প্রদর্শিত piles গ্রুপের জন্য 3 factor of safety প্রয়োজন।
 Maximum load নির্ণয় করুন যখন—
 (i) পাইলগুলি স্বতন্ত্র (individual) ভাবে কাজ (act) করে; (ii) পাইলগুলি গ্রুপ হিসাবে কাজ করে।
 পাইলগুলি 20.00 m লম্বা এবং $q_n = 90 \text{ kN/m}^2$ বিশিষ্ট clay-র মধ্যে ডোকান।
 প্রয়োজনীয় অতিরিক্ত data-এর জন্য যুক্তিসঙ্গত মান ধরে নিন।



খ সেকশন

- ১। একটি সড়ক বাকের (curve)-এর দুটি straight T_1V এবং VT_2 60° ডিগ্রি কোণে মিলিত হয়েছে। এর radius of curve বের করুন P বিন্দুতে যাহা $PI(V)$ হতে ৩০ মি. দূরত্বে এবং T_1VP কোণটি 30° । ১৫
 ২। (ক) বাংলাদেশে কি কি ধরণের pavement ব্যবহৃত হয়? এর কোনটি অত্যধিক ব্যবহৃত হয় এবং কেন? ৭
 (খ) আপনার মতে সড়কের বাজার অংশ এবং শহর অংশে কি ধরণের pavement ব্যবহার করা উচিত? আপনার মতামতের স্বপক্ষে যুক্তিগুলি দিন। ৮
 ৩। (ক) সর্ফিসিং নোট লিখুন : ১০
 (i) Passing sight distance;
 (ii) Tack coat এবং prime coat এর মধ্যে পার্থক্য;
 (iii) CBR;
 (iv) Highway capacity;
 (v) Design speed.

- (খ) Water bound macadam নির্মাণে পানির function ব্যাখ্যা করুন।
 (গ) Seal coat দেওয়ার উদ্দেশ্যসমূহ লিখুন।
 গ সেকশন

- ১। (ক) Septic tank দিয়ে sewerage treatment ও disposal এর theory বর্ণনা করুন। ৬
 (খ) ১০০ জন লোকের জন্য একটি septic design করে সবগুলি elements দেখিয়ে sketch আঁকুন। প্রয়োজনীয় সকল data assume করুন। ৯
 ২। পানি softening-এর জন্য কি কি পদ্ধতি সাধারণতঃ ব্যবহৃত হয়? কেচসহ যেকোন একটি পদ্ধতি বিশদ বর্ণনা করুন। ১৫
 ৩। (ক) Slow sand এবং Rapid sand filteres মধ্যে তুলনা করুন—এই সকল বিষয়ে (i) adaptability, (ii) rate of filtration, (iii) turbidity removal, (iv) flexibility এবং (c) sand specification। ৮
 (খ) Chlorination কি? Chlorination-এর type সমূহ উল্লেখ করুন। ৭

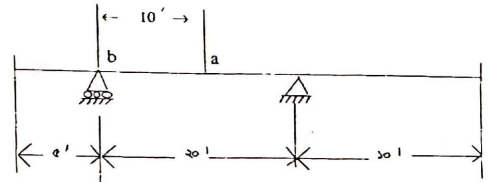
২৫তম বিসিএস

পুরকৌশল (এঞ্জিক)

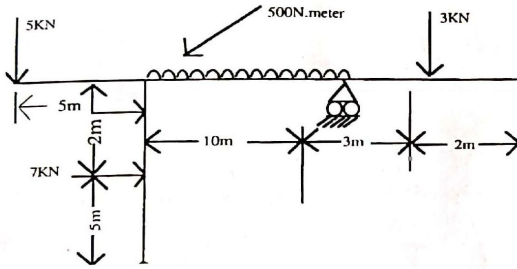
দ্রষ্টব্য : ইংরেজি অথবা বাংলা যে-কোন একটি ভাষায় প্রশ্নের উত্তর দিতে হবে। তবে টেকনিক্যাল শব্দগুলো ইংরেজিতে লেখা চলবে। প্রত্যেক প্রশ্নের মান প্রশ্নের শেষ প্রান্তে দেবানো হয়েছে।

গ্রুপ-১ (যেকোন দুইটি প্রশ্নের উত্তর দিন)

- ১। একটি আয়তাকার (rectangular) বীমের প্রস্থ (width) = ১২" এবং কার্বকর গভীরতা (effective depth) = ১৭.৫০"। বীমটিকে এক সারিতে (in one row) ৪টি—নং ৯ রড (4—No. 9 bars) দিয়ে (re-inforced) করা হয়েছে। যদি $f_y = ৬০,০০০ \text{ psi}$ এবং $f_c = ৪,০০০ \text{ psi}$ হয়, তবে ACI কোড অনুযায়ী Nominal flexural strength এবং $\text{Max } \frac{m}{x}$ Moment বাহিরকরুন, যাহা বীমটির জিজাইন স্বত্বের উপযোগী হবে।
 ২। (ক) Influence line-এর সংজ্ঞা কি? চিত্র (sketch) সহ বুঝিয়ে লিখুন। ৫
 (খ) নিম্নে বর্ণিত ১ নং চিত্রে— ৫×৩=১৫



- (i) 'a' বিন্দুতে Shear-এর Influence line diagram আঁকুন।
 (ii) 'a' বিন্দুতে Moment এর Influence line diagram আঁকুন।
 (iii) 'b' বিন্দুতে Reaction এর Influence line diagram আঁকুন।
 ৩। (ক) Beam, Column, Truss এবং Cable এর মধ্যে Structural ব্যবধান বর্ণনা করুন।
 (খ) নিম্নে দেখানো Structure টির সম্পূর্ণ Shear force এবং Bending moment diagrams অংকন করুন।



গ্রুপ-২

(এই গ্রুপ হইতে যেকোন দুইটি সেকশনের প্রশ্নের উত্তর দিতে হবে।
 প্রত্যেক সেকশন হ'তে যেকোন দুইটি প্রশ্নের উত্তর দিন)

ক সেকশন **Geotechnical Engineering**

- ১। (ক) নিম্নে বর্ণিত মাটির গুণাগুণের (soil properties) সংজ্ঞা লিখুন : $\frac{1}{2} \times 6 = 3$
 (i) Moisture Content; (ii) Specific Gravity; (iii) Unit weight; (iv) Shearing Resistance; (v) Permeability; (vi) Capillarity.
 (খ) (i) মাটির Compaction এবং Consolidation-এর মধ্যে পার্থক্য কি? ৩
 (ii) Compaction এবং Consolidation সম্পন্ন করার কাজে ব্যবহৃত পদ্ধতি এবং যন্ত্রপাতি/সরঞ্জাম সম্বন্ধে লিখুন। ৩
 ২। ভবনের ভিত্তি নির্মাণে Pile foundation কখন বিবেচনায় আসে? Cast-in-situ pile এবং Pre-cast pile-এর সুবিধা/অসুবিধাগুলি কি কি বর্ণনা করুন। ঢাকা সিটির একটি বাণিজ্যিক এলাকার জন্য উপরোক্ত দুই প্রকার Pile এর মধ্যে কোনটিকে আপনি প্রাধান্য দেবেন এবং কেন দেবেন? ব্যাখ্যা করুন। ১৫
 ৩। নিম্নোক্ত Terms গুলির সংজ্ঞা লিখুন :
 (ক) Ultimate bearing Capacity, Net ultimate bearing Capacity, Safe

- bearing Capacity এবং Allowable bearing Capacity.
 (খ) মাটির bearing capacity factor-গুলি কি বর্ণনা করুন। ভূ-গর্ভস্থ water table-এর অবস্থান মাটির bearing capacity কে কিভাবে প্রভাবিত করে, তাহা সবিস্তারে বর্ণনা করুন। ৫
 (গ) SPT কাকে বলে? SPT-এর value বা মান কখন Correct করার প্রয়োজন হয়? ৫

খ সেকশন-পরিবহন কৌশল (Transportation Engineering)

- ১। (ক) একটি সড়কে (road-way) যখন Designs speed প্রতি ঘণ্টায় ১০০ কি.মি. এবং radius of curvature = ৫০০ মিটার, তখন ঐ সড়কের super elevation rate কত বাহির করুন। ধরুন $f = 0.11$.
 (খ) নিম্নোক্ত Term গুলির উপর টীকা লিখুন : $\frac{3}{2} \times 8 = 12$
 (i) Signalling and Inter locking;
 (ii) Ballast;
 (iii) Points and crossings;
 (iv) বিভিন্ন প্রকার railway sleepers গুলি কি কি এবং তাদের পারস্পরিক গুণাগুণ বা সুবিধা/অসুবিধাগুলি কি বর্ণনা করুন।
 ২। (ক) "The importance of roads in a country is comparable to the vein in the human body". ব্যাখ্যা করুন। ৫
 (খ) Flexible pavement এবং Rigid pavement-এর মধ্যে তুলনা করুন। বাংলাদেশের জন্য কোনটি কেন উপযোগী ব্যাখ্যা করুন। ১০
 ৩। যেকোন তিনটির উপর টীকা লিখুন : $৫ \times ৩ = ১৫$
 (ক) Highway Intersection; (খ) California Bearing Ratio; (গ) Sub-grade; (ঘ) Traffic signals.

গ সেকশন-পরিবেশ কৌশল (Environmental Engineering)

- ১। (ক) আর্সেনিকযুক্ত পানির প্রধান প্রধান রাসায়নিক Forms গুলি কি? বর্ণনা করুন। ভূ-গর্ভস্থ পানিতে কোন্ form-এ আর্সেনিকের অস্তিত্ব বিদ্যমান বলে প্রতীয়মান হয়, বর্ণনা করুন। $\frac{3}{2} \times ৪ = ৬$
 (খ) আর্সেনিক দূরীকরণ প্রযুক্তির broad categories কি কি লিখুন। বাংলাদেশে আর্সেনিক দূরীকরণে কোন্ প্রযুক্তিসমূহ আপনার বিবেচনায় অধিক কার্যকর বলে প্রতীয়মান হয় এবং কেন? ব্যাখ্যা করুন। ভূ-গর্ভস্থ পানিতে স্বাভাবিকভাবে প্রকৃতিগতভাবে বিদ্যমান লৌহ (Iron) কিভাবে আর্সেনিক দূরীকরণে গুরুত্বপূর্ণ ভূমিকা পালন করে। ব্যাখ্যা করুন। $৩+৩+৪=১০$

- ২। সবগুলো Element দেখিয়ে একটি সেপটিক ট্যাংক (Septic Tank)-এর cross section আঁকুন এবং প্রত্যেকটি element-এর function কি লিখুন। ১৫০ জন ব্যবহারকারীর জন্য একটি septic tank ডিজাইন করুন। প্রয়োজনমত data assume করুন। $5+10=15$
- ৩। যেকোন তিনটির উপর টীকা লিখুন : $5 \times 3 = 15$
 (ক) Green house effect; (খ) BOD; (গ) pH value; (ঘ) Population growth estimate.

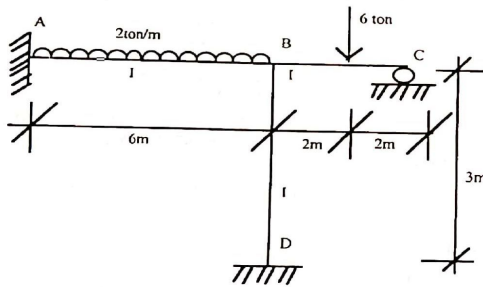
২৭তম বিসিএস

CIVIL ENGINEERING-First Paper

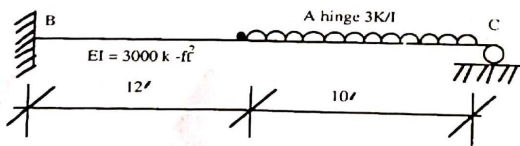
দ্রষ্টব্য : ইংরেজি অথবা বাংলা যে-কোন একটি ভাষায় প্রশ্নের উত্তর দিতে হবে। তবে টেকনিক্যাল শব্দগুলো ইংরেজিতে লেখা চলবে। প্রতি গ্রুপ থেকে দুইটি করে মোট ছয়টি প্রশ্নের উত্তর দিন। প্রত্যেক প্রশ্নের মান প্রশ্নের শেষ প্রান্তে দেখানো হয়েছে।

Group I-Structure

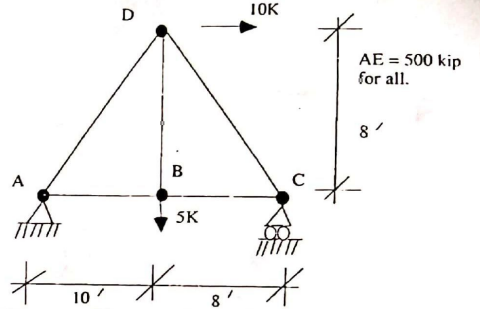
1. চিত্র-১ এ প্রদর্শিত কাঠামোটি Moment distribution পদ্ধতিতে সমাধা করিয়া উহার Shear force এবং bending moment লেখচিত্র সঠিক মানসহ অংকন করুন। ২০



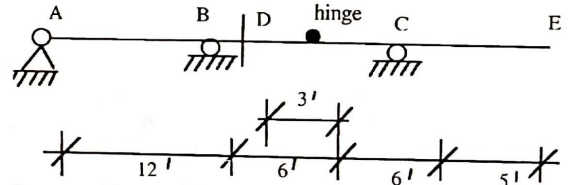
2. (a) চিত্র-২এ প্রদর্শিত Beam টির A বিন্দুতে উল্লম্ব deflection বাহির করুন। ১০



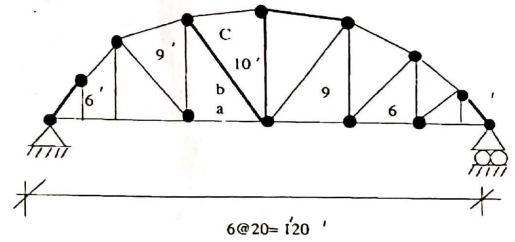
- (b) চিত্র-৩ এ প্রদর্শিত TRUSS টির B বিন্দুতে উল্লম্ব deflection বাহির করুন।



3. (a) চিত্র-৪ এ প্রদর্শিত Beam-টির সাপোর্ট A, B ও C তে Reaction-এর এবং D বিন্দুতে Shear ও moment-এর Influence line অংকন করুন। ১০



- (b) চিত্র-৫ এ প্রদর্শিত Truss-এর member a, b ও c-এর influence line অংকন করুন। ১০



Group II-Water Resource Engineering

4. Discuss various types of surface irrigation methods and their suitability. 15
 5. Derive the formula for yield of a well. 15

$$Q = \frac{2.3}{T} \log_{10} \frac{H_1}{H_2} \cdot A.H$$

Where Q = Yield of well in m^3/h

- H_1 = Depth of well water level when pumping is stopped.
 H_2 = Depth of water level after recuperation in time T .
 A = Cross sectional area of well.
 H = Depth of water level.

6. What are the components of a Canal Irrigation System? Derive Dupuit's Equation for the center to center spacing of circular tile drains. 15

$$L = 2\sqrt{\frac{K}{V}(b^2 - a^2)}$$

- Where, L = Spacing between closed drains.
 A = Height of center of the drain pipe above the impervious layer in meter.
 B = Maximum height of water table above the impervious layer in meters.
 K = Darcy's constant.
 V = Rate of discharge per unit area of land surface.

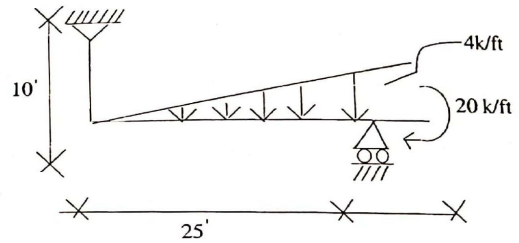
Group III-Environmental Engineering

7. What are the different stages of water purification? Discuss the process of disinfections by chlorination in details. 15
 8. (a) What are the factors affecting sludge digestion? 15
 (b) Discuss the stages of sludge digestion process.
 9. For the distribution main of a city water supply, a 30 cm diameter supply main is required. However, pipes larger than 25 cm dia are not available in the market. So it has been decided to lay two parallel mains of same diameter. Determine the diameter of the parallel mains. 15

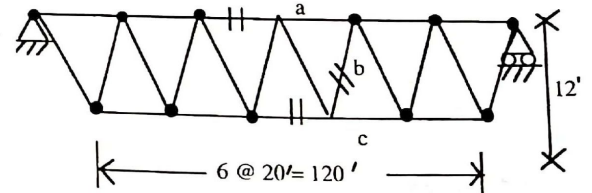
২৭তম বিসিএস

CIVIL ENGINEERING-Second Paper
 (N.B.—The figures in the margin indicate full marks.)
Section A- Structure-40
 (Answer any four questions)

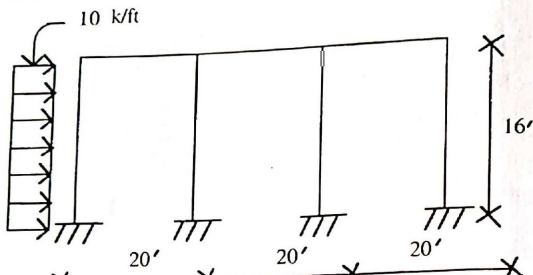
1. Draw shear and moment diagrams for the members of the frame shown in Fig. 1 : 10



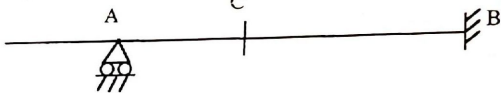
2. Determine the bar forces a, b and c of the truss shown in Fig 2 : 10



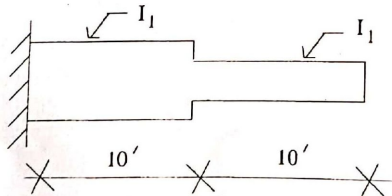
3. Draw shear force and bending moment diagram of the Indeterminate structure shown in Fig 3. Use Approximate method :



4. Draw influence lines in the beam shown in Fig. 4 for (i) reaction at A, (ii) shear at C, (iii) moment at B and (iv) moment at C : 10



5. Calculate maximum deflection for the beam shown in Fig. 5 : 10
 Given : $E = 30 \times 10^6$ psi
 $I_1 = 100 \text{ in}^4$
 $I_2 = 200 \text{ in}^4$



Section B-Transportation Engineering-30
 (Answer any two questions)

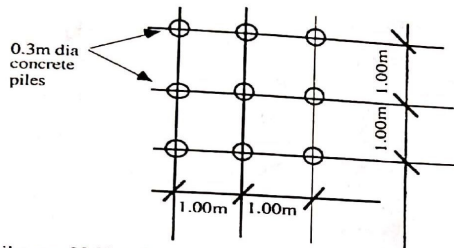
- (a) List the names and functions of various Ministries and Departments/Agencies involved in the management and operation of roads and railways in Bangladesh. 5
 (b) Briefly describe how traffic characteristics influence highway design. Name different roadway furniture and their purposes. Draw a neat sketch of a typical roadway cross-section showing various geometric elements. 3+4+3=10
- (a) How does flexible pavement differs from rigid pavement? Give few usages of PIEV and PCU. When to conduct traffic delay and O-D studies? 2+3+2=7
 (b) Describe how to manage right turning movements at a junction. Mention few underlying reasons about how oneway and tidal flow operations enhance roadway capacity. At what circumstances grade-separated traffic management measures are considered? 3+3+2=8
- (a) Draw a typical cross-section of a complete railway track system and label its different essential features. Mention few operational problems of Bangladesh Railways (BR). Why point, crossing and interlocking are used in railway track? 3+3+2=8
 (b) Describe the potential benefits of air transportation system. In your opinion what are the inherent constraints of air transportation in Bangladesh? Briefly state the role of civil engineer in air transportation. 2+3+2=7

Section C-30

(Answer any two questions)

- Express mass density (P) in terms of other parameters of cases of soil (a) partially saturated (SL 100%); (b) Fully saturated (S = 100%); (c) Fully dry (s = 0) and (d) Submerged. 15
- (a) Write short notes on any three : 6
 (i) Plastic limit; (ii) Liquid limit; (iii) Plasticity Index; (iv) Shrinkage limit; (v) SPT.
 (b) In soil what is meant by—
 (i) Moisture content; (ii) Porosity and (iii) Void ratio?
 Show the above terminology in formula when.
 $M = \text{Weight of Water}$
 $W = \text{Weight of Solids}$ } some unit
 $V_s = \text{Volume of Solid}$
 $V_m = \text{volume of water}$ } some unit
 $V_a = \text{volume of Air}$
 $e = \text{Void ratio.}$
- (a) Explain the term negative skin friction in relation to pile foundation. 3

- (b) A factor of safety of 3 is required for the group of piles shown below. Find the maximum load as determined by :-
 (i) the piles acting as individual; 12
 (ii) the piles acting as a group.



The piles are 20.00 m long and are driven in clay having a $q_n = 90 \text{ kN/m}^2$. Assume reasonable values for any necessary additional data.

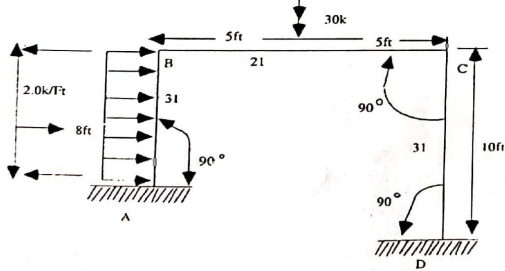
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পুরকৌশল-প্রথম পত্র

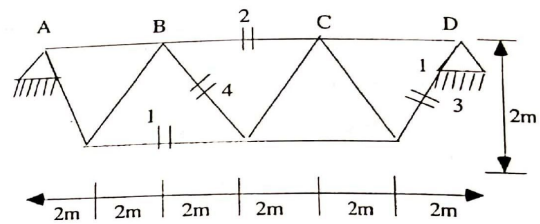
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Group I-Structure

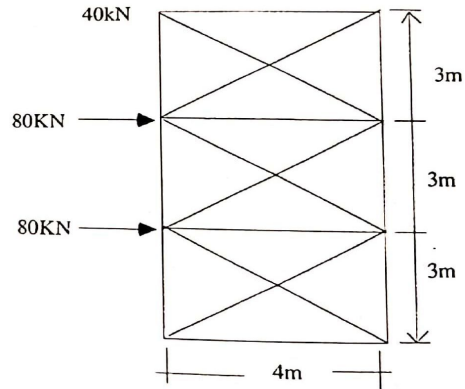
1. Fig-1 এ প্রদর্শিত কাঠামোটি Moment distribution পদ্ধতিতে সমাধা করিয়া উহার Shearforce এবং Bending moment লেখচিত্র সঠিক মানসহ অংকন করুন : 20



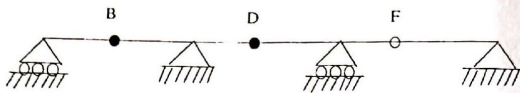
2. (a) For a unit load moving from Point A to Point D on the truss shown in fig-2; construct/draw influence line for the numbered members : 10



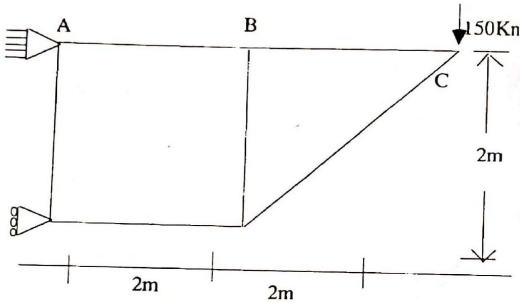
- (b) Determine the bar forces for the numbered bars (members) shown in Fig-3. Use suitable assumptions : 10



3. (a) Fig-4 এ বর্ণিত কাঠামোটির C বিন্দুতে Reaction এবং D বিন্দুতে Bending Moment and Shearforce এর influence line অংকন করুন : 10



(b) For the truss shown in Fig-5; use the method of virtual work to determine the vertical deflection at E:
 $E = 70 \text{ GPa}$, and $A = 1200 \text{ mm}^2$ for each member. 10



Group II-Water Resource Engineering

4. (a) Write short notes on : 2x3=6
 (i) Optimum utilization of irrigation water; (ii) Net irrigation requirement; (iii) Importance of duty.
 (b) Show the depth of water stored in root zone in fitting the soil up to field capacity = $\frac{F_c v_d}{v_w}$ meter, where the symbols mean their natural meaning. 9
5. (a) Discuss the necessity and importance of irrigation in Bangladesh. 5
 (b) Discuss various types of surface irrigation and their suitability in Bangladesh, specify the geographical area. 10
6. (a) Write down the various types of impurities, which make the water unfit for irrigation. 6
 (b) What is meant by saline and alkaline soils? What precautions would you adopt to prevent salinity of irrigation land? 9

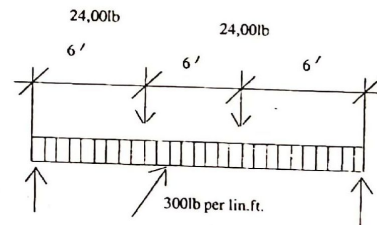
Group III-Environmental Engineering

7. Design a low rate trickling filter to treat 6.0 MI/d of sewage of BOD of 210 mg/l. The final effluent should be 30 mg/l and organic loading rate is 320g/m³/d. 6
8. (a) Describe what is meant by Initial Environment Examination (IEE) and Environmental Impact Assessment (EIA). 6
 (b) Describe how pollution of environment can be mitigated during planning, implementations and use of different projects. 9
9. (a) Write down the sanitary significance of the following impurities : 9
 (i) Arsenic; (ii) Fluoride; (iii) Lead.
 (b) Define Break Point Chlorination. Draw a sketch to show different zones in a Typical Break Point Chlorination. Name the factors influencing the Disinfection Process. 10

২৮তম বিসিএস

CIVIL ENGINEERING-Second Paper
 [N.B.—The figures in the margin indicate full marks.]
Section A- Structure-40
 (Answer any two questions)

1. (a) A reinforced concrete beam has a maximum bending moment of 900,000 in.-lb. Given data : $f_s = 20,000 \text{ psi}$, $f_c = 1350 \text{ psi}$, $n = 9.22$. 10
 Assuming that the beam width is 10 in. determine the required area of the longitudinal steel reinforcement.
 (b) Investigate the necessity of web reinforcement of the beam shown below 10



- The beam has a width of 12 in and an effective depth of 22 in. Assume allowable concrete stress $V_c = 55 \text{ psi}$.
2. (a) A tied column has to carry a design load of 290,000 lb of which concrete will carry 163,000 lb. Determine the required cross-section of a square column and the size and number of required vertical bars. 10

Specification data : $f'_c = 3,000$ psi and $f_s = 24,000$ psi.
 (b) A short spiral column has a gross diameter of 18 in. with 2 in of protecting concrete. The vertical reinforcement consists of 10 No. 6 bars. Specification data : $f'_c = 3,000$ psi, $f_y = 60,000$ psi, $f_s = 24,000$ psi. cross-sectional area of No. 6 bar = 0.44 sq.in. Determine the allowable column load and also the size and pitch of the spiral reinforcement.

- (a) As per ACI Code, in case of -ve moment co-efficients for design of slab are same for Dead load and Live load but in case of +ve moment co-efficients for Live load is higher than that of Dead load. Explain why.
 (b) Design an interior slab panel of 20'x20' supported by 12" beams on edges with the following particulars :
 $f'_c = 3,000$ psi; $f_y = 60,000$ psi; LL = 60 psf. 15
 ACI Design co-efficients for, (i) -ve moment = 0.045 (For LL&DL); (ii) +ve moments DL = 0.018; LL = 0.027.
 Draw a neat sketch for Reinforcement detail.

Section B-Transportation Engineering-30
 (Answer any two questions)

- Define Rigid pavement and Flexible pavement. Discuss in detail the advantages and disadvantages of both the types of pavement with respect to Bangladesh soil and weather conditions. 15
- Describe the criteria for Highway Design. 7
- (a) Why transition curves are provided in Railway Track? Enumerate the essential requirements of an ideal transition curve. 7
 (b) Calculate the maximum speed to be provided on a 2° B.G. transitioned curve. The maximum sanctioned speed is 96 kmph. [Cant deficiency = 75 mm] 8

Section C-Foundation Engineering-30
 (Answer any two questions)

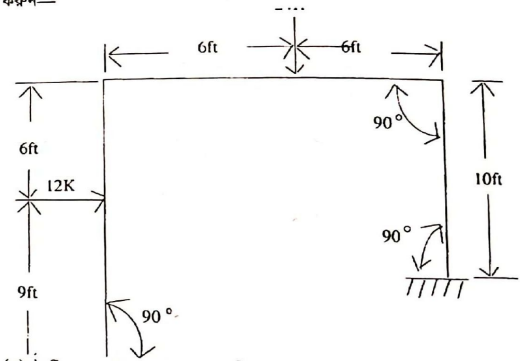
- When and why pile foundation is considered for construction of Bridge/tall building? Discuss the merits and demerits of (i) Cast-in-situ concrete pile; (ii) Pre-cast concrete pile. 15
- Write short notes on any five : s15
 (a) Plastic limit, LL; (b) Plastic limit, PL; (c) Secondary settlement; (d) Cassion/well fundation; (e) Co-efficient of permeability; (f) Cofferd dam; (g) Degree of saturation; (h) SPT.
- (a) What are the causes of soil sample disturbance in soil test? Mention the effects of soil sample disturbance on the engineering properties of soil. 6
 (b) Design a square footing to carry a column load of 500 kips with a factor of safety of 3. The base of the footing will be placed at a depth of 6 ft below the level of surrounding ground. The clay beneath the footing has an unconfined compressive strength of 3,000 lb/ft². The position of the water table at great depth.
 $f'_c = 3,000$ psi; $f_y = 40,000$ psi. Assume other data if necessary. 9

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 পূর্বকৌশল-প্রথম পত্র

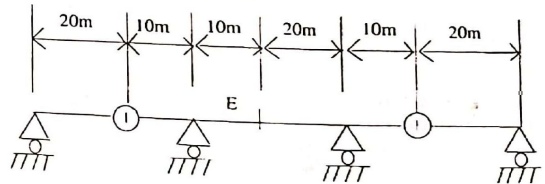
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Group I-Structure

- Fig-1 এ প্রদর্শিত কাঠামোটি Moment Distribution পদ্ধতিতে সমাধা করিয়া উহার Shear Force এর Bending Moment লেখ চিত্র সঠিক মানসহ অঙ্কন করুন— 20

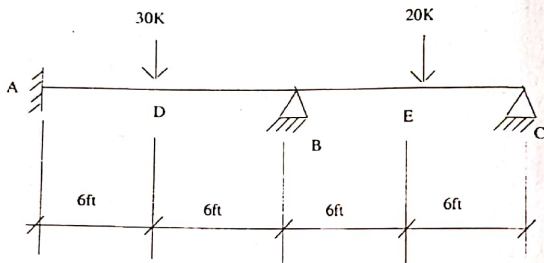


- (a) Influence line এর সংজ্ঞা লিখুন। Influence line এর সাহায্যে Fig-2-তে দেখানো বীমাটি E বিন্দুতে maximum negative shear এবং maximum negative moment বাহির করুন যখন বীমাটিতে 2000 kg per meter সমানভাবে distributed load চলাচল করে।

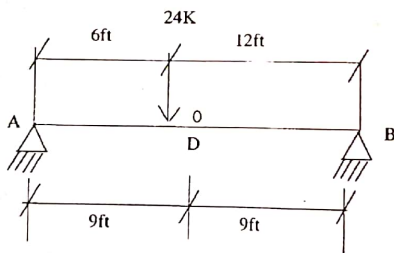


(b) চিত্রসহ চার প্রকারের TRUSS এর নমুনা লিখুন। Trussed structure সমূহে stress নির্ণয় করিতে কি কি assumptions করিতে হয় লিখুন। Portal method এ Statically indeterminate structure এর বিশ্লেষণে কি কি assumptions করিতে হয় ভাষাও লিখুন। 8

3. (a) Determine all reaction components and draw shear force and bending moment diagrams for the beam shown in Fig. 3.



(b) Find the deflection ΔD in inches and θA in radians by the unit load method for Fig. 4.



Group II-Water Resource Engineering

4. Write short notes on : 3x5=15
 (i) Root-zone-depth; (ii) Willing co-efficient and Field capacity; (iii) Delta and Duty; (iv) Cut-offs; (v) Lurching apron.
 5. (a) Describe various types of river training and protection works. 8
 (b) What is a guide bank or Bell's Bund? Where is it used? Draw a good sketch of a guide bank and explain the different parts of it. 7
 6. How the yield of a well is determined? 15

Group III-Environmental Engineering

7. (a) Explain the process of coagulation sedimentation. How does it differ from plain sedimentation? 8
 (b) State systematically the process of design of branched as well as looped network of distribution systems. 7
 8. (a) Explain the biological treatment process of sewage. 8
 (b) Design a standard filter to treat 8.0 ML/d sewage of BOD5 of 210 mg/l. The final effluent should be 30 mg/l and organic loading rate is 320g/m²/day. Assume reasonable data, if necessary. 7
 9. (a) Name some of the factors influencing water consumption. State the ways in which these factors influence water consumption. 7
 (b) Design a rectangular sedimentation tank to treat 24 million litres of raw water per day. The overflow rate is 0.5m/hr. and the detention time is 3 hours. 8

২৯তম বিসিএস

পুরকৌশল-দ্বিতীয় পত্র

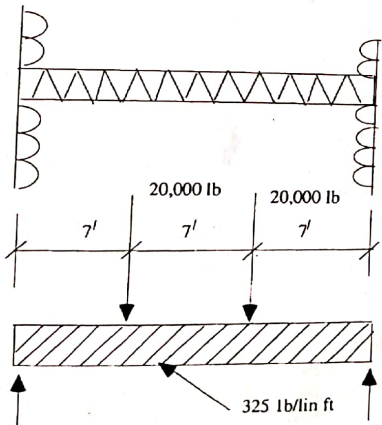
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Section A- Structure-40

(Answer any two questions)

1. (a) Describe briefly what are meant by stress design and strength design in respect of concrete structures. 2 1/2
 (b) Why shrinkage stresses are developed in concrete and how they are taken care of? 2 1/2
 (c) Write briefly why water-cement ratio is so important. Also define workability of concrete. 2 1/2
 (d) Briefly describe the failure pattern of an underdesigned and overdesigned beam. 2 1/2
 (e) Design a rectangular RCC Column (WSD) to carry a load of 150k from slab and 80k from wall and beam given $F_c = 4,000$ psi and $F_s = 24,000$ psi. 10
 Also define a slender column.
 2. (a) According to ACI Code for design, the moment co-efficients for live load is higher than that of Dead load, while for -ve moment co-efficient, they are the same. Can you explain why? 5

- (b) Design an interior slab panel of 21'x21', supported by 11.5" beams at edges.
- Given conditions are :
- $F'_c = 2,500$ Psi
 - $F_y = 60,000$ Psi
 - Live load = 55 Psf.
- ACI design co-efficients are (i) -ve moment = 0.045 (for LL&DL) and (ii) the moment, DL = 0.018 & LL = 0.027.
- Draw a clean sketch showing reinforcement details.
3. (a) An isolated T-beam has the following features and dimensions: 14
- Flange width = 28"
 - Thickness = 6"
 - Cast monolithically with the wef, $w = 10$ "
 - Depth below the slab-bottom = 24"
 - The beam is reinforced with 6# 10 bars given in two layers.
 - Centroid of bars is 26" from the top of the beam.
 - $f'_c = 3,000$ Psi $f_y = 60,000$ Psi.
- Determine the useful moment capacity.
- (b) Investigate the necessity of wef reinforcement of the beam shown below: 6



The beam has a width of 12" and an effective depth of 21". Assume allowable concrete stress $V_c = 55$ Psi.

Section B-Transportation Engineering-30
(Answer any two questions)

1. Describe briefly as to what are meant by rigid pavement and flexible pavement. Elaborate on the advantages and disadvantages of these two types of pavement, keeping in view the sub-soil and climatic conditions of Bangladesh. 15
2. (a) Define maintenance of roads. Briefly describe what are the different types of maintenance categories. What are the main shortfalls in the maintenance planning and implementation practices in Bangladesh? 8
(b) What are the main classification of the country's Road network system? Which organization is responsible for their construction and maintenance? Why drainage is important for a road? 7
3. (a) Calculate the rate of super-elevation where curve radius is 170m, $g = 9.8$ m/sec², design speed is 100 km/hr with a side friction factor of 0.09. 7
(b) Describe the criteria for design of highway. 8

Section C-Foundation Engineering-30
(Answer any two questions)

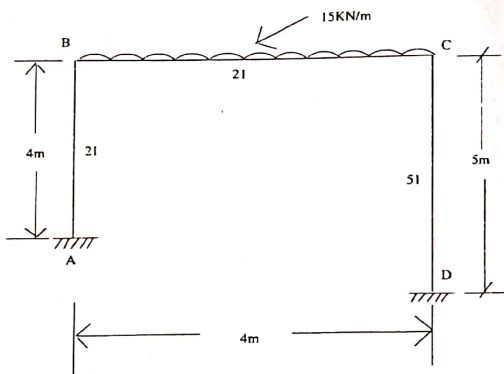
1. (a) What are the main types of soil? How they differ from each other in respect of their characteristics and behaviour? What is meant by sensitivity of clay? 6
(b) Why pile foundation is recommended for a civil engineering structure? What are different types of piles? Describe their use. 9
2. (a) Design a square footing to carry a vertical load (column) of 600 kips. Factor of safety shall be 3. The base of the footing shall be placed 6' below the surrounding ground level. The clay material below the footing has an unconfined compressive strength of 3000 lb/ft². Water table exists at a great depth.
 $f'_c = 3,000$ Psi $f_y = 60,000$ Psi
Other data may be assumed.
(b) Name the causes of soil sample disturbance in soil test. What are the effects of soil sample disturbance on the engineering properties of soil? 5
3. Write short notes on any six of the following: $2 \frac{1}{2} \times 6 = 15$
(a) Plastic limit; (b) Plasticity index; (c) Geotextile and its use; (d) Coefficient of permeability; (e) Cofferdam and its use; (f) Cantilever retaining wall; (g) Compaction of soil; (h) Mat foundations; (i) Quick sand condition.

৩০তম বিসিএস
CIVIL ENGINEERING—FIRST PAPER

[N.B.—The figures in the right margin indicate full marks Answer any two questions from each group.]

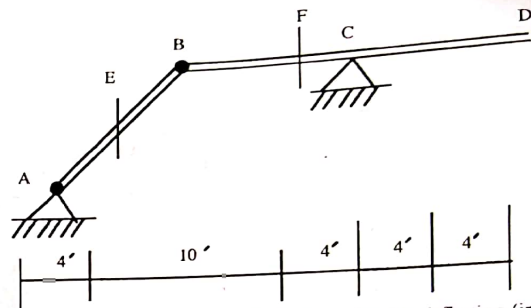
Group I—Structure—40

1. (a) Analyze the rigid frame shown in figure 1 (a) by slope deflection method. Also draw shear force and bending moment diagrams. E is constant for all the members: 15



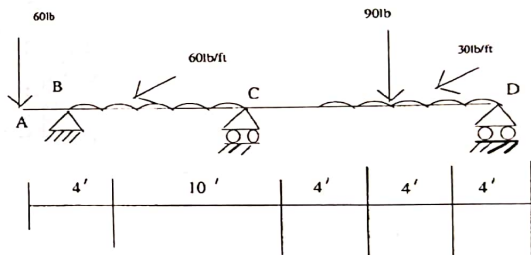
(b) Differentiate between cable and arch from the structural point of view. State and expansion the basic assumptions required for the analysis of cable.

2. (a) Establish the criteria for developing absolute maximum bending moment in a girder for a series of moving loads on it. 5
 (b) Draw the following influence lines for the structure shown in fig-2 15
 (b) as unit load moves from B to D. 15
 (i) Reaction at C; (ii) Shear at E, F; (iii) Moment at E, F; (iv) Shear just at left of C; (v) Moment at C.



3. For the continuous beam in fig-3, determine the deflection (in inches) under the 60lb load of the continuous beam: 20

$I = 2 \times 10^5 \text{ in}^4$
 $E = 3 \times 10^6 \text{ lb/in}^2$



Group II—Water Resource Engineering—30

4. (a) What is meant by meandering of rivers? What are its causes? Explain different meander parameters with neat sketch. 5
 (b) What are the objective and requirements of bank protection? Mention the causes of bank failure. 5
 (c) What is meant by "regime of a river"? Compare briefly silt theories of Kennedy and Lacey. 5

5. (a) Define consumptive use of water. What are the factors affecting consumptive use of water? 7
 (b) Differentiate between Furrow irrigation with sprinkler irrigation. Which one is preferred in Bangladesh and why? 7
6. (a) What are the causes of water-logging? Explain in brief the measures adopted for controlling water-logging. 8
 (b) Design a regime Channel to carry a discharge of 50 cumec. Assume silt factor as 1.0. Use Lacey's theory for design. Assume reasonable value for missing data. 8

Goup III—Environmental Engineering—30

7. (a) What are the basic concepts of small bore sewerage (SBS) system? What factors bring in sufficient cost saving for this system? Explain the suitability of this system in Bangladesh. 8
 (b) "A continuous method water supply is always better than the intermittent method."—Critically discuss the statement. 7
 Also state the basic principles of Hardy-Cross method for analyzing water flow in a pipe network.
8. (a) Define potable and palatable water. Which one can be used for drinking purposes? What are the basic requirements of drinking water? 7
 (b) How many kilograms of bleaching powder with 30% of available chlorine will be required to treat 4 million litres of water with a dosage of 0.5 mg/lit? 7
9. (a) Explain the biological treatment process of sewage. 7
 (b) Calculate the BOD removal efficiency for the single stage high rate trickling filter. BOD loading is 750 g/m³/d and re-circulation ratio is 0.60. 8

৩০তম বিসিএস

CIVIL ENGINEERING—SECOND PAPER
 [N.B.—The figures in the right margin indicate full marks]

Goup I—Structure—40

(Answer any two questions)

1. (a) Define shear of a beam. Mention the location of critical shear for failure for simply supported and fixed supported beam from the support centerline. Draw the sketches. 5
 (b) What is balanced steel ratio? In a well designed RC beam, actual steel ratio is well below the balanced steel ratio? Why? 5
 (c) Design an RC circular spiral column from the given data : 10
 $P_{DL} = 180k$, $P_{LL} = 80k$; $f'_c = 3ksi$, $f_y = 60ksi$. Use USD method.
2. (a) What is corner reinforcement in RC slab? Why and where are they used? State the ACI/BNBC specification for such reinforcement. 7
 (b) Mention the different types of spread footing generally used in RC construction. Also state the suitability of each type. 7

- (c) Why does ACI/BNBC code recommend a relatively smaller value of shear as design shear that occur at a distance 'd' from the support face? 6
3. (a) Write down the classification of pre-stressed concrete structures. Explain any three. 5
 (b) Compare pre-stressed concrete with reinforced concrete with respect to serviceability, safety and economy. 5
 (c) Design a suitable spread footing for 15" x 15" RC column reinforced with $W - \frac{7''}{8}$ ϕ under the following condition : 10
 $P_{DL} = 100k$; $P_{LL} = 70k$; $f'_c = 3ksi$; $f_y = 60ksi$, $q_a = 1.5$ Tsf at 5' below G.L.
 Make a suitable sketch of footing mentioning the reinforcement details.

Section B—Transportation Engineering—30

(Answer any two questions)

4. (a) Compare between bitumen and tar as a binding material of flexible pavement. 5
 (b) Write short notes on application of seal coats, prime coats and tack coats in the construction of flexible pavement. 5
 (c) A density test was made on a sub-grade with the following results : 5
 (i) Wt. of wet soil from hole = 2.45 kg;
 (ii) Volume of hole = 1200 cm³;
 (iii) Moisture content = 12%;
 (iv) Wet density when compacted = 1.94 gm/cm³;
 (v) OMC = 22%.
 Determine percent compaction.
5. (a) What is meant by the term "Point and crossing" in railway engineering? How the detailed inspection of points and crossing is carried out? 6
 (b) Mention the introduction requirements of one-way traffic operation. 4
 (c) State with examples the underlying reasons of improving roadway capacity and safety with the introduction of one-way traffic operation system. 5
6. (a) What are the design criteria for rigid pavement design in PCA method? 4
 (b) What is modulus of sub-grade reaction? 3
 (c) Draw and explain the variation of serviceability index (SI) with time. 4
 (d) What are the advantages and drawbacks of cement concrete road? 4

Section C—Foundation Engineering—30

(Answer any two questions)

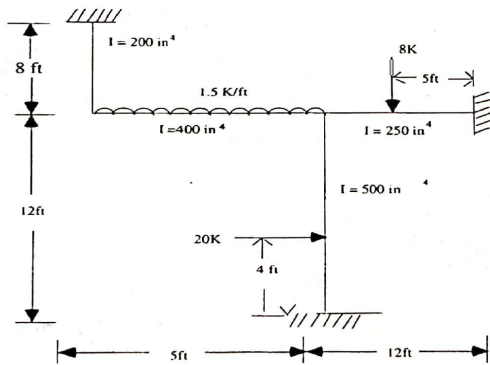
7. (a) Write short notes on the following : 2x5=10

- (i) Pile foundation; (ii) Raft foundation; (iii) Liquefaction of soil; (iv) Over-consolidated clay; (v) Pore water pressure.
- (b) The time required to reach 50% consolidation for a soil specimen of 3cm thick tested in a consolidometer under single drainage condition was 30 minutes. Determine the time required for the same soil of 4m thick to reach the same degree of consolidation, if it has double drainage paths. 5
8. (a) State the different methods for determining the co-efficient of permeability of soil. Explain the factors affecting the permeability of soil. 8
 (b) Differentiate between primary consolidation and secondary consolidation. Explain the different causes of preconsolidation of soil. 7
9. (a) What is meant by SPT of soil? How is it carried out in field? Explain the relationship of SPT value with bearing capacity of soil. 8
 (b) Define shear strength of soil. Explain the shear characteristics of cohesive and cohesionless soil. 7

৩১তম বিসিএস

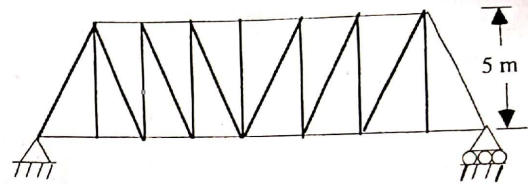
CIVIL ENGINEERING—FIRST PAPER
 [N.B.—Figure in the margin indicate full marks.]
Section A—Structure—40
 (Answer any two questions)

1. Analyze the frame shown below by the moment distribution method. Draw the bending moment diagram and sketch the deflected shape of the structure. 20

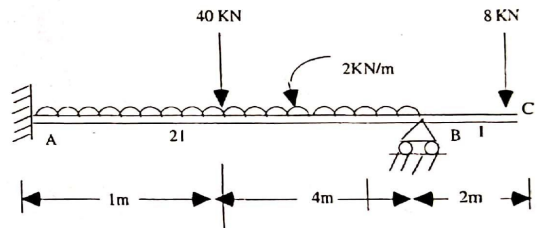


2. A truss as shown below consists of 8 panels each 3.5 metre long. Find

the maximum tension and compression in the member AB, when a concentrated load of 10 tonnes rolls over the truss.



3. A proper cantilever beam ABC is fixed at A, on a roller at B and free at end C. A concentrated load of 40 KN at mid of AB and a uniform distributed load of 2 KN/m over AB. Another 8 KN load is acting at C. Analyze the beam using the principle of consistent-deformation and determine the deflection at the free end C.



Section B—Water Resource Engineering—30
 (Answer any two questions)

4. (a) What are the advantages of sprinkler irrigation? Discuss its suitability in Bangladesh. 5
 (b) Why the irrigation channel is designed as regime channel? Justify your answer. 5
 (c) 15 cumes of water is delivered to a 34 hectare field for 4 hours. Soil proving after the irrigation indicates that 0.3 metre of water has been stored in the root zone. Compute the water application efficiency. 5
5. (a) What are the causes of water logging? 3
 (b) What is meant by 'meandering of rivers' and what are its causes? 4

- (c) The following data pertain to a bridge site of river : 8
 Maximum discharge = 17000 cumec
 Highest flood level = 288.0 m
 River bed level = 280.0 m
 Average diameter of river sand = 0.25 mm.
 Design and sketch a guide bank to train the river.
6. (a) What do you mean by flood management? Describe the different engineering measures to protect flood prone areas. 6
 (b) Discuss the various methods of estimating the design flood of a catchment. 6
 (c) Distinguish between 'Groyne' and 'Guide Bank'. 3

Section C-Environmental Engineering-30

7. (a) Explain the process of coagulation-sedimentation. How does it differ from plain sedimentation? 5
 (b) Draw a typical chlorination curve and explain the reaction zones. Explain break-point chlorination. 5
 (c) Calculate the dimension of a rectangular setting tank to treat 120 m³ of water per hour when the overflow rate is 0.75 m/hr and the detention time is 2 hours. 5
8. (a) Explain the principles of biological waste treatment processes. Outline the differences between aerobic oxidation and anaerobic digestion processes of waste treatment. 7
 (b) Describe the working principle of Activated Sludge Process for sewage treatment. 5
 (c) Briefly describe the composition of human body waste. 3
9. (a) Define per capita consumption of water. What are the factors affecting per capita consumption of water? 5
 (b) Define the sanitary landfill method of final disposal of solid wastes. What are the important aspects that need to be considered in the design and operation of sanitary landfills? 6
 (c) State and explain BOD removal kinetics. 4

৩১তম বিসিএস

CIVIL ENGINEERING-SECOND PAPER

[N.B.—The figures in the right margin indicate full marks]

Section A-Structure-40

(Answer any two questions)

1. (a) Explain the different methods for approximate analysis of building frame subjected to lateral loads. 5
 (b) How does the effect of earthquake load differ from wind load when imposed to structures? 3
 (c) In designing an interior panel of a flat plate slab with Direct Design

- Method the total static moment in the long direction is found to be 410 k-ft. Design the reinforcement for the panel in the column strip. Consider width of column strip = 10 ft and effective depth = 7.5 in. Use $f'_c = 4$ ksi and $f_y = 60$ ksi. Assume any reasonable data if required. 12
2. (a) What are diagonal tension cracks in beam? How does the formation of diagonal cracks cause the redistribution of internal stresses in RC beam? 4
 (b) Explain strength interaction diagram of RC column. Also state the necessity of using unsymmetrical reinforcement in RC column. 5
 (c) A rectangular RC beam having $b = 10$ in, $h = 22$ in, spans 18 ft of simple support. It is reinforced for flexure with 3 # 8 ϕ bar and is to carry a service DL = 1.3k/ft (excluding self wt.) and service LL = 2.2 k/ft, both uniformly distributed along the span. Material strengths are : $f'_c = 3$ ksi and $f_y = 60$ ksi.
 (i) What part of the beam to be web reinforced?
 (ii) Design the web reinforcement for the beam.
3. (a) Write down the classification of pre-stressed concrete structures. Explain any two. 5
 (b) Compare pre-stressed concrete with reinforced concrete with respect to serviceability, safety and economy. 5
 (c) A 15 in brick wall supports a DL = 12 k/ft and LL = 8K/ft. The wall footing is to be placed at 5'-0" below the G. L and $q_a = 4$ ksf is reported at that level. Design a RC footing using $f'_c = 3.5$ ksi and $f_y = 60$ ksi. 10

Section B-Transportation Engineering-30

(Answer any two questions)

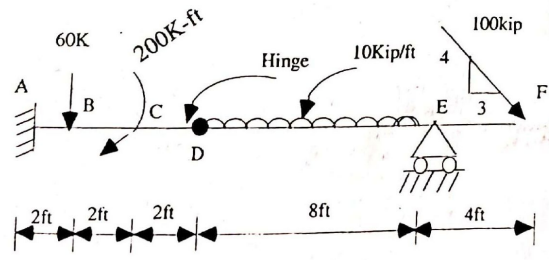
4. (a) What is right of way? State the factors governing the land width of a highway. 4
 (b) What do you mean by highway alignment? Discuss the factors controlling the alignment of a highway. 5
 (c) State the objectives of highway planning. Explain briefly the planning survey for a highway project. 6
5. (a) State the importance of geometric design of a highway. Briefly discuss the geometric design elements of a highway. 6
 (b) Define the term 'traffic volume'. Explain the different methods for carrying out traffic volume studies. 5
 (c) What are the common requisite properties of aggregates in highway construction? 4
6. (a) What is coning of rails? Why coning of wheels is mainly done. 4
 (b) Write the requirements of an ideal sleeper. Write the advantages of steel sleeper over wooden sleeper. 6
 (c) Draw the cross-section of ballast in railway. Write the function of ballast. 5

Section C-Foundation Engineering-30
(Answer any two questions)

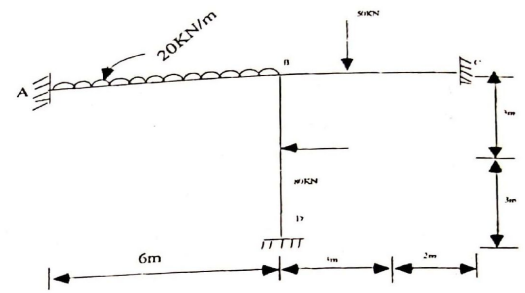
7. (a) What do you mean by active and passive earth pressure? 4
(b) Draw a neat diagram showing the variation of different co-efficient of earths pressure. 4
(c) A clay stratum 5 m thick has the initial voids ratio of 1.50 and the effective overburden pressure of 120 KN/m². When the sample is subjected to a increased pressure of 120 KN/m², the void ratio reduces to 1.44. Determine the co-efficient of volume compressibility and final settlement of the stratum. 4
8. (a) What are the principal objectives of soil exploration? Write down the most common types of in-site tests. 5
(b) Discuss the effect of water table on the bearing capacity of soil. 4
(c) What are the different types of raft foundation? Explain the procedure for designing a raft foundation. 6
9. (a) Explain the various types of pile foundation. 6
(b) Write short notes on : 4
(i) Plasticity index; (ii) Sand drain; (iii) Negative skin friction; (iv) Liquefaction of soil. 6
(c) A square concrete pile (30 cm side) 10 m long is driven into coarse sand ($r = 18.5 \text{ KN/m}^3$, $N = 20$). Determine the load capacity of the pile. 5

৩২তম বিসিএস
CIVIL ENGINEERING-FIRST PAPER
[N.B.—Figure in the margin indicate full marks.]
Section A-Structure-40
(Answer any two questions)

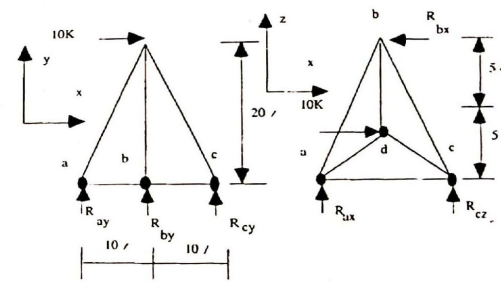
1. (a) Determine the reaction components and then draw the shear force and bending moment diagrams for the beam loaded as shown in Fig. 1 :



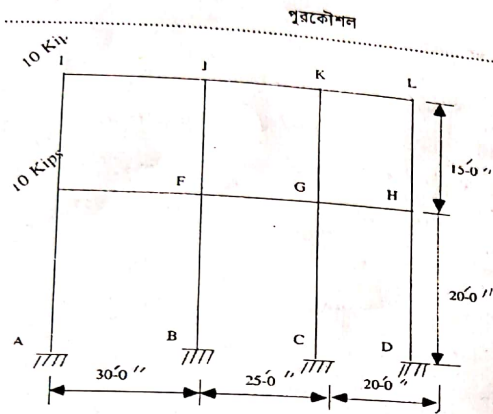
- (b) Analyze the frame, as shown in Fig. 2, by the moment distribution method. 'E' is same for all members. 10



2. Determine the bar forces and reaction components of the space truss loaded as shown in Fig. 3 : 20



3. (a) Mention the assumptions made in the Portal method of structural analysis for frames subjected to lateral loads. Illustrate with sketches. 5
(b) Determine the maximum bendings moments and shear forces in column 'CG' and girder 'JK' of the frame subjected to lateral load as shown in Fig. 4. Also draw the shear force and bending moment diagrams for these two members. Use Portal method :



Section B—Water Resource Engineering—30
(Answer any two questions)

- (a) Name the important types of river training method and indicate the purposes for which each type is adopted. 5
(b) Give a typical plan and sections of a Guide Bank and discuss its design procedure step by step. 10
- (a) Explain the terms : (i) Flood management; (ii) Flood proofing; (iii) Controlled flooding; and (iv) Design flood. 8
(b) Discuss the advantages and ill-effects of embankment as a measure for flood management. 7
- (a) What is spur? Explain the different types of spur based on their alignment with neat sketches. 6
(b) Design a concrete lined channel to carry a discharge of 350 cumecs by a slope of 1 in 5000. The side slopes of the channel are 1.5 : 1 and Manning's n value may be taken as 0.014. Assume the limiting velocity in the channel as 2m/sec. 9

Section C—Environmental Engineering—30

- (a) Explain the mechanism of filtration. 5
(b) What are the operational difficulties in Rapid Sand Filter? How can you overcome those? Explain. 10
- (a) Define the following terms : 6
(i) Break point chlorination; (ii) Critical settling velocity; (iii) Aquifer.
(b) What is meant by free available chlorine and combined available chlorine? Explain their mechanism with proper reactions. How these

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- destroy bacteria and viruses of polluted water? 9
3. (a) Describe the functional elements of solid waste management. 6
(b) What are the methods of sanitary land filling of final disposal of solid waste? Describe. 9

৩২তম বিসিএস

CIVIL ENGINEERING—SECOND PAPER
(N.B.—The figures in the right margin indicate full marks)
Section A—Structure—40
(Answer any two questions)

- (a) A rectangular beam having $b = 12''$ and $d = 22''$ spans 20' face to face of simple supports. It has to carry service dead load 1.63 k/ft and service live load of 3.10 k/ft, both uniformly distributed along the span. Design the shear reinforcement using # 3 bar as vertical U stirrups. Material strengths are $f_c = 4000$ psi and $f_y = 60,000$ psi. 3
(b) Define the following terms :
Bar cutoff, Development length and Bond stress. 5
(c) Write down the factors influencing development length of bar. 5
- (a) Discuss the situations in which each of the following types of retaining wall is used? Also draw neat sketches of them : 6+3=9
(i) Gravity wall; (ii) Cantilever wall and (iii) Counterfort wall.
(b) Write down the main requirements of ACI code for designing cantilever retaining wall. 7
(c) Design the stem of a cantilever retaining wall to support a bank of earth 20ft high. The top of the earth is to be level with a surcharge of 500 psf. Given that $\phi = 36^\circ$, allowable soil bearing capacity = 4 ksf, $f_c = 3.5$ ksi, $f_y = 60$ ksi, $\gamma_{\text{soil}} = 118$ psf and ground water level is 10 ft below top level of FGL. 7
- (a) When and why does corner reinforcement used in a two way RC slab? 3
(b) A rectangular slab is simply supported along all the sides and to be isotropically reinforced. Determine the ultimate resisting moment 'm' per linear foot required just to sustain a udl of 'w' psf. 12
(c) Why spiral column is shorter than tied column? Explain. 5

Section B—Transportation Engineering—30
(Answer any two questions)

- (a) Why joints are provided in rigid pavement? What do you mean by slip form paving? 5
(b) What are the factors affecting structural design of rigid pavement? Why do we need to blend the aggregates? 5
(c) Explain the following term : 5
(i) Apron; (ii) Taxiway; (iii) Runway; (iv) Hanger; (v) Area Traffic

Control (ATC).

5. (a) What is meant by gauge of rails? What are the gauges used in Bangladesh Railway? Would you advocate one uniform gauge throughout the country? Why? 6
- (b) Explain with neat sketches the various devices used in railways to divert trains from one track to another. 4
- (c) Discuss briefly the causes and remedies for creep of rails. 5
6. (a) Plate bearing test was carried out on sub-grade and base layers of the pavement. Plate diameter was adopted 30 cm and thickness of base layer 20 cm. The developed pressure at 0.5 cm deflections are 1.0 and 4 kg/cm² on sub-grade and base-layer respectively. Design pavement for 5443 kg wheel load. Tyre pressure is 6 kg/cm² for a permissible deflections of 0.5 cm. 9
- (b) Write short notes on : 6
- (i) Plash Paint; (ii) Fire Point; (iii) Loss on heating test.

Section C—Foundation Engineering—30

(Answer any two questions)

7. (a) Define the followings geotechnical terms : 5
- (i) Flow index; (ii) Toughness index; (iii) Liquidity index; (iv) Plasticity index; (v) Density index.
- (b) Mention the basic objectives and specifications for soil compaction. 5
- (c) A 27.50 lb soil sample has a volume of 0.220 cft, moisture content of 15.2% and specific gravity of soil solids of 2.67. Compute the bulk density, dry density, degree of saturation and void ratio. 5
8. (a) What is meant by OCR? Differentiate between OC clay and NC clay. How will you find the preconsolidation pressure for clay? 6
- (b) Where and why geotextiles are used? 3
- (c) When and why raft foundations are used? 3
- (d) When and why sheet pilings are used? 3
9. (a) Draw and discuss different types of footings. 6
- (b) Differentiate the following : 6
- (i) Seepage and permeability; (ii) Effective stress and total stress; (iii) Sand pile and sand drain.
- (c) When and why pile foundation is more suitable than that of shallow foundation? 3

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CIVIL ENGINEERING
FIRST PAPER
Subject Code : 881

Time Allowed — 3 hours

Full marks — 100

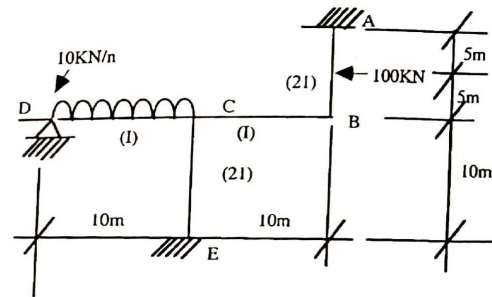
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Section A— Structure

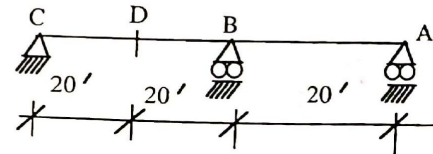
Marks—40

(Answer any two questions)

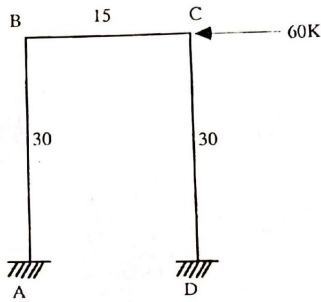
1. (a) Define stiffness and carryover factor of a structural member. Derive the expression for stiffness and carryover factor of a prismatic beam when the far end is fixed. 5
- (b) Analyse the frame shown in Fig 1(b) by moment distribution method. Draw SED & BMD of the frame. 15



2. (a) Define influence line (IL) diagram of a structure. State its practical aspects in structural analysis. 4
- (b) State Brelau Principle regarding IL diagram. Explain its practical application. 4
- (c) Draw IL diagram for shear at D of the continuous beam ABC Shown in Fig 2 (C). Compute the IL ordinates at interval. EI is constant. 12



3. (a) Analyse the following by portal method and draw SFD and BMD. 12



(b) List the methods available for approximate analysis of building frame subjected to lateral loads. Mention the assumptions required for each method. 8

Section B— Water Resources Engineering
Marks—40

(Answer any two questions)

4. (a) Write short notes on :- 3 × 5 = 15
 (i) Water losses in irrigation canal;
 (ii) Berms & counter berms;
 (iii) Lining of irrigation canals;
 (iv) Balancing depth;
 (v) Ill effects of irrigation.
5. (a) What is meant by river training? State the objectives of river training. 3
 (b) What are cutoffs and how are they artificially induced? What are the advantages and disadvantages? 4
 (c) Determine the size of a circular tile drain, draining 6 hectares of a drainage area if the drainage coefficient is 1.5 cm and grade is 4%. Assume rugosity coefficient for the tile material is 0.013. 8
6. (a) What is meant by water logging? Explain principal causes and effects of water logging in a irrigation canal. 4
 (b) Define flood. State the various causes of flood. What is meant by design flood? 3
 (c) Design a regime channel for a discharge of 60 cumecs. Assume silt factor = 1.10. Assume any reasonable value of missing data. 4

Section C— Environmental Engineering
Marks — 30

(Answer any two questions)

7. (a) What do you mean by filtration of water? Discuss briefly the theories of filtration. 4
 (b) Draw a typical chlorination curve and explain the reaction zones. Also explain the break point chlorination. 4
 (c) A slow sand filtration unit is producing 1500 m³ of water/day. How much bleaching powder with 30% available chlorine will be required per day to treat this water with a chlorine dose of 0.5 mg/L 7
8. (a) What are the main types of water distribution networks? State their relative advantages and disadvantages. 5
 (b) How can water demand of a community be estimated? Explain. 4
 (c) Mention step procedure to calculate the flow of water in a looped network Using Hardy Cross Method. 6
9. (a) Discuss the types of sewer. 4
 (b) A 15" sewer with $n = 0.015$ is laid on a slope of 0.018. What is the discharge and velocity of the sewer when flowing (i) half full and (ii) when the depth of flow is 5.0". 6
 (c) Define the functional elements of waste management. State the effect of solid waste management. 5

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CIVIL ENGINEERING
Second PAPER
Subject Code : 882
Time Allowed — 3 hours
Full marks — 100

[N.B. — The figures in the right margin indicate full marks.]

Section A— Structure
Marks—40

(Answer any two questions)

marks

1. (a) What are the criteria that required to the design of tall buildings? Explain them with their requirements for the same.
- (b) What are the different methods available for seismic design of reinforced structures? Write down the suitability of different methods according to BNBC.
- (c) List the methods available for the design of flat plate/slab. State the restrictions for the use of direct design method in flat plate/slab design.
- (d) Mention the strenght reduction factors (ϕ) for the followings (i) flexure; (ii) shear; (iii) torsion; (iv) spiral column Also state the reasons for variation of the above mentiones (ϕ) values.
- (e) What are the various structural forms of tall buildings? Explain the assumpins made in analysing by factor method.
- (f) "Concrete of substantially higher compressive strength and higher strength of steel should be used for prestressed concree construction" Justify the statement.
- (g) (i) What do you mean by preliminary and final design of prestressed concrete flexural member?
(ii) How $\frac{MT}{MCT}$ ratio influences the flexural design of a prestressed concrete structural element?
(h) Waht is partial prestressing? How can it be done? State the advantages and disadvantages of partial prestressing of prestressed concrete structures.
- (i) What do you mean by inflection point? Write down the assumptions needed for analysing of building frame subjected to vertical load.
2. A conecte floor system consists of parallel T-beam spaced 10ft on centers and spanning 32ft between supports. the 6 inch thick slab is poured monolithically with T-beam webs having width $b_w = 14$ inch and total depth measured from the top of the slab of $h = 28$ inch. In addition to its own weight, each T-beam must carry a superimposed dead load of 50 psf and service live load of 225 psf. Material strength $f_y = 60$ ksi and $f'_c = 3$ ksi. Determine the required tensile steel area and needed reoars for a tyical member. 20
3. (a) What is lap splices? What are the ACL code requirements for : $4 + 6 = 10$
(i) Lap splices in tension;
(ii) Compression splices;
(iii) Column splices.
(b) A $15'$ long and $10'$ wide uniformly loaded slab is simply supported along two short sides; the long sides are unsupported. The slab thickness

is $8''$ with # 5 ϕ bar spaced $6''$ dc as main flexural steel. Calculate the maximum uniformly load that the slab can carry. Given $f'_c = 4$ ksi and $f_y = 60$ ksi.

Section B— Transportation Engineering

Marks—30

(Answer any two questions)

1. (a) Write down the function of Ballast in a railway track. 4
(b) Define Yard. Discuss the important points needs to be considered in designing Marshalling Yard. 5
(c) Design the rate of super elevation for a curve of radius 400 m and speed of 80km/h. Also cheek the co-efficient of lateral frictions. 6
2. Answer any three from the following questions :- 5 × 3 =15
(a) What is transportation system? What are its various functional elements? Explain.
(b) What do you mean DHV? Discuss with neat sketch. What are the specifications of this for urban area?
(c) What are the various types of regulatory speeds? Explain them with neat sketch.
(d) Where and why is runway number to be provided? put the runway number for the

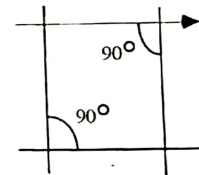


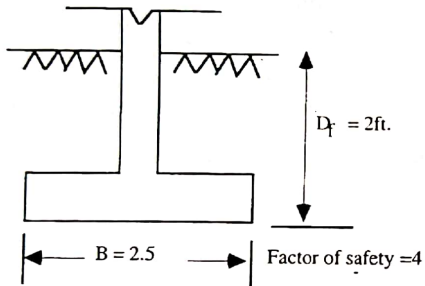
Fig. 1 :

- (e) How can it be differentiated between "apron" and "taxiway"? Explain them with neat sketch.
3. (a) Write down the advantages and disadvantages of rotary intersection. 4
(b) Define the following :- 6
(i) Overtaking sight distance;
(ii) Transition curve;
(iii) Rigid pavement.
(c) Write short notes on : 5

- (i) Flsh point.
- (ii) Loss on ignition.

Section C— Foundation Engineering
Marks —30
(Answer any two questions)

1. (a) A continuous footing is shown in the figure below. Using Terzaghi's bearing capacity factors, determine the gross allowable load per unit area (q_{all}) that the footing can carry :



- (b) Discuss the factors affecting the field compaction. 3
 - (c) Write short notes on :- 6
 - (i) Optimum moisture content and field moisture content;
 - (ii) Plasticity Index and Liquidity Index;
 - (iii) Seepage and permeability.
2. Answer any five questions from the following :- $5 \times 3 = 15$
- (a) What is the basic principle of tri-axial test? Explain its practical significance with neat sketch.
 - (b) What are the uses of plate load test? Discuss its limitations.
 - (c) What is meant by percent compaction? What are its practical application?
 - (d) What is zero air void line? Why does it not pass through the point of maximum dry density (MDD)? Explain.
 - (e) What is quick sand? What are the characteristics of quick sand condition?
 - (f) What are the various types of piles according to the method of

- installation? What are their uses?
 - (g) How would you determine the time-settlement curve in the field?
 - (h) Explain the suitability of various types of spread footing in reinforced concrete construction.
3. (a) Define the following :- 5
- (i) OCR;
 - (ii) Effective stress;
 - (iii) Sheet pile;
 - (iv) Density index;
 - (v) Overburden pressure.
- (b) Draw and discuss different types of footing. 5
- (c) The dry density of a sand with porosity of 0.381 is 1600 kg/m^3 . Find the void ratio of the soil and the specific gravity of the soil solids. 5

পুর-কৌশল

৩২৩

JULY

First Paper Subject Code : 881

নির্ধারিত সময় - ৩ ঘণ্টা

পূর্ণমান - ১০০

[N.B- the figures in the right margin indicate full marks.]

Section A- Structure
(Answer any two questions)
Marks-40

Marks

1. For the continuous beam in Fig-1, determine the deflection (in inches) under the 100lb load of the continuous beam. Given that $I = 2 \times 10^5 \text{ in}^4$ and $E = 30 \times 10^6 \text{ lb/in}^2$ 20

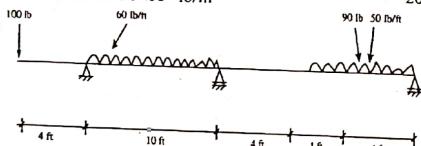


Fig - 1

2. (a) Define influence line. Why it is important in bridge design? 5
(b) Draw the influence line for the members indicated of a parallel chords truss as shown in Fig. 2(b) when unit load moves from I0 to I6

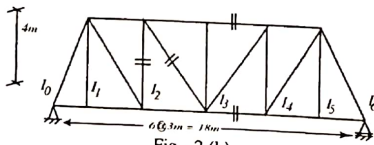


Fig - 2 (b)

3. (a) Distinguish between :-
(i) h20 and H20 S16 loading;
(ii) Wheel loading and lane loading;
(ii) Diaphragm and Girder. 6
(b) Analyze the rigid frame as shown in Fig 3(b) by force method. 14

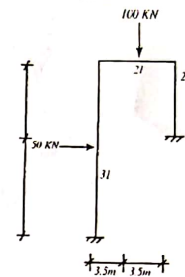


Fig - 2 (b)

Section B- Water Resources Engineering
(Answer any two questions)
Marks-30

4. (a) What is meant by 'regime of a river'? Compare briefly Silt theories of Kennedy and Lacey. 7
(b) Design a regime channel to carry a discharge of 66 m^3/sec . Assume silt factor as 1.10. Use Lacey's theory for design. Also assume reasonable value for any missing data. 8
5. (a) Explain the terms :-
(i) Controlled flooding;
(ii) Flood management;
(iii) Root zone depth;
(iv) Flood proofing. 8
(b) Discuss the advantages and ill-effects of embankment as a measure for flood management. 7
6. (a) Define consumptive use of water. What are the factors affecting consumptive use of water? 5
(b) Differentiate between Furrow irrigation and Sprinkler irrigation. Which one is preferred in Bangladesh and why? 5
(c) Name the important types of river training method and indicate the purpose for which each type is adopted. 5

Section C- Environmental Engineering
(Answer any two questions)
Marks - 30

7. (a) What do you understand by disinfection? Describe various methods of disinfection. 4
(b) Distinguish between:-
(i) Primary clarifier and secondary clarifier; 6

Structure-30

(Answer any Two of the following questions Q. 16 to Q. 18)

16. (a) What do you mean by "Passive earth pressure"?
 (b) Properties of a soil layer are $c = 15 \text{ kN/m}^2$, $\phi = 30^\circ$, $e = 0.6$ and $G = 2.7$. Determine the shear strength of the soil along a horizontal plane at a depth of 5 m in soil layer, if:
 (i) Water table is at the ground surface and (ii) Water table is at a depth of 3 m from the ground surface.
 (c) Write short note on Pile foundation and Mat foundation.
17. (a) The following results were obtained from tri-axial compression tests on a normally consolidated clay. Plot the strength envelope in terms of total and effective stresses. Determine the cohesion and angle of internal friction.

| Sample No. | Cell Pressure $\sigma_3 \text{ kN/m}^2$ | Deviator Stress, d kN/m^2 | Pore-water Pressure kN/m^2 |
|------------|--|---|--|
| 1 | 50 | 180 | -20 |
| 2 | 100 | 320 | 50 |
| 3 | 150 | 450 | 70 |

- (b) Define following terms (i) Cohesive soil (ii) Angle of internal friction (iii) Compression index (iv) Pre-consolidation pressure.
18. A layer of clay 2.0 m thick is subjected to a loading of 0.5 kg/cm^2 . After one year loading the average consolidation is 50%. The layer has double drainage:
 (i) What is the co-efficient of consolidation?
 (ii) If the co-efficient of permeability is 3 mm/yr , what is the settlement after one year?
 (iii) How much time will the layer takes to reach 90% consolidation? assume $T_{v2} = 0.848$.

Marks
3
7
5
7

সাহায্য

Subject Code : 881

Time - 4 hours

Full Marks-200

৩৭ BCS
স্বাক্ষর

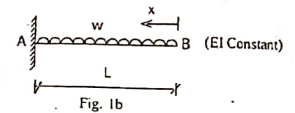
[দ্রষ্টব্য-প্রশ্নের উত্তর ইংরেজি ভাষায় বাংলা যে কোন একটি ভাষায় দিতে হবে। তবে টেকনিক্যাল শব্দগুলো ইংরেজিতে লেখা চলবে। প্রত্যেক প্রশ্নের মান প্রশ্নের শেষ প্রান্তে দেখানো হয়েছে।]

Part-I

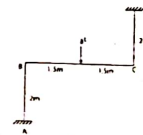
Structure-30

(Answer any Two of the following questions Q. 1 to Q. 3)

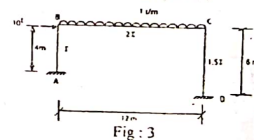
1. (a) Explain the terms :
 (i) Distribution factor (ii) Carry over factor
 (iii) Shear equations (iv) Rotation factor (v) Fixed Beam
 (b) Using virtual work, compute the deflection S_B and the slope Q_B at the tip of the uniformly loaded cantilever beam as shown in the following figure (1b)



2. Determine the joint moments of the frame given in the following figure- (2). Assume all members to have identical cross-section. Hence draw the bending moment diagram (BMD).



3. Analyze the frame shown in the following figure (3).



[Please turn over]

and a calculated dead load of 1.05 kip/ft on an 18 ft. Simple span is limited in cross section for architectural reason to 10 inch width and 20 inch total depth. If $f_y = 60,000$ psi and $f_c = 4000$ psi. Estimate the steel requirement.

- (b) An I-shaped beam is pre-stressed with $A_{ps} = 1050$ mm² as prestressing steel with an effective stress f_{se} of 1950 MPa. Material properties are : $f_{pu} = 2000$ MPa. $f_c = 49$ Mpa. Find the Ultimate resisting moment of the section following ACI code. Use the section given in fig (gb).

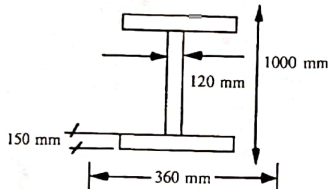


Fig. 8 (b) for question 8 (b)

9. (a) Compare Rigid Pavement with Flexible Pavement. Define Prime Coat, Tack Coat and Seal Coat. 8
- (b) What are different factors influencing Air Travel Demand?
10. (a) What are the different points that has to be considered in selecting a railway stations? A curve of 6° is situated on a B.G. Line and a train with a total weight of 1200 tons is passing over it. Calculate the curve resistance?
- (b) Define passenger load factor (PLF). Calculate the PLF with following data: 5 Flight per day; Seat Capacity = 100 Passengers; Average distance travelled per flight = 250 km; and average passengers per flight = 68.
- (c) What are the common requisites properties of aggregates in highway construction? 4
11. (a) What are principal objectives of soil exploration? What are common safety measures that should be taken during soil excavation. 8
- (b) Find the center of the critical circle for $\beta = 75^\circ$, $H = 60$ ft and $D = 18$ ft and toe circle failure. 5
12. (a) Show with diagram the different modes of slope failure. 6
- (b) Estimate F for a slope having $H = 20$ m, $D = 4$ m. $\beta = 25^\circ$, $\delta = 19$ KN/m³, $C_u = 50$ Kpa. 4

- (c) A closed ended steel pipe, 30 cm in diameter and 20m long is driven to a sand deposit with cut-off at ground level. The depth wise variations of N and ϕ values is given in the following Fig. 12 (c). The water table is 3m below ground level. Compute the ultimate load capacity of the pipe based on soil support using N value.

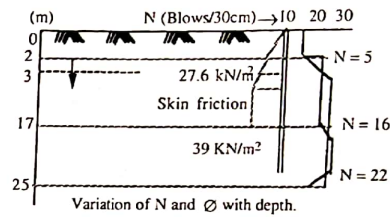


Fig. 12 (c) for question 12 (c)

Structure-30

(Answer any Two of the following questions Q. 4 to Q. 6)

- | | |
|---|-----------|
| | Marks |
| | 3 X 2 = 6 |
| 4. (a) Explain the following terms: | 5 |
| (i) Flood control (ii) Flood prevention (iii) Flood protection | 4 |
| (b) "All the waters are not fit for irrigating crops"-Explain the above statement. | 8 |
| (c) What do you mean by Electrical Conductivity of water in irrigation. | 7 |
| 5. (a) Compute the depth and frequency of irrigation required for a certain crop with the following data. | 7 |
| Root zone depth - 95 cm | |
| Field capacity - 28% | |
| Wilting point - 14% | |
| Apparent specific gravity of soil = 1.3 | |
| Consumptive use of water for the given crop = 15 mm/day | |
| Efficiency of irrigation = 70% | |
| (b) Derive a relationship between duty, base and delta. Explain with a neat diagram how does duty differs from that at the head of a water course and that at the head of a Canal bringing water to the water course. | 8 |
| 6. (a) Design a surface drainage channel in non-alluvial soil to carry a discharge of 12 m ³ /s with a velocity of 1.0 m/s. Assume side slopes 0.5 : 1 bed slope 1 : 6000 and Manning's n = 0.0225. | 7 |
| (b) State the necessity of drainage. Discuss briefly some of the important field investigations necessary for drainage works. | 5 |

Structure-30

(Answer any Two of the following questions Q. 7 to Q. 9)

- | | |
|---|----|
| 7. (a) Describe the elements of water supply system. | 5 |
| (b) The total population of an area was 7000 in 2015. | 10 |
| (i) Estimate the population of the area for the year 2020 (considering annual growth rate 1%). | |
| (ii) Determine the amount of water required for fire fighting for the same area in 2025. | |
| 8. (a) Explain the biological treatment processes of sewage. | 8 |
| (b) Calculate the BOD removal efficiency for the single high rate trickling filters. BOD loading is 750 g/m ² /d and re-circulation ratio is 0.70. | 7 |
| 9. (a) What are the requirements of materials used in sewer pipes? | 5 |
| (b) Why circular section is commonly used in sewer? | 5 |
| (c) Describe briefly quality of water in physical, chemical and biological views. | 5 |

Part-II

Structure-40

(Answer any Two of the following questions Q. 10 to Q. 12)

- | | |
|---|----|
| 10. (a) What do you mean by "balanced steel ratio"? Prove that the balanced steel ratio of a singly rectangular beam is given by | 9 |
| $\rho_b = 0.85 \beta_1 \frac{f'_c}{f_y} \frac{87000}{87000 + f_y}$ | |
| (b) What do you mean by "One way" and "Two way" slab? What are the conditions for a slab to be considered as a "One way" or "Two way" action? | 2 |
| (c) Define shear of a beam. | 2 |
| 11. (a) A rectangular beam which carry a service live load of 36.0 kN/m and a calculated dead load of 15.3 kN/m on a 6.5 m simple span is limited in size of 250 mm wide and 500 mm depth. If $f_y = 414$ MPa and $f'_c = 28$ MPa, what steel area (s) must be provided. Using $\beta_{max} = 0.0278$. | 6 |
| (b) What will be the design shear strength of a RCC beam having width b and effective depth d if the concrete is (i) light weight or (ii) normal density? | 5 |
| 12. (a) Write the recommendations for effective width of flange according to ACI code. | 15 |
| (b) A flange 700 mm wide and 150 mm deep poured monolithically with a web of 250 mm which extends 600 mm below the bottom surface of the flange to produce a beam of 750 mm total depth. Tensile reinforcement consists of eight ϕ 32 mm placed in two horizontal rows. The centroid of the bar group is 650 mm from the top of the beam. It has been determined that concrete has a strength of 23 MPa and that the yield stress of the steel is 414 MPa. What is the useful moment capacity of the beam? | |

Structure-30

(Answer any Two of the following questions Q. 13 to Q. 15)

- | | |
|---|---|
| 13. (a) State the advantages of uniform gauge of a railway line. | 3 |
| (b) Discuss the function and requirements of sleeper and ballast. | 3 |
| (c) Compare railways with highways and state the social and economic advantages of railway. | 5 |
| 14. (a) Describe the functions of base, sub-base and surface course of a flexible pavement. | 6 |
| (b) What are the desirable properties of course aggregate used in Pavement construction. | 3 |
| (c) List the laboratory test for sand and Bitumen. | 4 |
| 15. (a) Define ADT and AADT. | 3 |
| (b) Define Saturation flow, cycle time, amber period of a signalized intersection. | 6 |
| (c) "Mirpur road is unable to work as an arterial for Dhaka"-Explain. | 5 |

[Please turn over]

Subject Code: 881

Full Marks: 200

Time: 4 hours

[N.B. Figures in the right margin indicate full marks.]

Part I

Structure

Marks: 20×2=40

(Answer any two questions)

Marks
4×2.5 = 10

1. (a) Explain the following:
- (i) Static and kinematic indeterminacy.
 - (ii) Conjugate beam.
 - (iii) Space truss.
 - (iv) Stiffness factor.

- (b) Draw shear force diagram (SFD) and bending moment diagram (BMD) of the following continuous beam. 10

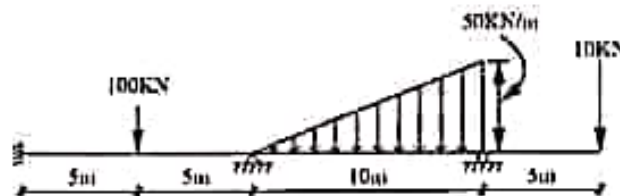


Figure for question 1(b)

2. (a) For what value of P, the deflection of beam at C will be Zero? $EI = \text{constant}$. 10

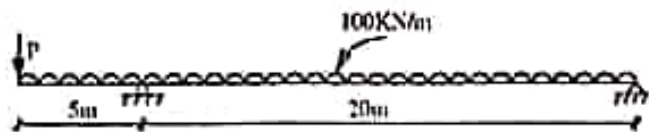


Figure for question 2(a)

- (b) Using energy method, determine the horizontal displacement of the joint D of the truss shown in the figure. Use $E = 29 \times 10^3 \text{ ksi}$. 10

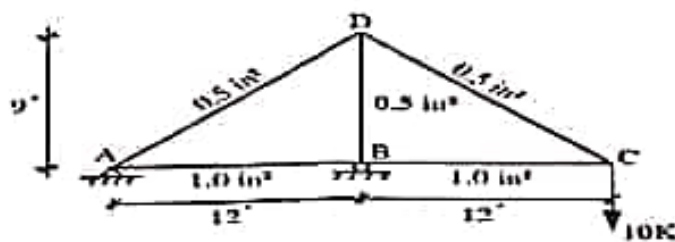


Figure for question 2(b)

3. Analyze the frame shown in the following figure. 20

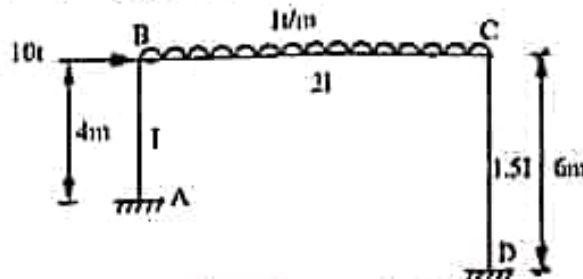


Figure for question 3

[Please turn over]

Water Resources Engineering

Marks: 15×2=30

(Answer any two questions)

- | | Marks |
|---|-------|
| 4. (a) Define consumptive use of water. What are the factors affecting consumptive use of water? | 7 |
| (b) What are the causes of water-logging? Explain in brief the measures adopted for controlling water-logging. | 8 |
| 5. (a) Define design flood. Explain the various methods for estimating the design flood of a catchment. | 7 |
| (b) Explain the principal causes of flood and possible remedial measures for flood mitigation. | 8 |
| 6. (a) Explain the term 'Leaching requirement.' | 3 |
| (b) What is SAR? Discuss the effect of salt on plant growth. | 8 |
| (c) A loam soil has field capacity of 25% and permanent wilting percentage 10%, the dry unit weight of soil is 14.72 kN/m^3 . If the depth of root zone is 0.75m, determine the storage capacity of the soil. Irrigation water is supplied when moisture content drops to 14%. If water application efficiency is 75%, determine the water depth required to be applied in the field. | 8 |

Environmental Engineering

Marks: 15×2=30

(Answer any two questions)

- | | |
|---|--------|
| 7. (a) State the basic assumptions in Hardy-cross method for pipe-flow distribution. Also, state the step-wise procedure for calculating pipe flow using Hardy-cross method. | 9 |
| (b) Write short notes on: | 3×2= 6 |
| (i) Aerobic and anaerobic bacteria. | |
| (ii) BOD and COD. | |
| 8. (a) Discuss, in brief, the principles involved in the design of sedimentation tank. | 5 |
| (b) It is required to disinfect 500,000 gpd of water with 0.3 mg/l of chlorine. If bleaching powder that contains 33.33% of available chlorine is used, how much bleaching powder is needed to treat the daily flow of water? | 5 |
| (c) What do you mean by coagulant and coagulation? Critically examine the purposes and process coagulation of sewage. | 5 |
| 9. (a) List the properties that are required to be analyzed if solid wastes are to be used as resources. | 4 |
| (b) Write short notes on: | 6 |
| (i) Activated sludge | |
| (ii) Sludge seeding | |
| (iii) Enzymes | |
| (c) For a domestic sewage having 5-day BOD of 200 mg/l at 20°C calculate the BOD at 1 and 5 days at 12°C. Assume the value of R as 0.18 per day at 20°C. | 5 |



**Part II
Structure**

Marks: 20×2=40

(Answer any two questions)

10. (a) State the necessity of approximate analysis of building frames. Also, explain the methods available for approximate analysis of building frames subject to wind or earthquake loads. Marks
7
- (b) Draw SFD and BMD of the building frames shown in the figure. Use approximate methods. 13

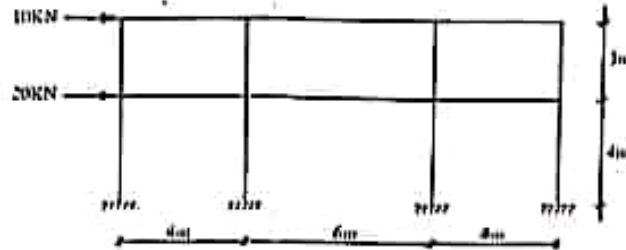


Figure for question 10(b)

11. (a) Write notes on: 2×5= 10
- (i) Modular ratio
 - (ii) Stress ratio
 - (iii) Transformed section
 - (iv) Tensioned controlled member
 - (v) Column strength interaction diagram
- (b) For the RC beam shown in the figure, calculate: 2×5= 10
- (i) Maximum and minimum permissible steel ratio
 - (ii) Depth of neutral axis
 - (iii) Allowable moment capacity
 - (iv) Nominal moment capacity
 - (v) Design flexural capacity
- [Use $f_c^1 = 4ksi$ and $f_y = 60ksi$?

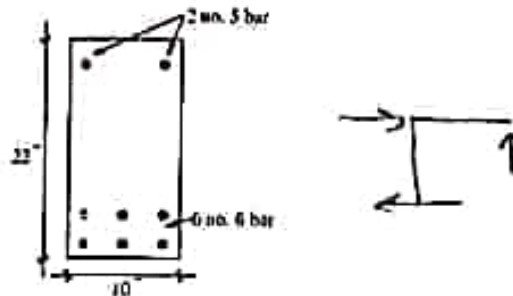


Figure for question 11(b)

12. (a) Write notes on: 2×5= 10
- (i) Flat plate
 - (ii) Flat slab
 - (iii) Punching shear capacity of RC slab
 - (iv) Two-way RC slab
 - (v) Loss of prestress
- (b) Why high strength materials are necessary in PC construction? Explain. 3
- (c) A post-tensioned PC beam 200mm×500mm is prestressed by a circular cable (APS=800mm²) with zero eccentricity at the ends and 160mm at the centre. The span of the beam is 12m. The cable is to be stressed from one end such that an initial stress of 850N/mm² is available in the unjacked end immediately after anchoring. Determine the stress in the wire at the jacking end and the percent loss of stress due to friction. 7
- Given $\mu=0.6$, $k=0.003/m$.

[Please turn over]

Transportation Engineering

Marks: $15 \times 2 = 30$

(Answer any two questions)

- | | Marks |
|---|------------------|
| 13. (a) State the advantages of uniform gauge of a railway line. | 4 |
| (b) Discuss the function and requirements of sleeper and ballast. | 6 |
| (c) Compare railways with highways and state the social and economic advantages of railway. | 5 |
| 14. (a) Describe the functions of base, sub-base and surface course of a flexible pavement. | 6 |
| (b) What are the desirable properties of coarse aggregate used in pavement construction? | 5 |
| (c) List the laboratory test for sand and bitumin. | 4 |
| 15. (a) Explain the necessity and objects of highway planning. | 4 |
| (b) Discuss the importance of highway drainage. State the requirements of a good highway drainage system. | 5 |
| (c) Write notes on: | $2 \times 3 = 6$ |
| (i) Geometric design of highway | |
| (ii) O & D study | |
| (iii) PIEV theory | |

Foundation Engineering

Marks: $15 \times 2 = 30$

(Answer any two questions)

- | | |
|---|------------------|
| 16. (a) What is meant by coefficient of permeability of soil? List the factors affecting the permeability of soil. | 4 |
| (b) Discuss the effect of water table on bearing capacity of soil. | 3 |
| (c) A clay layer 4m thick is subject to a pressure of 55 kN/m^2 . If the layer has a double drainage and undergoes 50% consolidation in one year, determine the coefficient of consolidation. Take $T_v = 0.196$. If the coefficient of permeability is 0.020 m/yr . determine the settlement and rate of flow of water per unit area in one year. | 8 |
| 17. (a) Write short notes on: | $2 \times 4 = 8$ |
| (i) Precast and cast in situ RC pile | |
| (ii) Shallow and deep foundation | |
| (iii) Consolidation and compaction | |
| (iv) SPT and cone penetration test | |
| (b) A soil sample was prepared by mixing a quantity of dry soil with 10% by mass of water. Find the mass of this wet mixture required to produce a cylindrical specimen of 15cm diameter and 12.5 cm deep and having 5% air content. Also find the void ratio and the dry density of the specimen if $G = 2.68$. | 7 |
| 18. (a) Discuss the shear characteristics of cohesive and cohesionless soils. | 5 |
| (b) Describe the salient features of a good subsoil investigation report. | 4 |
| (c) Differentiate between primary consolidation and secondary consolidation. Also differentiate between normally consolidated and over consolidated soils. | 6 |

$$\frac{e}{e_c} = k_i A$$

$$1.781 - 0.933 \log(100 - u)$$



[N.B. Figures in the right margin indicate full marks.]

**Part I
Structure**

(Answer any two questions)

Marks: 20×2=40

1. Draw the quantitative shear and bending moment diagrams, and qualitative deflected curve for the beam shown in Fig. 01. Support 'B' settles 10 mm and EI is constant. $E = 200 \text{ GPa}$, $I = 200 \times 10^6 \text{ mm}^4$ Marks 20

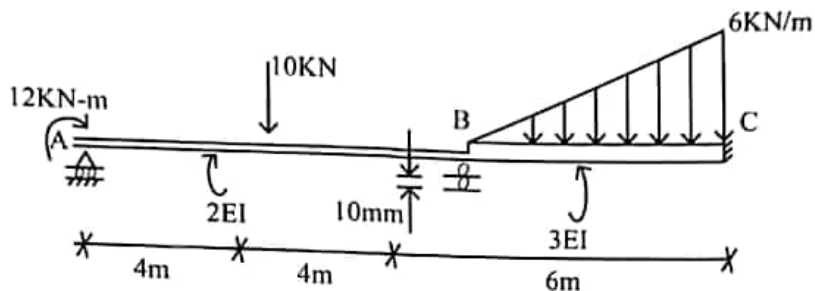


Figure for question 1

2. (a) Define influence line. Why is it drawn? 4
 (b) Analyze the frame shown in Fig. Q2 by slope deflection method. Assume EI is constant for all members. 16

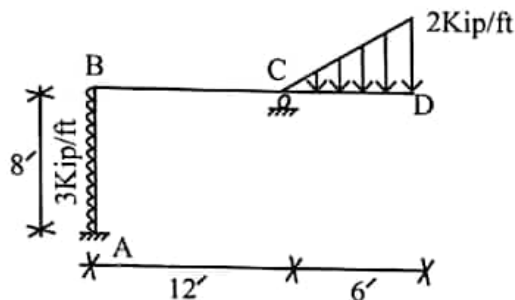


Figure for question 2(b)

3. (a) Compute the force in the tie rod of the following structure shown in Fig Q3(a). $I = 600 \text{ in}^4$, $A_2 = 20 \text{ in}^2$, and $A_1 = 2 \text{ in}^2$. 8

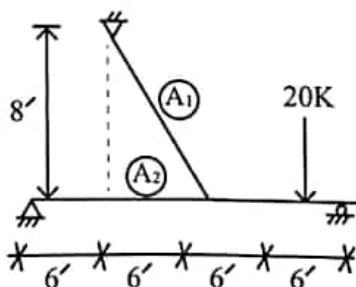


Figure for question 3(a)

- (b) A building frame is shown in Fig. 3(b). Analyze the frame using cantilever method. Area of the columns are shown at the top of each column. Draw shear force and bending moment diagrams for all members. 12

[Please turn over]

- (c) Write short notes on:
 (i) BOD and COD
 (ii) Activated sludge
 (iii) Break point chlorination
8. (a) Explain the process of arsenic removal by co-precipitation and adsorption indicating the probable chemical reactions involved. 5
 (b) Analysis of hardwater gave the following results: Total hardness = 5 meq/L; ca-hardness = 2.6 meq/L; alkalinity = 4 meq/L; acidity = 0.2 meq/L. Calculate the required doses of lime $[Ca(OH)_2]$ and soda (Na_2CO_3) for softening. Assume excess lime equivalent to 1.0 meq/L. 10
9. (a) Describe the effect of alkalinity in alum coagulation. 5
 (b) An aerated lagoon (50 m × 50 m at water surface) is 3 m deep with banks sloped at 2H: 1V receives a wastewater flow of 2.5 MLD with 600 mg/L BOD. Calculate the detention time, volumetric organic loading rate and F/M ratio. (Assuming that equivalent volatile SS concentration in the lagoon is 4000 mg/L = 0.4 kg/m³). 10

Part II

Structure

(Answer any two questions)

Marks: 20×2=40

10. (a) What do you mean by under-reinforced, balance and over-reinforced beams? Also explain the neutral axis depth position in the above-mentioned conditions of beams. 6
 (b) A rectangular beam has a width 12 inch (305 mm) and an effective depth to the centroid of the tension reinforcement of 18 inch (457 mm). The tension reinforcement consists of six no. 10 bars (7.59 in²) in two rows. Compression reinforcement of two no. 9 bars (2.0 in²) is placed 2.5 inch from the compression face of the beam. If $f_y = 50$ ksi (345 MPa) and $f_c' = 5$ ksi (34.5 MPa), What is the design moment capacity of the beam? 14
11. (a) An 18 inch × 18 inch column with $f_c' = 4$ ksi, reinforced with eight no. 8 bars of $f_y = 50$ ksi, supports a dead load of 225 kips and a live load of 175 kips. The allowable soil pressure q_u is 5 ksf. Design a square footing 5' below grade, using $f_c' = 4$ ksi and $f_y = 50$ ksi. 16
 (b) What are the advantages of T-beam over a rectangular beam? 4
12. (a) Draw typical stress-strain curve for pre-stressing steels. 3
 (b) Where should doubly reinforced beam should be provided? Give reasons. 3
 (c) Discuss various ways of failure of reinforced concrete structure. 4
 (d) What is diagonal tension? Derive an expression for spacing of vertical stirrups. 4
 (e) Write short notes on: 6
 (i) Flat slab and two-way RC slab
 (ii) Column interaction diagram
 (iii) Punching shear of RC slab

Transportation Engineering

(Answer any two questions)

Marks: 15×2=30

13. (a) What are the considerations in selecting a highway alignment? What special considerations are needed in hilly areas and desert areas? 5
 (b) Develop an equation for determining the breaking distance of a vehicle in terms of initial speed and coefficient of friction. 5
 (c) Calculate the safe stopping distance of a vehicle while travelling at a speed of 80 km/hour on an upward gradient of 2%. Assume perception and brake reaction time = 2.5 sec and coefficient of friction = 0.36. 5

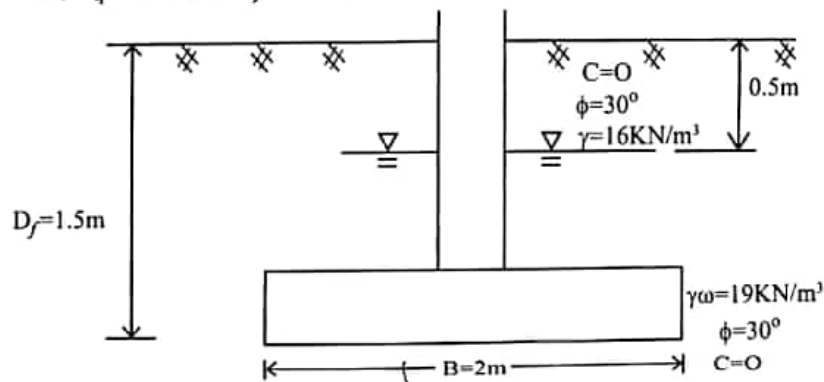
- | | Marks |
|--|-------|
| 14. (a) Explain the desirable properties of aggregate to be used in different types of pavement construction. | 5 |
| (b) A 7-degree curve branches off from a 4-degree main curve in an opposite direction in the layout of a B.G. Yard. If the speed of the branch line is restricted to 30 km/hr, determine the speed restriction on the main line. Assume permissible cant deficiency 75 mm. | 5 |
| (c) Explain the principle and factors affecting the properties of soil-cement stabilization. | 5 |
| 15. (a) What are the different causes of traffic accidents? Explain various measures that may be taken to prevent accidents. | 5 |
| (b) Explain the importance of road drainage. List out the requirements of a good highway drainage system. | 4 |
| (c) Write short notes on: | 6 |
| (i) Level crossing | |
| (ii) Compensator | |
| (iii) Negative super elevation | |

Foundation Engineering

(Answer any two questions)

Marks: 15×2=30

- | | |
|--|---|
| 16. (a) Write down the laboratory and field test generally used in determining the shear strength of soil. State the sources of shear strength of clay. | 5 |
| (b) What is an influence diagram? Discuss various methods for the determination of vertical stress at a point. What are their limitations? | 5 |
| (c) A square footing is shown in Fig. Q. 16 below. Determine the gross allowable load that the footing can carry. Use Terzaghi's bearing capacity equation for general shear failure. Given factor of safety = 3, $N_c = 30$, $N_q = 18$ and $N_f = 15$. | 5 |



- | | |
|--|---|
| 17. (a) What is soil liquefaction? Discuss with neat sketches the mechanism of liquefaction. | 5 |
| (b) What is pre-compression? Describe how you can describe pre-compression parameters in the field? | 4 |
| (c) A sand-fill compacted to a bulk density of 18.84 KN/m^3 is to be placed on a compressible saturated marsh deposit 3.5 m thick. The height of sand-fill is to be 3m. If the volume of compressibility of the deposit is $7 \times 10^{-4}\text{ m}^2/\text{kN}$, estimate the final settlement of the fill. | 6 |
| 18. (a) Under what circumstances wet sieve analysis is preferred over conventional dry sieve analysis? | 4 |
| (b) Discuss the effect of water table on bearing capacity of soil. | 3 |
| (c) Write short notes on: | 8 |
| (i) SPT and cone penetration test | |
| (ii) Consolidation and compaction | |
| (iii) Friction circle method of stability analysis | |
| (iv) Over consolidation ratio | |

41

Subject Code: 881

संख्या

Full Marks: 200

Time: 4 hours

[N.B. Figures in the right margin indicate full marks.]

Part I

Structure

(Answer any two questions)

Marks: $20 \times 2 = 40$

Marks

1. (a) Calculate the reactive forces and draw the bending moment diagram for the three-pinned portal as shown in Fig. 1(a). 10

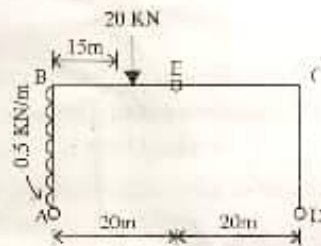


Fig. 1(a)

- (b) For what value of P, the deflection of the beam at the free end will be zero? 10

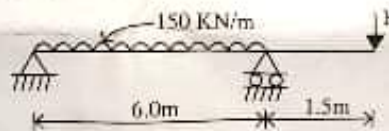
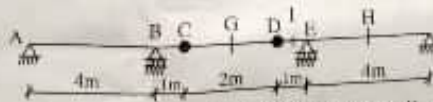


Fig. 1(b)

2. (a) Draw the influence lines for the following points of the line diagram of a balanced cantilever bridge as shown in Fig. 2(a). 10

- (i) Reaction at B and F.
- (ii) Shear and moment at G.
- (iii) Shear and moment at C.
- (iv) Shear and moment at H.
- (v) Shear and moment at L.



- (b) Compute the support reactions and then draw the shear force and bending moment diagram for the beam as shown in Fig. 2(b). 10



Fig. 2(b)

Please turn over

3. Analyse the rigid frame as shown in Fig. 3 using slope-deflection method. Draw shear and moment diagrams. Sketch the deformed structure. Marks 20

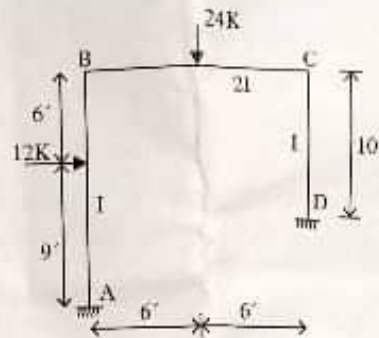


Fig. 3

Water Resources Engineering

(Answer any two questions)

Marks: $15 \times 2 = 30$

4. (a) 'The sprinkler system of irrigation is an excellent method but not used in Bangladesh.' Discuss critically in brief. 5
- (b) Write short notes: 10
- (i) Threshold motion of sediment
 - (ii) Duty and delta
 - (iii) Watershed management
 - (iv) Artesian aquifer
 - (v) Intensity of irrigation
5. (a) What are 'cut-offs' and how are they artificially induced? What are their advantages and disadvantages? 5
- (b) A pump is installed on a well to lift water and to irrigate rice crop sown over 4.5 hectares of land. If the duty of rice is 864 hectare/cumec on the field and pump efficiency is 80%, determine the minimum input (HP) required by the pump if the lowest well water level is 8.5 m below the highest portion of the field. Assume negligible field channel losses. 10
6. (a) Explain the various methods for estimating the design flood of a catchment. 5
- (b) Discuss the advantages and ill effects of embankment as a measure for flood management. 4
- (c) Design a surface drainage channel in non-alluvial soil to carry discharge of $15 \text{ m}^3/\text{s}$ with a velocity of 1.2 m/s. Assume side slope 0.6:1, bed slope 1:6000 and Manning's $n = 0.025$. 6

Environmental Engineering

(Answer any two questions)

Marks: $15 \times 2 = 30$

7. (a) Explain the theories of filtration. Mention the operating difficulties of rapid sand filtration. How can these difficulties be removed? 10
- (b) Calculate the dimension of a rectangular settling tank to treat 220 m^3 of water per hour when the overflow rate is 1.15 m/hr and the detention time is 3 hours. 5

8. (a) Explain the biological treatment process of sewage. 7
 (b) Why is industrial waste water treatment more complicated than sewage? 4
 (c) Write short notes: 4
 (i) BOD and COD
 (ii) Activated sludge
9. (a) Why is circular section commonly used in sewer? 5
 (b) An aerated lagoon (60m×60m at water surface) is 3 m deep with banks slope at 2 H : IV receives a waste water flow of 3.5 MLD with 550 mg/L BOD. Calculate the detention time, volumetric organic loading rate and F/M ratio. (Assuming that equivalent volatile ss concentration in the lagoon 4000 mg/L = 0.4 kg/m³). 10

Part II
Structure

(Answer any two questions)

Marks: 20×2=40

10. (a) What are the basic concepts of the design of beams under the section uncracked and section cracked? 5
 (b) Design a spiral column to support an axial dead load of 600 kips and a live load of 425 kips using $f_c = 4500$ psi, $f_y = 60,000$ psi and steel ratio of 3.5%. 15
11. (a) Write short notes: 6
 (i) Temperature and shrinkage reinforcement
 (ii) Punching shear of RC slab
 (iii) Flat slab and two-way RC slab
- (b) Find the cross-section of concrete and area of steel required for a simply supported rectangular beam with a span of 20 feet that is to carry a computed dead load of 1.27 kips/ft and a service live load of 2.44 kips/ft. Material strengths are $f_c = 4000$ psi and $f_y = 60,000$ psi. 14
12. (a) 'Higher strength concrete is necessary in pre-stressed concrete.'—Explain why. 3
 (b) Where should doubly reinforced beam be provided? Give reasons. 3
 (c) An I-shaped beam is pre-stressed with $A_{ps} = 1750$ mm² as pre-stressing with an effective stress, f_{se} , of 1100 Mpa. The cgs of the strands which supply the pre-stress is 115 mm above the bottom of the beam as shown in the Fig. 12(c). Material properties are: $f_{pu} = 1860$ Mpa, $f_c = 48$ Mpa. Find the ultimate resisting moment of the section for design following the ACI code. 14

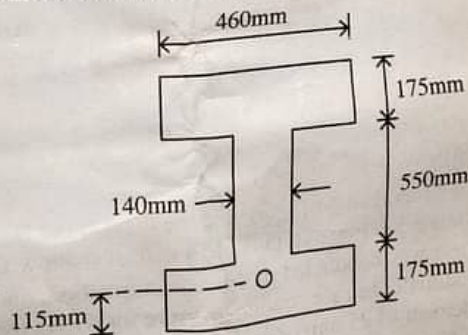


Fig. 12(c)

Transportation Engineering

(Answer any two questions)

Marks: $15 \times 2 = 30$

13. (a) Define ADT and AADT with examples. 4
(b) What are the different causes of traffic accidents? Explain various measures that may be taken to prevent accidents. 6
(c) What is 'stopping sight distance' and 'passing sight distance'? Explain with sketches. 5
14. (a) Explain in short various resistance which a locomotive has to overcome before hauling a train. 5
(b) Discuss the importance of highway drainage. State the requirements of a good highway drainage system. 5
(c) Write short notes: 5
(i) Cant and cant deficiency
(ii) Points and crossings in railway
15. The maximum capacity of a 2-lane carriageway of a four-lane dual carriageway is 2000 veh./hour. Due to pipe laying operations the width of the 2-lane carriageway is reduced restricting the maximum capacity to 1100 veh./hour. When the upstream beyond the influence of the bottleneck is reasonably steady and free-flowing at 1500 veh./hour, find: 15
(i) The mean speed of the traffic in the bottleneck
(ii) The rate at which the queue of congested conditions outside the bottleneck grows. The mean space headway the vehicles are stationary is 8 m. The relation between speed and concentration is linear.

Foundation Engineering

(Answer any two questions)

Marks: $15 \times 2 = 30$

16. (a) Differentiate the following geotechnical terms: 12
(i) MDD and OMC
(ii) Swelling index and compression index
(iii) Sand drain and sand pile
(iv) Seepage and permeability
- (b) Discuss the effect of water table on the bearing capacity of soil. 3
17. (a) Define over-consolidation ratio. Classify clay soil considering the value of over-consolidation ratio. 4
(b) A 3m thick clay layer beneath a building is overlain by a permeable stratum and is underlain by an impervious rock. The coefficient of consolidation of the clay (using $C_v = \frac{T_v d^2}{t}$) was found to be $0.025 \text{ cm}^2/\text{minute}$. The final expected settlement for the layer is 8 cm. 11
(i) How much time will it take for 80% of the total settlement to take place?
(ii) Determine the time required for a settlement of 2.5 cm to occur.
(iii) Compute the settlement that would occur in one year.
[Assume 80% settlement $T_v = 0.567$
31.25% settlement $T_v = 0.078$ and
42.9% settlement $T_v = 0.146$]
18. (a) Differentiate between the general shear failure and the local shear failure. 4
(b) When and why is pile foundation more suitable than that of shallow foundation? 3
(c) Static cone penetration test was conducted in dry sand formation, and the average cone resistance was found to be 50 kg/cm^2 . Estimate the safe bearing pressure for a strip footing of width 1.5 m and depth 1.5 m, for a permissible settlement of 25 mm [$\beta = 1.5$]. Use a factor of safety for 3 of shear failure. The soil has a unit weight of 17 KN/m^3 . 8
[Using $q_p = 2.1 q_c \left(1 + \frac{1}{\beta}\right)^2 \text{ KN/m}^2$ and $\frac{q_{nf}}{q_c} = 0.2$].

43
BCS

Subject Code: 881

মাধ্যমিক

Full Marks: 200

Time: 4 hours

[N.B. Figures in the right margin indicate full marks.]

Part I

Structure

(Answer any two questions)

Marks: 20×2=40

Marks

1. (a) Compute the **deflection** at point C for the beam shown in Fig. 1(a) by virtual work method. 10
Assume EI is constant.



Fig. 1(a)

- (b) A cable-supported roof carries a uniform load $w = 0.6$ kip/ft shown in Fig. 1(b). If the cable sag at midspan with parabola behaviour of $y = 4hx^2/L^2$ is set at 10 ft, what is the maximum tension in the cable (i) between points B and D and (ii) between points A and B?

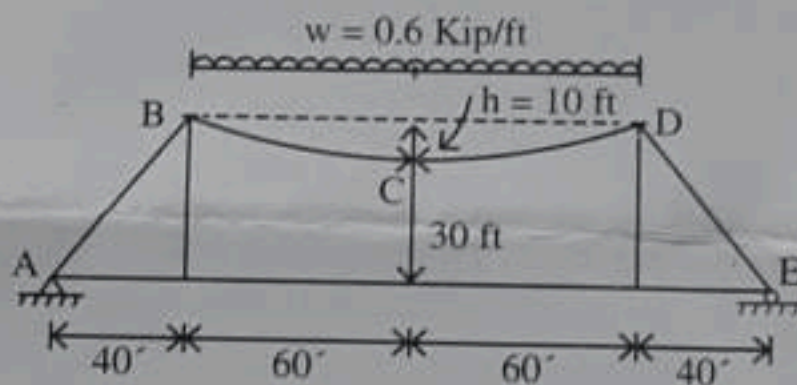


Fig. 1(b)

2. Analyze the rigid frame shown in Fig. 2 by **slope-deflection method**. Find the direct stresses, shears and moments in all members. Sketch the deformed structure. 20

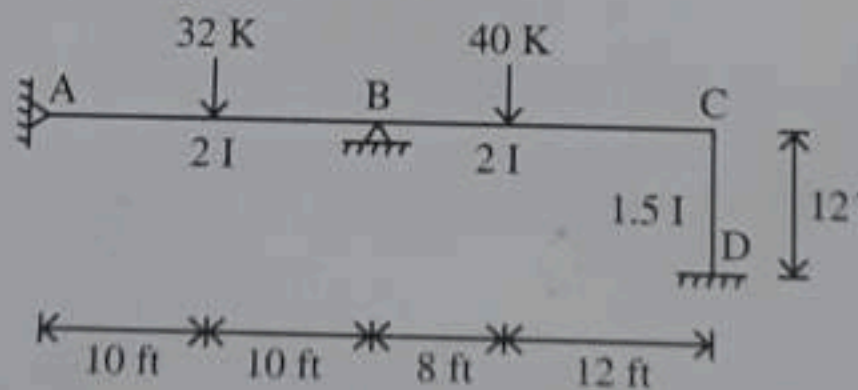


Fig. 2

3. Determine all reaction components and draw shear and moment diagrams for the beam of Fig. 3 by **consistent deformation method**. 20

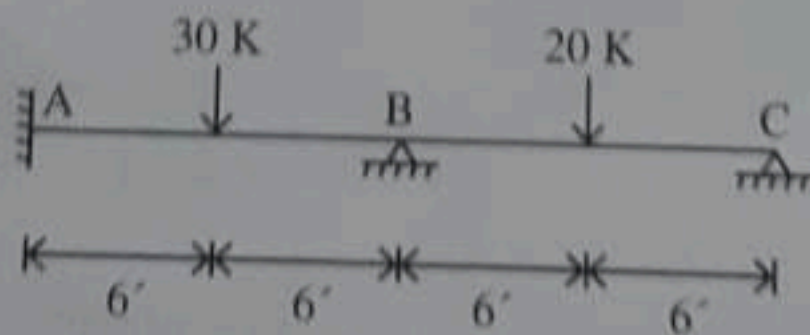


Fig. 3

[Please turn over]

Water Resources Engineering

(Answer any two questions)

Marks: $15 \times 2 = 30$

- | | Marks |
|---|-------|
| 4. (a) What is potential evapotranspiration? Do you agree that evapotranspiration and consumptive use are the same? If yes give reasons. | 4 |
| (b) Name the different methods for determining consumptive use of crop. Describe any one method among them. | 6 |
| (c) A loam soil has field capacity of 25% and permanent wilting percentage 10%. The dry unit weight of soil is 14.72 KN/m^3 . If the depth of root zone is 0.75 m, determine the storage capacity of the soil. Irrigation water is applied when moisture content drops to 14%. If water application efficiency is 75%, determine the depth required to be applied in the field. | 5 |
| 5. (a) Define water-logging. Write various measures for controlling water logging. | 5 |
| (b) What do you mean by flood management? Mention different options for flood management. | 5 |
| (c) The analysis of a 30-year flood data at a point on river yielded $\bar{X} = 1200 \text{ m}^3/\text{sec}$ and $S_x = 650 \text{ m}^3/\text{sec}$. For what discharge would you design the structure at this point so that the structure would not fail in the next 100 years? The value of y_n and σ_n for a record length of 30 years are $n = 30$, $\bar{y}_n = 0.53622$, $\sigma_n = 1.11238$. | 5 |
| 6. (a) What is SAR? Discuss the effect of salts on the plant growth. | 5 |
| (b) The depth of penetration along the length of a border strip at points 30 m apart was probed. There observed values are 1.9, 1.8, 1.5, 1.4, 1.3 and 1.2 metres. Compute the water distribution efficiency. | 5 |
| (c) Write short notes on the following: | 5 |
| (i) Water storage efficiency | |
| (ii) Net irrigation requirement | |
| (iii) Leaching requirement | |

Environmental Engineering

(Answer any two questions)

Marks: $15 \times 2 = 30$

- | | |
|--|----|
| 7. (a) Write the various factors that influence the capita consumption and how this affect the water supply distribution system. | 7 |
| (b) Determine the diameter of the storm sewer crossing the highway for the peak discharge of $70.0 \text{ m}^3/\text{sec}$, with sewer material having $n = 0.013$ and laid at a slope of 0.001. The velocity at full flow should be less than 3.0 m/sec. | 8 |
| 8. (a) What are the characteristics of SSF and RSF? Explain in brief. | 10 |
| (b) Find the dimension of a settling tank to treat 45 m^3 of raw water per hour when the overflow rate is 0.5 m/hour and the detention time is 3 hours. | 5 |
| 9. (a) Define coagulation and flocculation. As a process of water purification, explain disinfection system with break point chlorination curve. | 7 |
| (b) Design a septic tank to serve a household of ten persons who produce 90 lpcd of wastewater. If the soil is sandy loam with a long-term infiltration rate of about $30 \text{ l/m}^2 \text{ day}$. Also give suggestion if the water table is high. | 8 |

$$= \frac{\pi d^2}{4} \cdot \frac{1}{\pi d}$$

**Part II
Structure**

(Answer any two questions)
Marks: 20×2=40

$$\frac{e/m}{2} + \frac{e/m}{2} = \frac{e}{m}$$

Marks

10. (a) What are the advantages of T-beam over a rectangular beam? 4
 (b) An 18 in. × 18 in. column with $f_c = 4$ ksi, reinforced with eight number of bars of $f_y = 50$ ksi, supports a dead load of 225 kips and a live load of 175 kips. The allowable soil pressure q_a is 5 ksf. Design a square footing 5' below grade, using $f_c = 4$ ksi and $f_y = 50$ ksi. 16
11. (a) What is diagonal tension? Derive an expression for spacing of vertical stirrups. 5
 (b) Determine the moment capacity of the T-beam, using the values $f_c = 2.5$ kip/in² and $f_y = 60$ kips/in². The dimensions of T-beam are $b = 28''$, $b_w = 14''$, $h_f = 4''$, $d = 18''$ and $A_s = 4.68$ in². 15
12. An I-shaped beam is prestressed with $A_{ps} = 1750$ mm² as prestressing steel with an effective stress, f_{sc} of 1100 MPa. The c.g.s. of the strands which supply the prestress is 115 mm above the bottom of the beam. Material properties: $f_{pn} = 1860$ MPa, $f_c = 48$ MPa. Find the ultimate resisting moment of the section for design following the ACI Code. The dimension of I-shaped beam are top flange and bottom flange: 460 × 175 mm and web section is 140 × 550 mm. 20

Transportation Engineering

(Answer any two questions)
Marks: 15×2=30

13. (a) What are the factors on which geometric design of highway depends? Explain briefly. 5
 (b) Derive an expression for calculating the OSO on a highway. 5
 (c) Calculate the safe stopping sight distance for a design speed of 50 Km/hour for (i) two-way traffic on a two-lane road, and (ii) two-way traffic on a single-lane road. Assume co-efficient of friction as 0.37 and reaction time of driver as 2.5 seconds. 5
14. (a) What are the different types of sleepers generally used in Bangladesh? Discuss their utility, availability and life. 6
 (b) Write the various resistances which a locomotive has to overcome before hauling a train. 5
 (c) The case that longer rails will require longer gaps at ends has now disappeared. Explain. 4
15. (a) What are the basic difference between stopping-sight distance and passing-sight distance? Describe how to measure the minimum passing-sight distance with sketch. 6
 (b) What are the advantages and disadvantages of rotary intersection? Sketch a 5-leg rotary intersection and show the movements of vehicles in line diagram. 6
 (c) Define: (i) Prime coat (ii) Tack coat, and (iii) Seal coat. 3

Foundation Engineering

(Answer any two questions)
Marks: 15×2=30

16. (a) What are the assumptions made in the derivation of Terzaghi's bearing capacity theory? Write the equation for the ultimate bearing capacity. 5
 (b) Discuss the effect of water table on bearing capacity of soil. 4

[Please turn over]

[N.B. Figures in the right margin indicate full marks.]

Part I

Structure

(Answer any two questions)

Marks: 20×2=40

Marks

1. (a) Determine the maximum deflection of the steel beam shown in Fig 1 (a). Given $E=200$ GPa, $I = 60 \times 10^6 \text{ mm}^4$. 10

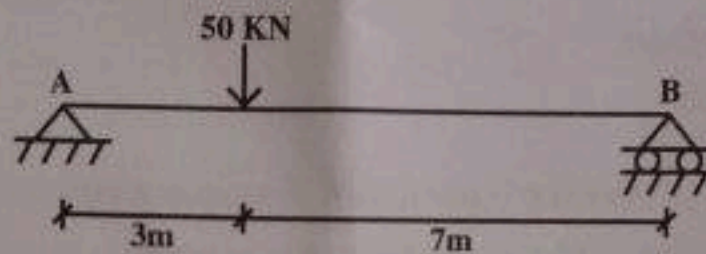


Fig. 1(a)

- (b) Determine the vertical displacement of joint C of the truss shown in Fig 1 (b). Take, $A = 250 \text{ mm}^2$ and $E=200$ GPa for each member. 10

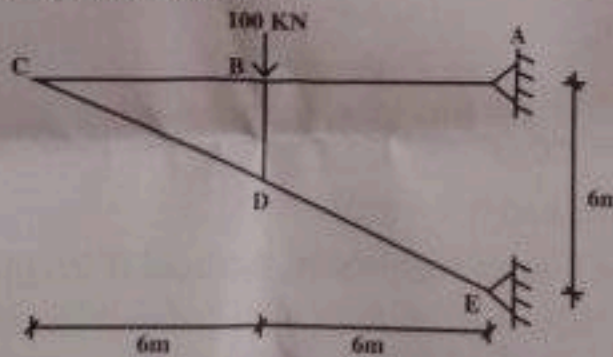


Fig. 1(b)

2. (a) Using moment distribution method, draw SFD and BMD of the frame shown in Fig 2 (a). 10

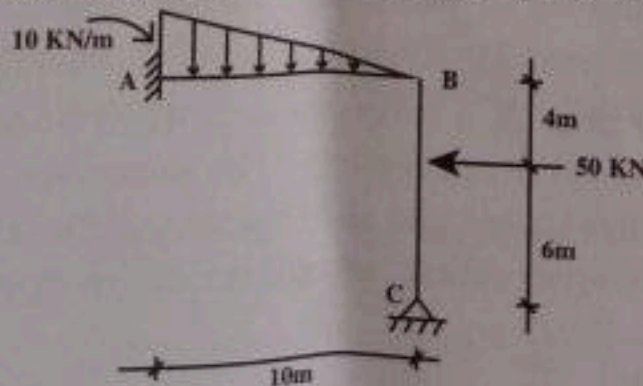


Fig. 2(a)

- (b) Draw influence line diagram for (+ve) moment at D of the continuous beam shown in Fig 2 (b). Take influence line ordinates at 5 ft intervals. 10

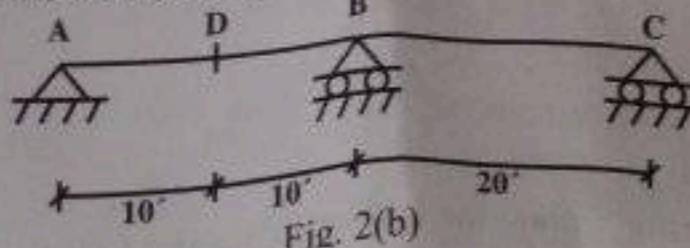


Fig. 2(b)

3. Analyse the rigid frame shown in Fig. 3(a) by slope deflection method. Also draw SFD and BMD. 15
 E is constant for all members.

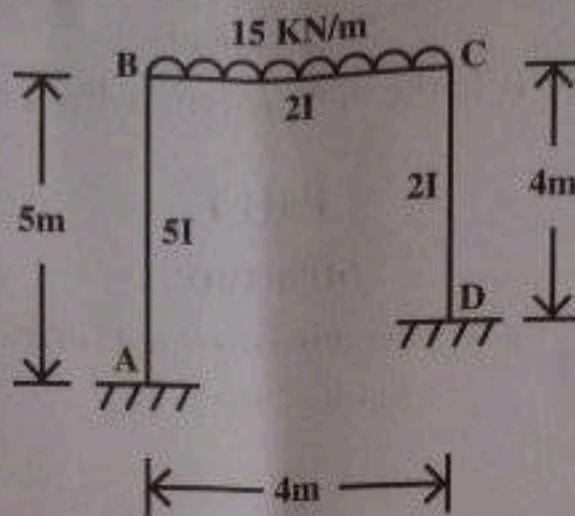


Fig. 3(a)

- (b) Write short notes:
 (i) Conjugate beam method
 (ii) Virtual work method

2.5×2=5

Water Resources Engineering

(Answer any two questions)

Marks: 15×2=30

4. (a) Define consumptive use of water. Mention the factors affecting consumptive use of water. 5
 (b) Determine the storage capacity of the soil from the following data: 10

Field capacity = 32%

Wilting point = 15%

Depth of root zone = 1.0 m

Dry unit weight of the soil = 1.8 gm/cm^3

Also determine the depth of water required in the field if irrigation water is supplied when the moisture content falls to 20% and the field application efficiency is 80%. If the conveyance losses in the watercourses and the field channels are 12% of the outlet discharge, calculate the depth of water needed at the canal outlet.

5. (a) What is meant by the term duty of water? Explain the influence of several factors that affect duty. What are the different ways by which duty can be expressed? 5
 (b) The culturable command area of a watercourse is 1200 hectares. Intensities of sugar and wheat crops are 20% and 40% respectively. The duties for the crops at the head of the watercourse are 730 hectares/cumec and 1800 hectares/cumec respectively. Find (i) discharge required at the head of the water course, and (ii) the design discharge at the outlet assuming a time factor of 0.8. 10

6. Design and draw the cross-section of a flood embankment with the following data: 15
 Maximum flood discharge = $1500 \text{ m}^3/\text{s}$
 Distance to be protected = 10.5 km
 HFL at the starting point of the level = 26.03 m
 HFL at the tail end of the level = 22.02 m
 Distance of the point of upstream end = 2 km
 Lacey's silt factor = 1.10
 Propose a suitable pitching with stone and calculate the volume of stone required per meter length.

Environmental Engineering

(Answer any two questions)

Marks: $15 \times 2 = 30$

- Marks
7. (a) State the step-by-step procedure of Hardy Cross method for computing flow distribution in a pipe network. 6
- (b) The Savar tannery with a wastewater flow of $0.011 \text{ M}^3/\text{S}$ and a BOD_5 of 590 mg/L discharges into Dhaleshwari river having a flow rate of $1.7 \text{ m}^3/\text{S}$. Upstream of the tannery, the BOD_5 of the river is 0.6 mg/L . The BOD rate constants for tannery wastewater and river water are 0.115 day^{-1} and 3.7 day^{-1} , respectively. Calculate the initial ultimate BOD after mixing. 9
8. (a) Write short notes: 2×5=10
- (i) Super chlorination
 - (ii) Pump characteristic curve
 - (iii) Activated sludge
 - (iv) DO sag curve
 - (v) Artesian aquifer
- (b) Draw a typical chlorination curve and explain the reaction zones. 5
9. (a) What are the basic concepts of small-bore sewerage system (SBS)? What factors bring sufficient cost saving for SBS? Explain the suitability of this system for Bangladesh. 9
- (b) How many kg of bleaching powder with 30% available chlorine will be required to treat 4 million litres of water with a dosage of 0.5 mg/L ? 6

Part II

Structure

(Answer any two questions)

Marks: $20 \times 2 = 40$

10. (a) Write short notes: 2×3=6
- (i) Flat plate and flat slab
 - (ii) Spiral column and tied column
 - (iii) Pre-tensioned and post-tensioned PC member
- (b) Draw SFD and BMD of the building frame shown in Fig. 10(b) using portal method. 14

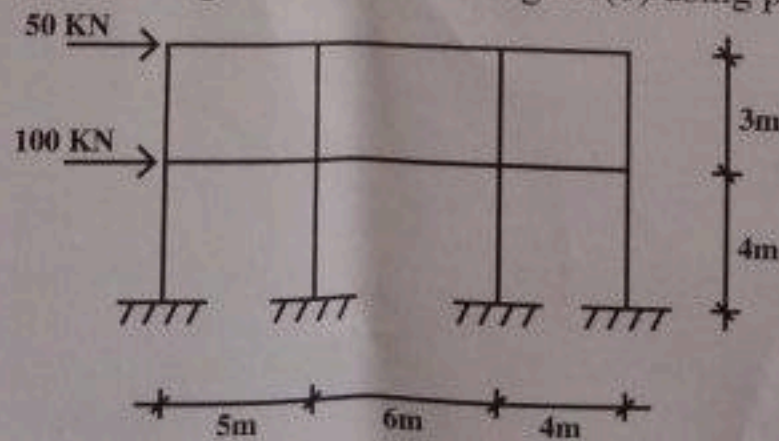


Fig. 10(b)

- M1. (a) What is corner reinforcement in RC slab? Why and where are they used? State the ACI/BNBC specifications for such reinforcement. 6
- (b) Mention the different types of spread footing generally used in RC construction. Also state the suitability of each type. 6
- (c) Design an RC circular spiral column from the given data: 8
- $P_{DL} = 180 \text{ kip}$, $P_{LL} = 80 \text{ kip}$
 $f_{c'} = 3 \text{ ksi}$, $f_y = 60 \text{ ksi}$
Use USD method.

Please turn over]

12. (a) Design a suitable spread footing for $15'' \times 15''$ RC column reinforced with $W - \frac{7''}{8} \text{ } \emptyset$ under the following condition:

$$P_{DL} = 100 \text{ kip} \quad P_{LL} = 70 \text{ kip}$$

$$f_c' = 3 \text{ ksi} \quad f_y = 60 \text{ ksi}$$

$$q_a = 1.5 \text{ tsf at 5 ft below GL}$$

Make a suitable sketch of footing with reinforcement details.

- (b) A one-way RC slab is supported by a $10''$ brick wall and has a clear span of 16 feet. The slab has to carry a service live load of 90 psf and a floor finish load of 30 psf in addition to its self weight. Design the slab using $f_c' = 4 \text{ ksi}$, $f_y = 60 \text{ ksi}$.

Transportation Engineering

(Answer any two questions)

Marks: $15 \times 2 = 30$

13. (a) Explain flexible and rigid pavements and state their differences. 5
- (b) State the importance of highway drainage. Mention the requirements of a good highway drainage system. 5
- (c) Calculate the maximum allowable speed on a horizontal curve of radius 350 m if the maximum allowable value of lateral coefficient of friction is 0.15 and the rate of superelevation is 0.07. 5
14. (a) What is meant by the term 'point of crossing' in railway engineering? How is the detailed inspection of points and crossing carried out? 5
- (b) Compare between bitumen and tar as a binding material of flexible pavement. 5
- (c) What is equilibrium cant? A curve of 5° is situated on a section of broad gauge. The maximum permissible speed in the section is 50 km/hr. Find out the amount of equilibrium cant. 5
15. (a) Calculate the safe stopping distance for design speed of 50 km/hr for— 4
- (i) two-way traffic in a two-lane road
- (ii) two-way traffic in a single-lane road
- (b) Name some methods to design the thickness of flexible pavement. 4
- (c) Compute the minimum sight distance to avoid head-on collision of two buses approaching from opposite directions. The speed of both the buses is 70 kph. Assume, a total perception and brake reaction time of 2.5 sec coefficient of friction is 0.4 and brake efficiency = 60%. 7

Foundation Engineering

(Answer any two questions)

Marks: $15 \times 2 = 30$

16. (a) What are the principal objectives of soil exploration? Write down the most common types of in-situ tests. 6
- (b) A static CPT was performed in a cohesive soil at a depth of 7.0 m with a tip resistance q_c of 1Mpa and friction ratio 3%. The soil is intensive and has plasticity index of 15%. What is the undrained shear strength of the soil? 9
17. (a) Differentiate between consolidation and compaction of soil with suitable examples. 5
- (b) State the different methods of determining permeability of soil. 3
- (c) What is meant by SPT of soil? How is it carried out in the field? Explain the relationship of SPT value with bearing capacity of soil. 7
18. (a) Explain plate load test. Also, state its uses and limitations. 5
- (b) Show with diagram different modes of slope failure. 5
- (c) Find the centre of the critical circle for $\beta = 75^\circ$, $H = 60 \text{ ft}$ and $D = 18 \text{ ft}$. 5