

Sylhet Engineering College, Sylhet
(Shahjalal University of Science & Technology)
Department of Civil Engineering

Final Examination, 2023
Course No.: CE 715
Time: 02 (Three) hours

4th Year 1st Semester
Course Title: Structural Analysis III
Full Marks: 40

N.B. : (i) Answer any two question from each PART
 (iii) Marks allotted are indicated in the margin

(ii) Use separate answer scripts for each PART
 (iv) Special Instruction (if any)-----N/A-----

PART- A

(Answer any two questions)

1. a. What are the Advantages of the Finite Element Method? 03
 b. Using the principle of minimum potential energy solve the spring attached with a metal ball of radius 23 cm shown in Figure 1. Verify that the displacement that yields the minimum potential energy yields the stable equilibrium position. The density of the metal is 2000kg/m^3 . 07

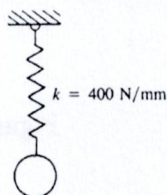


Figure-1

2. a. Determine the force in each member of the two-member truss shown in Figure 2. AE is constant. 10

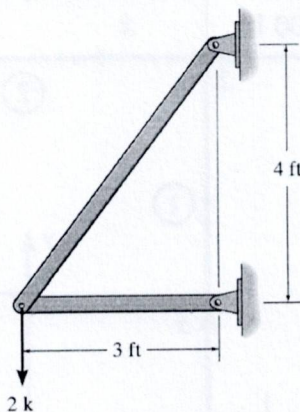


Figure-2

3. a. Determine the nodal displacements and rotations and the global and element forces for the beam shown in Figure 3. The beam is fixed at node 1, has a roller support at node 2, and has an elastic spring support at node 3. A downward vertical force of $P = 50\text{ kN}$ is applied at node 3. Let $E = 210\text{ GPa}$ and $I = 2 \times 10^{-4}\text{ m}^4$ throughout the beam, and let $k = 200\text{ kN/m}$. 10

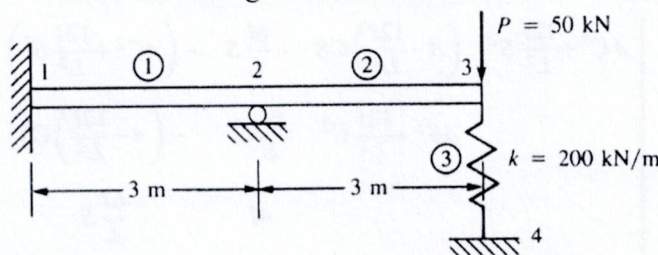


Figure-3

PART- B

(Answer any two questions)

4. a. Describe briefly the general steps of the finite element method. 04
 b. Determine the reactions at the supports of the beam shown in Figure 4. EI is constant. 06

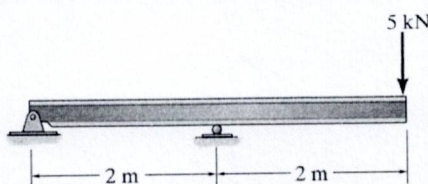


Figure-4

5. a. Solve the two-bar truss supported by a spring shown in Fig: -5. Both bars have $E = 210 \text{ GPa}$ and $A = 5.0 \times 10^{-4} \text{ m}^2$. Bar one has a length of 5 m and bar two a length of 10 m. The spring stiffness is $k = 2000 \text{ kN/m}$. 10

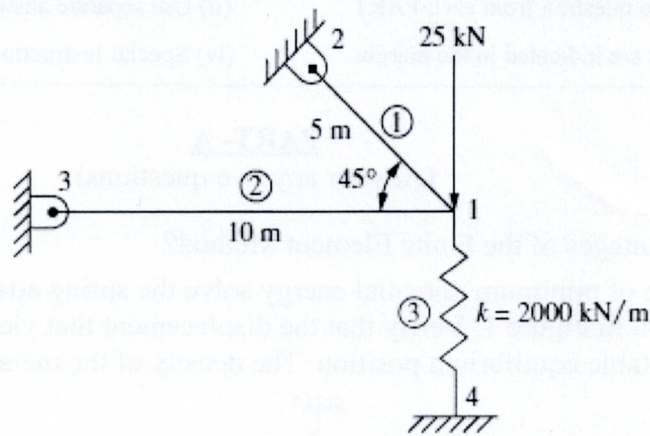


Figure: 5

6. a. Solve the rigid plane frame shown in Fig:-6. The frame is fixed at nodes 1 and 4 and subjected to a positive horizontal force of 10,000 lb applied at node 2 and to a positive moment of 5000 lb-in. applied at node 3. The global-coordinate axes and the element lengths are shown in Fig:-6. Let $E = 30 \times 10^6 \text{ psi}$ and $A = 10 \text{ in}^2$ for all elements, and let $I = 200 \text{ in}^4$ for elements 1 and 3, and $I = 100 \text{ in}^4$ for element 2. 10

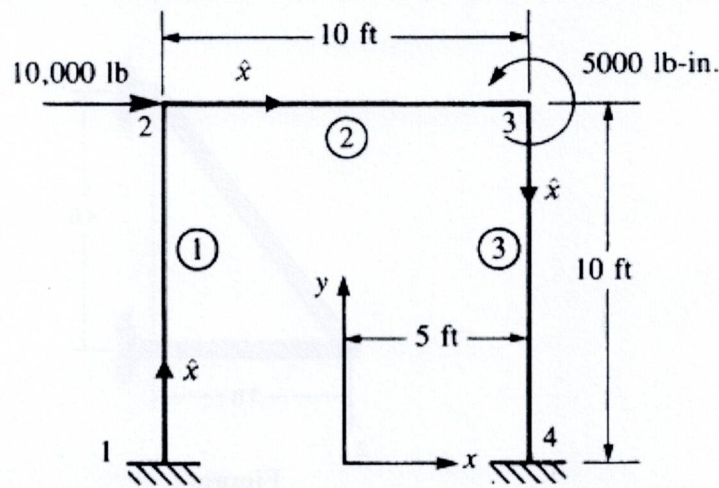


Figure: 6

Use the following matrix to obtain the global stiffness matrices for each element.

$$\underline{k} = \frac{E}{L} \times \begin{bmatrix} AC^2 + \frac{12I}{L^2} S^2 & \left(A - \frac{12I}{L^2}\right) CS & -\frac{6I}{L} S & -\left(AC^2 + \frac{12I}{L^2} S^2\right) & -\left(A - \frac{12I}{L^2}\right) CS & -\frac{6I}{L} S \\ & AS^2 + \frac{12I}{L^2} C^2 & \frac{6I}{L} C & -\left(A - \frac{12I}{L^2}\right) CS & -\left(AS^2 + \frac{12I}{L^2} C^2\right) & \frac{6I}{L} C \\ & & 4I & \frac{6I}{L} S & -\frac{6I}{L} C & 2I \\ & & & AC^2 + \frac{12I}{L^2} S^2 & \left(A - \frac{12I}{L^2}\right) CS & \frac{6I}{L} S \\ & & & & AS^2 + \frac{12I}{L^2} C^2 & -\frac{6I}{L} C \\ \text{Symmetry} & & & & & 4I \end{bmatrix}$$

Sylhet Engineering College, Sylhet
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Department of Civil Engineering

Final Examination, 2023

Course No.: CE 717

Time: 02 (Two) hours

4th Year 1st Semester

Course Title: Steel Structure

Full Marks: 40

N.B: (i) Answer any two questions from each part (ii) Use separate answer script for each part (iii) Marks allotted are indicated in the margin (iv) **Assume data if necessary.**

Part- A

(Answer any two questions)

1. (a) Enumerate your idea on shear lag effect. How can you minimize the shear lag effect of a tension member? What do you mean by a) E703X b) C12 X 32 c) A 490 07

(b) What do you mean by limit state? Explain the term ‘design strength of a tension member’ in light of limit states. 03

2. (a) Describe “Block Shear”, and how it can be reduced. 3.0

(b) The bolt arrangement pattern on both faces of the angle section in Figure 2.1 is identical (not the same spacing). Compute the design tensile strength. Material type: A36 steel. Bolt diameter = $\frac{7}{8}$ inch (standard bolt) 7.0

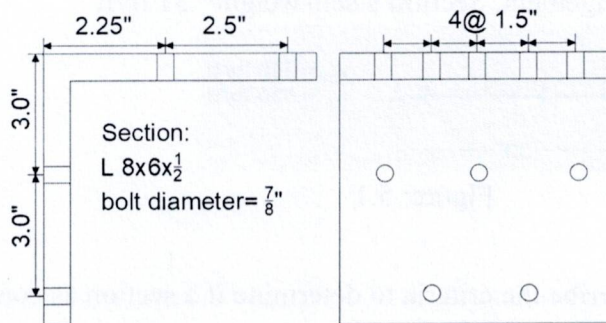


Figure: 2.1

3. (a) Determine the required bolts and an appropriate layout to transmit a dead load of 80 kips and a live load of 240 kips through two C 10x30 to one gusset plate as shown in Figures: 3.1 and 3.2. All materials are A36. Bolts are $\frac{3}{4}$ inch. Use three lines of bolts across the web of the channel. A 325 (standard holes) in a bearing-type connection with threads excluded from shear planes. Channel Section properties: $A_g=8.82 \text{ in}^2$, Web thickness = 0.673 in, Flange thickness = 0.436 in 7.0

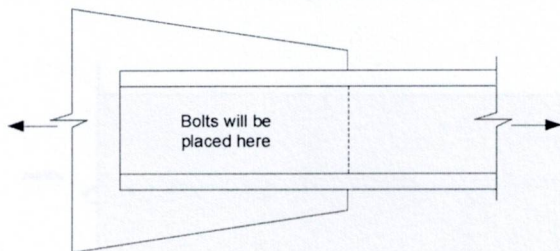


Figure: 3.1

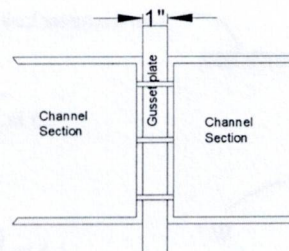


Figure: 3.2

(b) Validate your answer (number of bolts from the 3.(a) portion) concerning the channel sections and the gusset plate. 3.0

Part B

(Answer any two questions)

4. (a) Determine the effective length factor for columns BC and AB.

Corresponding Figure: Figure 4.1

Moment of Inertia:

$$W12 \times 96 = 833 \text{ in}^4$$

$$W24 \times 55 = 1350 \text{ in}^4$$

$$W24 \times 68 = 1830 \text{ in}^4$$

$$W12 \times 120 = 1070 \text{ in}^4$$

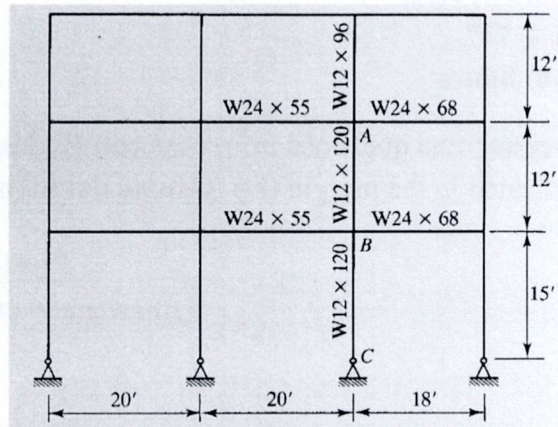


Figure: 4.1

6.0

- (b) Distinguish between Bearing Type Connection and Slip Critical Connection. Also, express your idea of where moment connections should be used.

4.0

5. (a) A section of W 16x31 of A992 steel supports a service load of 450 lb/ft and a live load of 550 lb/ft shown in Figure 5.1. Comment on whether the beam is adequate for this arrangement. Section's self-weight= 31 lb/ft

8.0

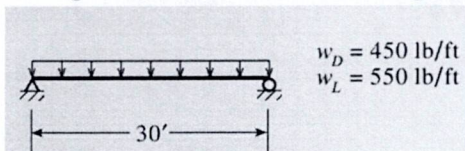


Figure: 5.1

- (b) Describe the criteria to determine if a section is compact or non-compact.

2.0

6. (a) In Figure 6.1 the section is W8x10 with flange thickness= 0.205 inch, web thickness= 0.17 inch, depth= 7.89 inch, flange width=3.94 inch. Evaluate the tension capacity of the section (considering net section fracture strength and block shear rupture strength). The member is a wide flange connected through the flanges using eight 3/4 inch diameter bolts in two rows of four each as shown in the figure below. The center-to-center distance of the bolts in the direction of loading is 4 in. The edge distances are 1.5 inches and 2.0 inches as shown in the figure below. The steel material is A992.

10

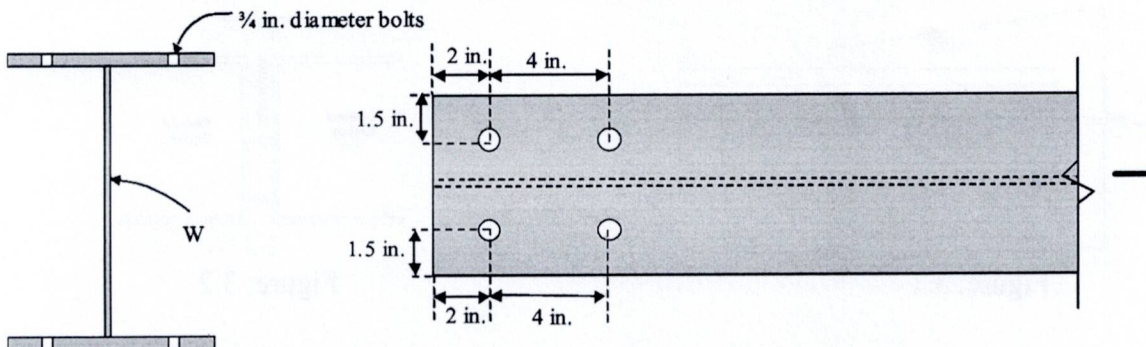


Figure: 6.1

Attachments

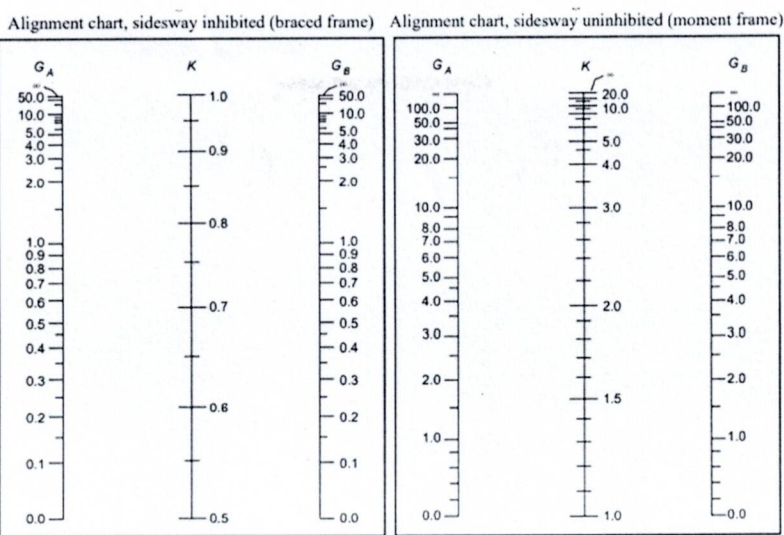


Figure A.1

Designation Imperial (in x lb/ft)	Depth h (in)	Width w (in)	Web Thickness t_w (in)	Flange Thickness t_f (in)	Sectional Area (in^2)	Weight (lb/ft)	Static Parameters			
							Moment of Inertia		Elastic Section Modulus	
							I_x (in^4)	I_y (in^4)	S_x (in^3)	S_y (in^3)
W 16 x 36	15.86	6.985	0.295	0.430	10.6	36	448	24.5	56.5	1
W 16 x 31	15.88	5.525	0.275	0.440	9.12	31	375	12.4	47.2	4.5
W 16 x 26	15.69	5.5	0.250	0.345	7.68	26	301	9.6	38.4	3.5

Figure A.2

Specification allowable stresses* for high-strength structural bolts (ksi)

Condition	A325			A490		
	AISC/ASD	AASHTO	AREA	AISC/ASD	AASHTO	AREA
Tension	44	39.5	44	54	48.5	54
Shear, slip-critical connection†						
Standard hole	17	16	17.5	22	20	22
Oversize hole	15	13.5	15‡	19	17	19‡
Shear, bearing-type connection:						
Threads in shear plane	21	19.5	...	28	25	
No threads in shear plane	30	27	...	40	36	
Bearing	$1.2F_u$ ‡	$1.35F_u$ ‡	$1.5F_u$ ‡	$1.2F_u$ ‡	$1.35F_u$ ‡	$1.5F_u$ ‡

* On unthreaded-body area, also called nominal area.
 † Class A surface, clean mill scale.
 ‡ Ultimate strength of lowest-strength connected material.
 § Special permission by the engineer required.

Figure: A.3

Allowable working stress* on fasteners or connected material (ksi)

Load condition	A325	A490
Applied static tension†‡	44	54
Shear on bolt with threads in shear plane	21	28
Shear on bolt without threads in shear plane	30	40
Bearing on connected material with single bolts in line of force in a standard or short slotted hole		$1.0F_u$ ‡§
Bearing on connected material with two or more bolts in line of force in standard or short slotted holes		$1.2F_u$ ‡§
Bearing on connected material in long slotted holes		$1.0F_u$ ‡§

* Ultimate failure load divided by factor of safety.
 † Bolts must be tensioned to requirements of Table 2-7.
 ‡ F_u = specified minimum tensile strength of connected part.

Figure: A.4

Note: For Figure A.4 tabulated values apply when the distance L parallel to the line of force from the center of the bolt to the edge of the connected part is not less than $1.5d$ and the distance from the center of a bolt to the center of an adjacent bolt is not less than $3d$

Sylhet Engineering College, Sylhet
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Department of Civil Engineering

Final Examination, 2023

Course No.: CE 733

Time: 02 (Two) hours

4th Year 1st Semester

Course Title: Environmental Engineering-II

Full Marks: 40

N.B. : (i) Answer any two question from each PART

(ii) Use separate answer scripts for each PART

(iii) Marks allotted are indicated in the margin

(iv) Special Instruction (if any)-----N/A-----

PART- A

(Answer any two questions)

1. (a) Why COD is greater than BOD? 02

(b) Wastewater is flowing through a circular concrete sewer partially. The depth of the water in sewer is $d = 0.94D$. Prove that the discharge ratio $(q/Q) = 1.07$, where D is the dia of the sewer, q = discharge at partial flow and Q = discharge at full flow condition. 08

2. (a) Discuss the various stages followed in the construction of sewers. 04

(b) A city with population 50,000 residing in area of 50 Acres. A sewer line is to be designed as a combined sewer section if: 06

1) Rate of water supply = 200 lpcd

2) Time of concentration = 50 minutes

3) The surface Area has following run off coefficients:

% Surface Area	Surface	Runoff coefficient
50%	Hard parament	0.85
20%	Unpaired street	0.30
20%	Gardens	0.15
10%	Wooded Area	0.10

Assume the design flow equivalent to wet weather flow plus 1.8 times the dry weather flow. Assume any other data.

3. (a) Explain the term “Eutrophication”. What is its impact on the environment? 02

(b) The 5-day 20° C BOD of a wastewater is 310mg/L. What will be the ultimate BOD? What will be the 15-day demand? If the bottle had been incubated at 30° C, what would be the 5-day BOD? 08

PART- B

(Answer any two questions)

4. (a) Define the term ‘Wastewater’. Draw a complete flow diagram of conventional wastewater treatment process. 07

(b) Enumerate the types of floatation in the wastewater treatment system. Write down the working principle of “Screening” and “Skimming tank”. 03

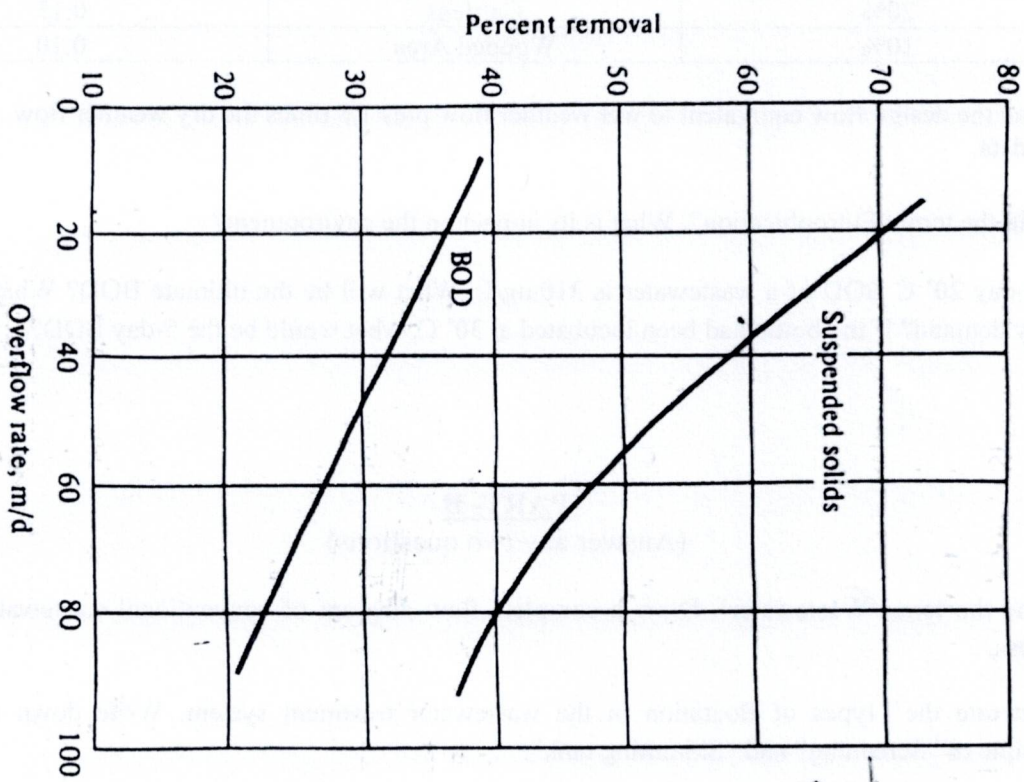
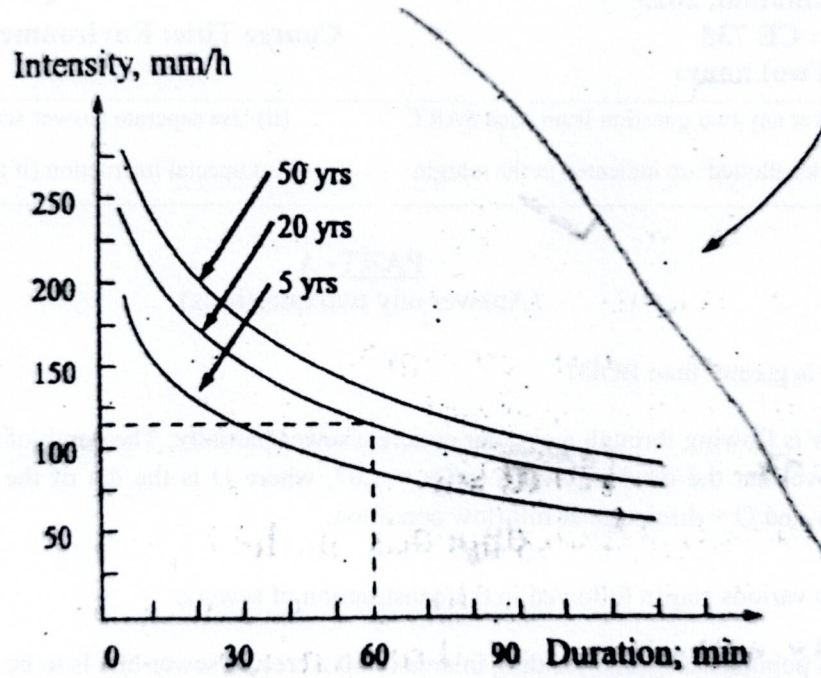
5. (a) Describe the process in a septic tank. 02

(b) A horizontal grid chamber is 11.5m long and 0.45 m wide. If the average grit chamber flow is 0.2 m³/s and the horizontal velocity is 0.25m/s, then check the weather a particle with radius of 0.10 mm and a specific gravity of 2.65 will be captured in the grit chamber or not. Assume the dynamic viscosity of water = 0.000995 Pa.s and density of water = 1000 kg/m³. 08

6. (a) What do you understand by Activated sludge? Explain with a flow diagram the secondary treatment of sewage using Activated sludge process. 06

(b) Explain the stages of oxygen consumption when a waste water is discharged in River giving the various pollution zones with neat diagram. 04

Necessary graphs



Sylhet Engineering College, Sylhet
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Department of Civil Engineering

Final Examination, 2023

4th Year 1st Semester

Course No.: CE 753

Course Title: Transportation Engineering II

Time: 03 (Three) hours

Full Marks: 60

N.B. : (i) Answer any three questions from each PART

(ii) Use separate answer scripts for each PART

(iii) Marks allotted are indicated in the margin

(iv) Special Instruction (if any)-----N/A-----

PART- A

(Answer any three questions)

1. (a) What are the objectives of mix design? 02

(b) The result of Marshal Method of mix design is shown below: 08

Asphalt Content	Flow value	Stability	VFA (%)	VMA (%)	Air void (%)	Unit Weight (%)
45	14	1585	51.77	18.58	8.96	142.6
4	18	1613	49.19	17.97	9.13	142.9
5	23	1517	63.68	17.76	6.45	144.3
55	17	1773	68.22	17.84	5.67	145.4
6	16.8	1460	77.33	18.45	4.92	145.08

Find the Optimum Asphalt content (OAC). Draw at least required graphs.

2. (a) What are factors affecting pavement slab thickness in AASHTO method? 02

(b) Traffic growth = 10% 08

Design life = 10 years

Reliability, R = 92%

Standard deviation, $S_D = 0.31$

Effective soil resilient modulus, $MR_1 = 24000$ psi, $MR_2 = 10,000$ psi, $MR_3 = 1500$ psi.

Design serviceability, $\Delta_{psi} = 2.0$

Here, $a_1 = 0.42$; $a_2 = 0.113$; $a_3 = 0.075$; $m_2 = 0.90$; $m_3 = 0.95$

ESAL of 2×10^6

Design the depth of Pavement.

3. (a) What types of materials commonly used in highway construction? 02

(b) What is the function of Base, sub base and subgrade of a road construction? 02

(c) Design flexible pavement using CBR curves with the following data (i) subgrade CBR = 5%, sub base CBR = 15% and water bound macadam base CBR = 93% and vehicle number 350; design life = 20- years; rate of growth of traffic 4.5% considering the construction period = 2years. 06

4. (a) Differentiate between flexible pavement and rigid pavement. 03

(b) Calculate the stress at interior, end and corner region of cement concrete pavement using the stress equation developed by Wastergaard. Use the following data 07

Wheel load = 6000 Kg

Modulus of elasticity of concrete = 3×10^5 Kg/cm²

Poissons ratio = 0.15

Pavement thickness = 22 cm

Modulus of sub grade = 6.00 Kg/cm³

Radius of contact area = 12 cm

PART- B

(Answer any three questions)

5. (a) What is train resistance? Describe different types of train resistance. 03

(b) What are the advantages and disadvantages of concrete and wooden sleeper? 02

(c) Calculate the super elevation to be provided and the maximum permissible speed for a 2-degree B.G transition curve on a high route having maximum sanctioned speed for the section as 110 kmph. The speed for calculating equilibrium S.E has been considered by engineer as 80 kmph 05

6. (a) Define signal. What are the objectives of railway signal? 03

- (b) Calculate the maximum permissible load that a B.G steam locomotive with 3 pairs of driving wheels with axel load of 22 tones each on a straight level track at a speed of 80 kmph. Also calculate the reduction in speed if the train has to run on a rising gradient of 1 in 200. What would be the further reduction in speed if the train has to negotiate a 40 curve on the rising gradient? Assume coefficient of friction as 0.2 07
7. (a) Write function of semaphore signal. Write advantage and disadvantages of concrete sleeper. 04
 (b) Government of Bangladesh decide to purchase a locomotive with four pairs of driving wheels with an axle load of 28.42ton each on a BG track for Dinajpur to Rajshahi with a ruling gradient of 1 in 200 and a maximum curvature of 3° travelling at a speed of 48.3 km/h. Calculate the maximum permissible train load that can be pulled by the proposed locomotive. Take the coefficient of friction to be 0.2. 06
8. (a) Define (any two) (i) point and crossing (ii) Double headed rails (iii) Yards, (iv) Tongue rail and stack rail 03
 (b) What are switch lead and curve lead? 03
 (c) What is ballast? Mention the functions of ballast? 04

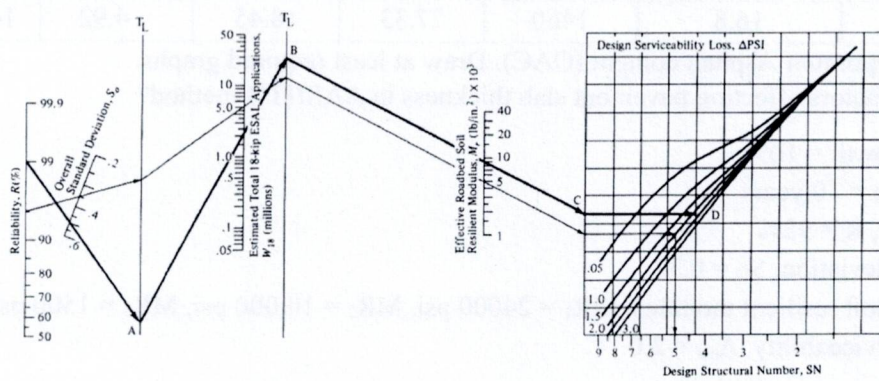


Figure: 1 Design Chart for Flexible Pavements Based on Using Mean Values for each Input

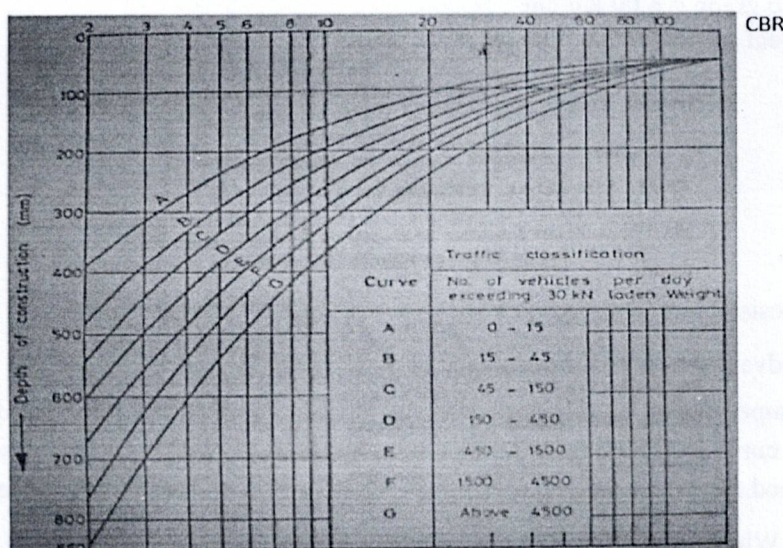
Wheel Load Stresses
 Westergaard solutions for a Poisson ratio of 0.15 for concrete

Interior loading (tensile stress at the slab bottom)
 $\sigma_i \text{ (psi)} = (0.3162P/h^2) [4 \log_{10} (l/b) + 1.069]$

Edge loading (tensile stress at the slab bottom)
 $\sigma_e \text{ (psi)} = (0.572P/h^2) [4 \log_{10} (l/b) + 0.359]$

Corner loading (tensile stress at slab top)
 $\sigma_c \text{ (psi)} = (3P/h^2) [1 - ((a/2)^{1/2} / l)^{0.6}]$

19.3kg./cm²
 24.27kg./cm²
 28.54 kg./cm²



Sylhet Engineering College, Sylhet
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Department of Civil Engineering

Final Examination, 2023

Course No.: CE 767

Time: 02 (Two) hours

4th Year 1st Semester

Course Title: Irrigation and Flood Control

Full Marks: 40

N.B. : (i) Answer any two question from each PART

(ii) Use separate answer scripts for each PART

(iii) Marks allotted are indicated in the margin

(iv) Special Instruction (if any)-----N/A-----

PART- A

(Answer any two questions)

1. a. Define Irrigation and its necessity in Bangladesh. What are the advantages and disadvantages of Irrigation? 03
- b. Write briefly the various techniques used for distributing water in irrigation field. 02
- c. A sandy loam soil holds water at 140 mm/m depth between field capacity and permanent wilting point. The root depth of the crop is 30 cm and the allowable depletion of water is 35%. The daily water use by the crop is 5 mm/day. The area to be irrigated is 60 ha and water can be diverted at 28 litres/sec. The surface irrigation application efficiency is 40%. There are no rainfall and ground water contribution. Determine (i) allowable depletion depth between irrigations. (ii) Frequency of irrigation (iii) net application depth of water (iv) volume of water required (v) time to irrigate 4 ha plot. 05
2. a. What is Basin Flooding? How you can develop furrow method in field and calculate mathematically. 03
- b. Describe different impurities in irrigation water. What is field capacity? show that the depth of water stored in the root zone in filling the soil up to field capacity $= \frac{Y_d \cdot d \cdot F}{Y_w}$ 03
- c. Estimate the leaching requirement when electrical conductivity (EC) value of a saturated extract of soil is 10 m-mho/cm at 25% reduction in the yield of a crop. The EC of irrigation water is 1.2 m-mho/cm. What will be the required depth of water to be applied to the field if the consumptive use requirement of the crop is 80 mm? EC value of the leaching water may be suitably assumed. 04
3. a. Define Duty, Delta and Base period of irrigation water and derive a relationship among Duty, Delta & Base period. 03
- b. After how many days will you supply water to soil in order to ensure sufficient irrigation of the given crop, if, field capacity of the soil is 25% and permanent wilting point = 13% where effective depth of root zone = 70cm. Consider dry density of soil = 1.30 gm/cc and Daily consumptive use of water for the given crop = 18 mm. Assume any other data, not given. 04
- c. Determine the time required to irrigate a strip of land of 0.04 hectares in area from a tube-well with a discharge of 0.02 cumec. The infiltration capacity of the soil may be taken as 5 cm/hr, and the average depth of flow on the field as 10 cm. Also determine the maximum area that can be irrigated from this tube well. 03

PART- B

(Answer any two questions)

4. a. What are the effects of water logging? How could you control the water logging? 04
- b. What are the functions of River? Write critical characteristics of flood hazards. 06
5. a. Define flood. Discuss causes of flood in Bangladesh shortly. 03
- b. Define Design flood. Briefly discuss the effects of flood. 02
- c. The culturable commanded area for a distributary is 15,000 hectares. The intensity of irrigation for Rabi (wheat) is 40% and for Kharif (rice) is 15%. If the total water requirement of the two crops are 37.5 cm and 120 cm and their periods of growth are 160 days and 140 days respectively; 05
(a) Determine the outlet discharge from average demand considerations;
(b) Also determine the peak demand discharge, assuming that the kor water depth for two crops are 13.5 cm. and 19 cm. and their kor periods are 4 weeks and 2 weeks respectively.
6. a. What is leaching? Discuss different type of land drainage. 02
- b. Sugarcane (root zone depth 1.8 m) is grown in a particular area where the ground water table is 2.0 m below ground. If the size of the soil pores is 0.08 mm in diameter and surface tension = 0.054 N/m, is the field water-logged? If so. determine the vertical location of closed drains below ground, spaced at 15 m. Take drainage coefficient as 0.116 cumecs/km². Coefficient of permeability as 10⁻⁶ m/s, and the impervious stratum to occur at 7.0 m, below ground. 05
- c. Define drainage co-efficient. Determine the size of a tile at the outlet of a 6 hectare drainage system, if the D.C. is 1 cm and the tile grade is 0.3%. Assume the rugosity coefficient for the tile drain material as 0.011. 03

