L-3/T-1/WRE **Date : 15/02/2012**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B. Sc. Engineering Examinations 2010-2011

Sub : **CE 311** (Structural Analysis and Design - I)

Full Marks: 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **SEVEN** questions in this Section. Answer any **FIVE**.

1. Draw the influence lines for shear at a (left), moment at b and reaction at c of the beam shown in Fig. 1 **(21)**

2. Draw the influence lines for sheer and moment at 'f' in the beam CD of the frame shown in Fig. 2 as a unit load moves from A to B. **(21)**

3. For the floor beam system shown in Fig. 3, draw influence lines for (a) shear in panel DE; (b) moment at panel point E **(21)**

4. Calculate the absolute maximum moment on a 60 ft span beam due to the load shown in Fig. 4 **(21)**

5. Calculate the maximum bar force in member 'a' due to the wheel load shown in Fig. 5. **(21)**

6. Draw influence line for members L_4L_6, M_5V_6, V_6L_6 of the truss shown in Fig. 6 **(21)**

7. Calculate the counter stress in panel 3-4 of the truss shown in Fig. 7 due to the following loading: **(21)**

   Dead load = 3.0 kip/ft

   Live load = 4.0 kip/ft

SECTION – B

There are **SEVEN** questions in this Section. Answer any **FIVE**.

8. Find the bar force in members MK, ME, DE and EK for the truss shown in Fig. 8. **(21)**

9. Find reactions at the supports and draw shear force and bending moment diagrams for member ABCD of the structure shown in Fig. 9. **(21)**

Contd P/2

10. Draw the shear force and moment diagram for the Frame shown in Fig. 10 **(21)**

Given : Moment at D = – 300 kip.ft

Shear at F = + 10^k

11. For the wheals load shown in Fig. 11, calculate maximum shear at one-third point from left in a simple supported beam of span 75 ft. **(21)**

12. (a) Derive general cable theorem. **(8)**

(b) Derive an expression for maximum tension in a cable subjected to uniformly distribute load (horizontal foot). Assume the right end of the cable is higher than the left end. **(8)**

(c) Define elastic behavior of suspension bridge **(5)**

13. For the cable shown in Fig. 12 **(21)**

(a) Maximum tension in the cable

(b) Stretch in cable

(c) Unstressed length of cable

(d) Reactions at the support C of pole

Assume : E = 30,000 ksi X – A = 25 in^2 (for cable)

14. (a) Calculate force in the hangers of the suspension bridge (Fig. 13) **(21)**

(b) Draw the shear force and bending moment diagrams for the stiffening girders of the suspension bridge.

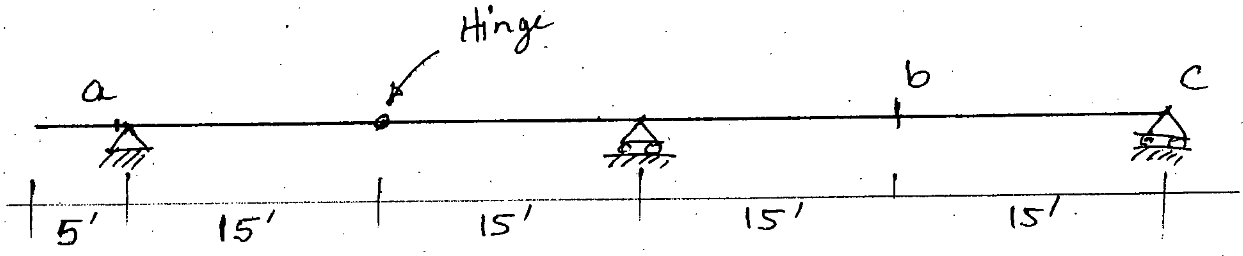


Fig. 1

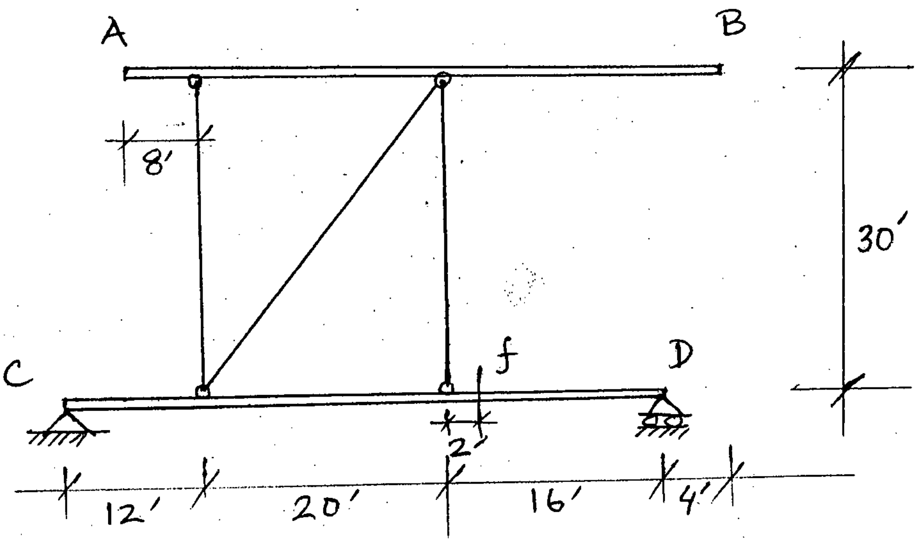


Fig. 2

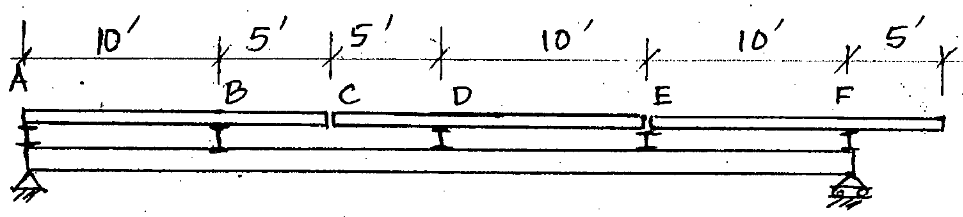


Fig. 3

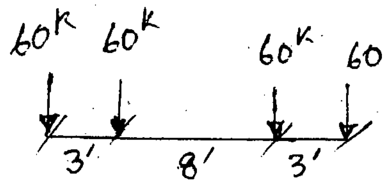


Fig. 4

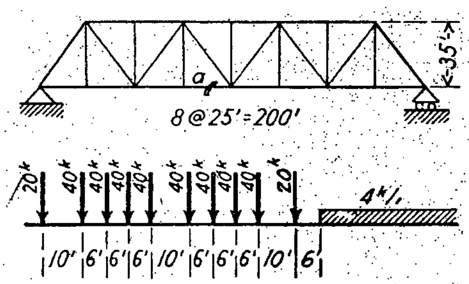


Fig. 5

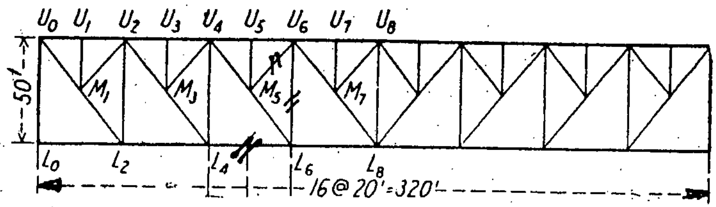


Fig. 6

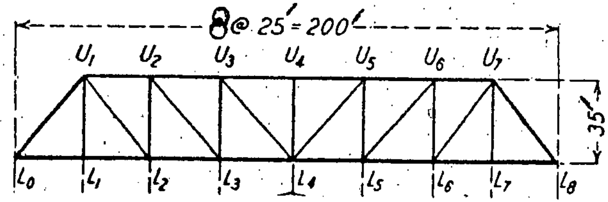


Fig. 7

Sol.

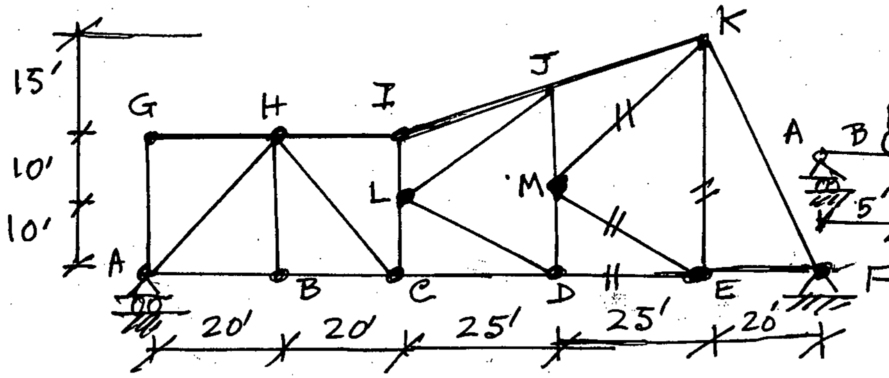


Fig. 8

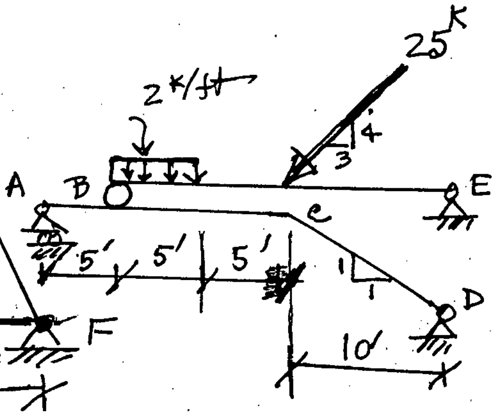


Fig. 9

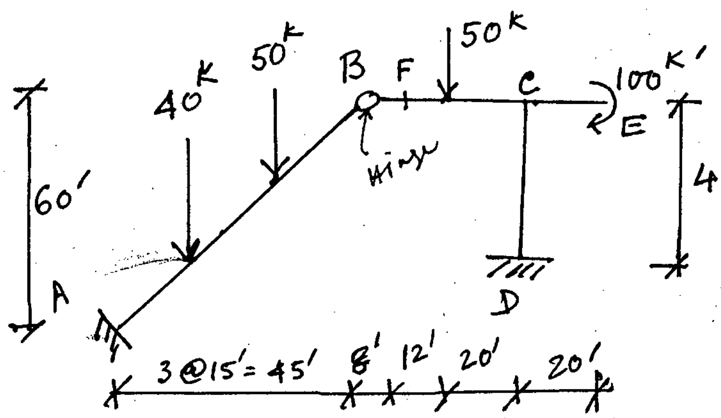


Fig. 10

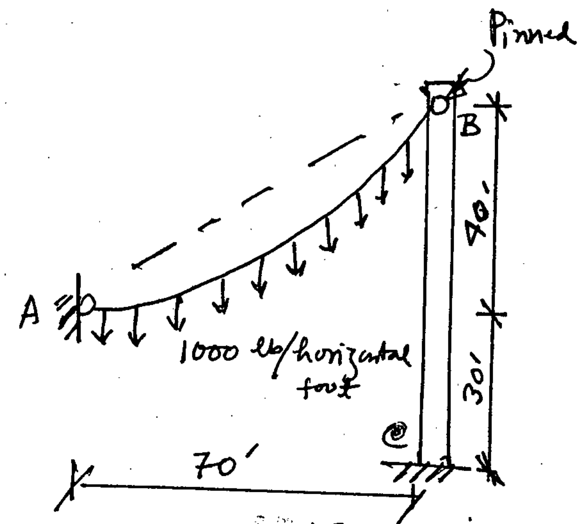


Fig. 12

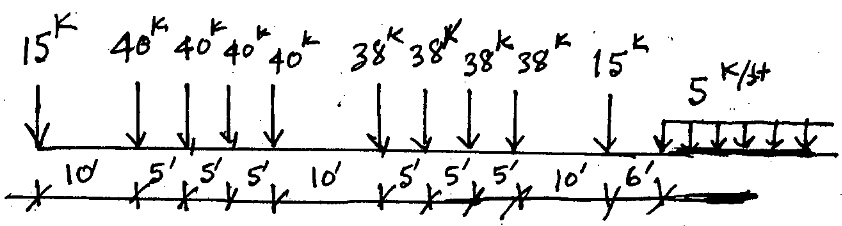


Fig. 11

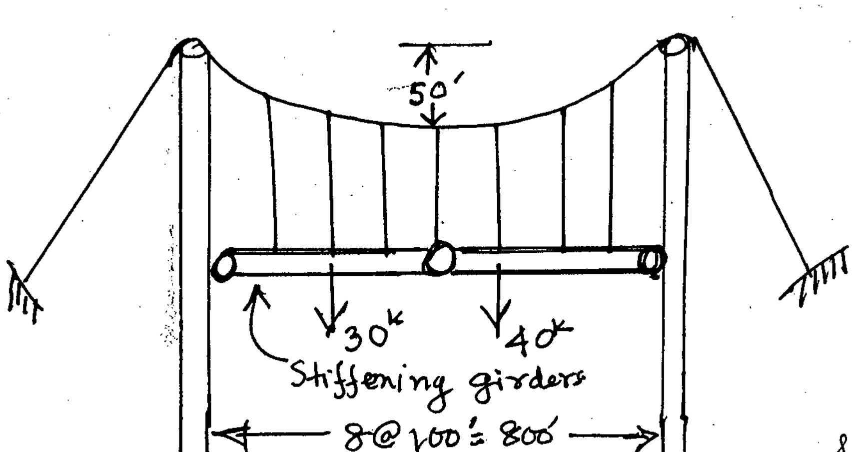


Fig. 13

L-3/T-1/WRE **Date : 29/02/2012**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B. Sc. Engineering Examinations 2010-2011

Sub : **CE 315** (Design of Concrete Structures I)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

Symbols carry their usual meanings.

Assume reasonable value for any missing data.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Differentiate between 'overreinforced' and 'underreinforced' beam. **(5)**

(b) A rectangular reinforced concrete beam as shown in Fig. 1 has width of 12 in and effective depth to the centroid of tension reinforcement of 22.5 inch. The tension reinforcement consists of six No. 9 bars in two rows. Compression reinforcement consisting of two No. 8 bars is placed 2.5 inch from the compression face of the beam. **(30)**

Given:

$f'_c = 3$ ksi, $f_y = 60$ ksi

$f_c = 1.35$ ksi, $f_s = 24$ ksi, $n = 9$

Determine:

(i) Maximum allowable working moment by WSD.

(ii) Design moment capacity by USD.

Given: $\phi = 0.9$ for $\varepsilon_t > 0.005$ and $\phi = 0.65$ for $\varepsilon_t < 0.002$ else, $\phi = 0.483 + 83.3\ \varepsilon_t$.

2. (a) Explain ACI 'tension controlled' and 'compression controlled' reinforced concrete member with particular reference to factor 'ϕ'. **(5)**

(b)A rectangular beam that must carry a service live load of 3 k/ft and a calculated dead load including its self weight of 1.3 k/ft on a 21 ft simple span is limited in cross-section for architectural reasons to 10 in width and 20 inch total depth. Design the beam for flexure by WSD and USD method. **(30)**

Given:

$f'_c = 4.0$ ksi, $f_y = 60$ ksi, $f_s = 24$ ksi, $n = 8$

Also, find out the percent of overdesign moment in each method for the section you have designed. Comment on your results.

For USD method use,

$\phi = 0.9$ for $\varepsilon_t \geq 0.005$

$\phi = 0.65$ for $\varepsilon_t < 0.002$

else, $\phi = 0.483 + 83.3\ \varepsilon_t$

Contd P/2

CE 315 (WRE)

3. A beam-slab floor system consisting of 5″ slab is shown in Fig. 2.

   (i) Find out the effective width for Beam B1 and Beam B2. **(10)**

   (ii) For beam B2 web dimensions as determined by negative moments at supports are $b_\omega = 12''$ and $d_\omega = 15''$ what tensile steel area is required at midspan to resist a factored moment of 400 k-ft? **(25)**

   Given: $f'_c = 3.5$ ksi, $f_s = 60$ ksi

4. (a) What are the factors that influence the development length of a reinforcing bar. **(5)**

   (b)A 16 in wide cantilever beam frames into the edges of a 16 inch thick wall as shown in Fig. 3. At ultimate, the No. 8 bars at the top of the cantilever are stressed to their yield strength at point A at the face of the wall. Compute the minimum embedment of the bars into the wall. **(12)**

   Given:

   Normal wt. concrete with $f'_c = 3$ ksi, $f_y = 60$ ksi

   Closed # 3 stirrups @ 6″ spacing is used in the beam

   The cover is 1.5 inch to the stirrup. The 3 No. 8 bars are inside the No. 4 at 12″ vertical steel in each face of the wall.

   (c) For the T-section of RC beam shown in Fig. 4 calculate the design moment capacity and As_{min}. **(18)**

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) State the fundamental assumptions for flexural analysis of reinforced concrete beams. **(7)**

   (b) What are the advantages of using steel as reinforcement for concrete? **(5)**

   (c) A single reinforced concrete beam with a square opening as shown in Fig. 5 has a width of 12″ and an effective depth of 21″. The tension reinforcement consists of three No. 9 bars in one row. Given: $f'_c = 4.0$ ksi, $f_y = 60$ ksi, $f_r = 7.5\sqrt{f'_c}$ psi, $f_s = 24$ ksi. Determine: **(23)**

   (i) The maximum allowable moment

   (ii) The maximum stresses in concrete and steel caused by a bending moment, M = 130 k-ft.

6. (a) What is serviceability? How is it ensured for slabs? **(7)**

   (b) Why are load factors different for dead and live load in USD? Explain. **(5)**

Contd P/3

CE 315 (WRE)

Contd ... Q. No. 6

(c) A 6″ thick on-way slab is supported on brickwall as shown in Fig. 6. The slab is subjected to a service dead load of 70 psf (excluding self wt) and service live load of 40 psf. Calculate critical design moments and reinforcements. Show the necessary reinforcements in sketches. **(23)**

Given: $f'_c = 3.0$ ksi and $f_y = 60$ ksi.

7. (a) Describe the mechanism of shear resistance in reinforced concrete beam with vertical stirrups. **(7)**

(b) Discuss why and how temperature and shrinkage reinforcement is provided in one-way slab. What are the recommended (ACI) ratios for such steel? **(5)**

(c) Using USD method, design shear reinforcement of the beam as shown in Fig. 7. The loads shown in the figure are factored. Show the reinforcement in a neat sketch. **(23)**

Given: $f'_c = 3.0$ ksi and $f_y = 60$ ksi.

8. (a) Why minimum reinforcement ratio needed to be ensured in RCC beam? Give the values for different cases. **(5)**

(b) Discuss the flexural behaviour of reinforced concrete rectangular beam under increasing load by drawing neat sketches of stress and strain distribution for uncracked, cracked and ultimate condition. **(10)**

(c) Draw the deflected shape and show the primary rebar layout (qualitative) in concrete of the structures shown in Fig. 8 for the given loading condition. **(5)**

(d) The beam shown in Fig. 9 is simply supported with a span of 20 ft. The beam is to carry a distributed load of 4 k/ft (factored). The reinforcement consists of 4 No. 8 bars at an effective depth of 20″. Identity the location along the span, where two of the four rebars can be discontinued. **(15)**

Given: $f'_c = 3.0$ ksi and $f_y = 60$ ksi.

CE 315 (WRE)

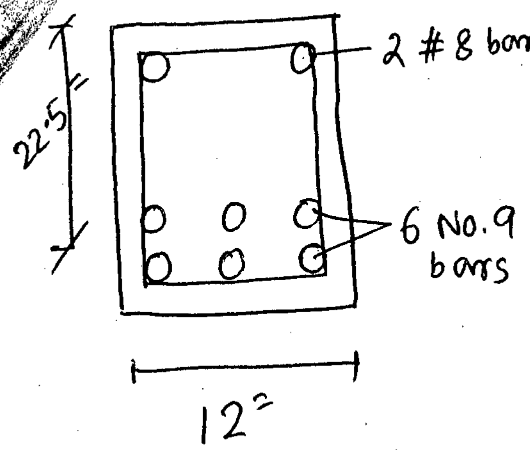


Fig. 1

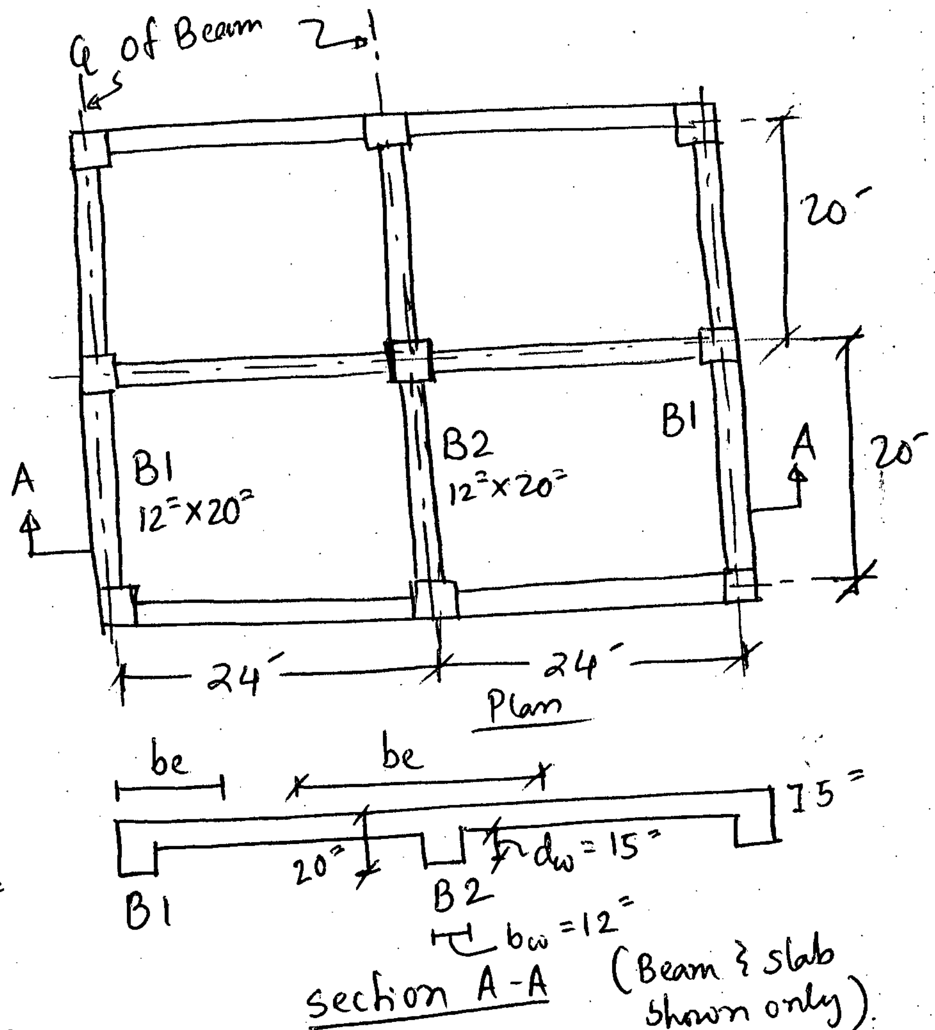
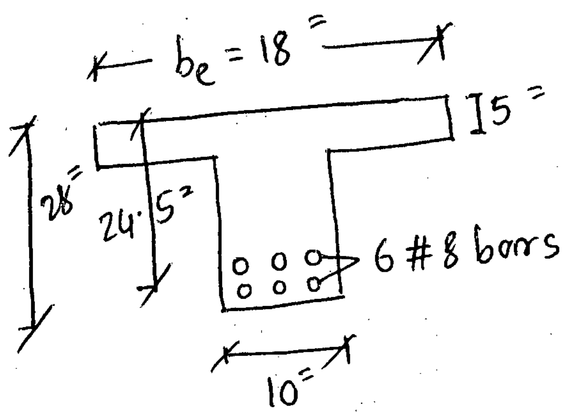
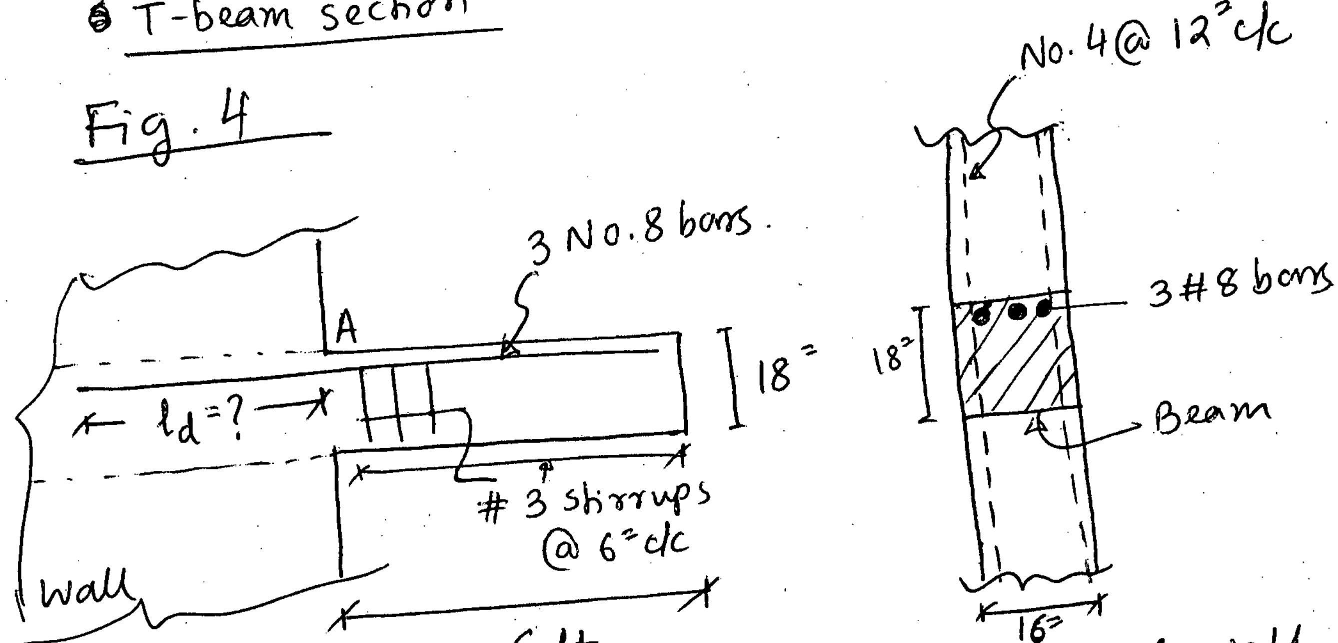


Fig. 2



T-beam section

Fig. 4



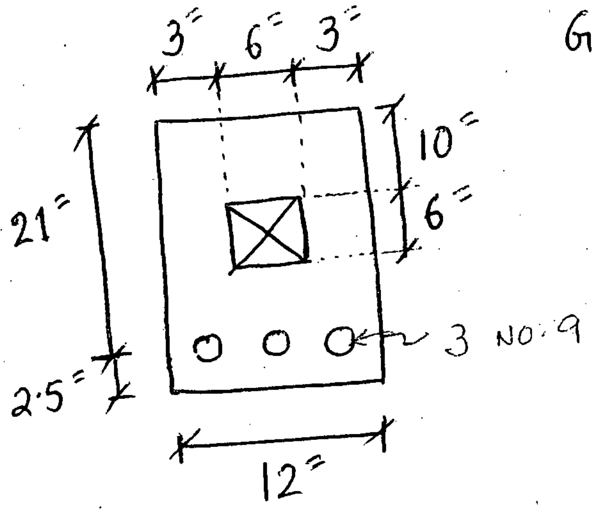
elevation

Vertical Section through wall

Fig. 3

mahbubur

CE 315 (WRE)



Given: $f'_c = 4$ ksi $f_y = 60$ ksi

$f_r = 7.5\sqrt{f'_c}$ $f_s = 24$ ksi

$n = 8$.

Fig. 5

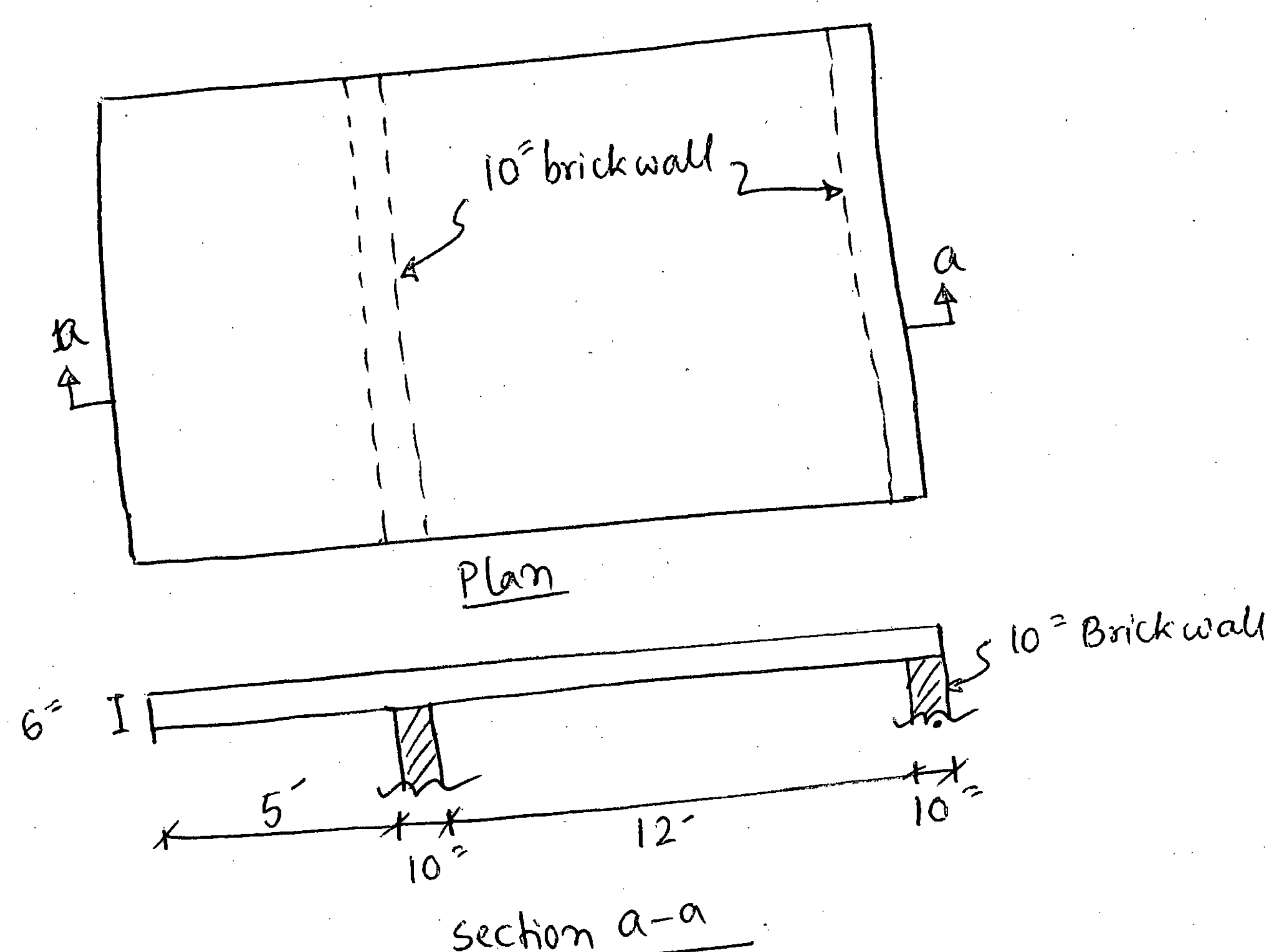
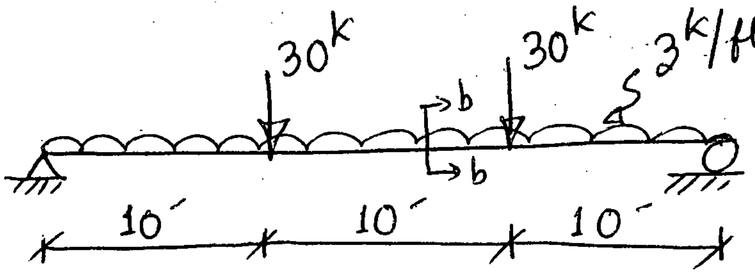
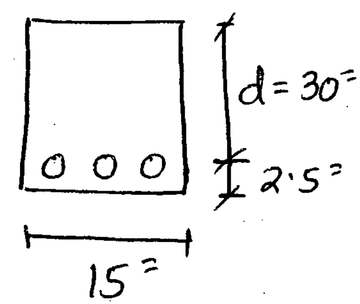


Fig. 6

26.12.2011

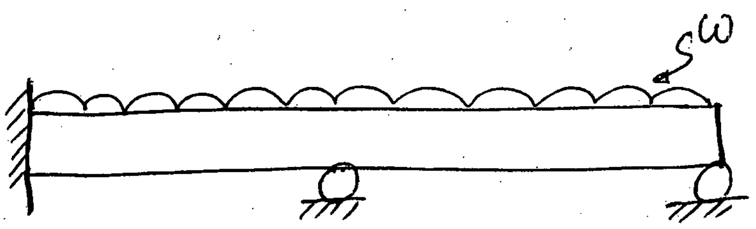
CE 315 (WRE)



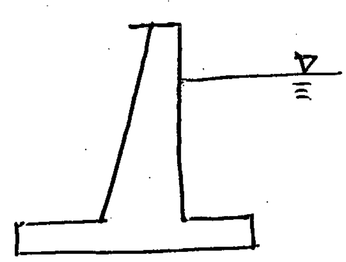


Section: b-b

Fig 7

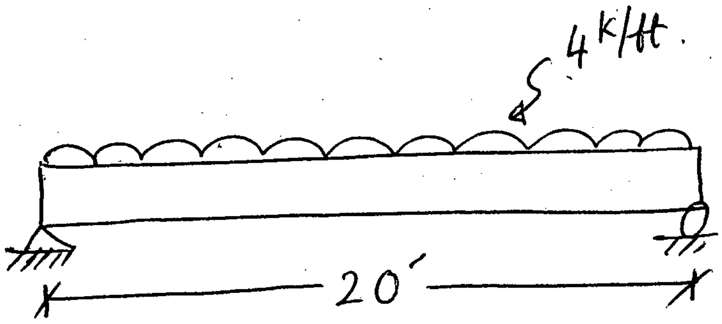


(a) Reinforced concrete beam.



(b) Retaining wall.

Fig 8



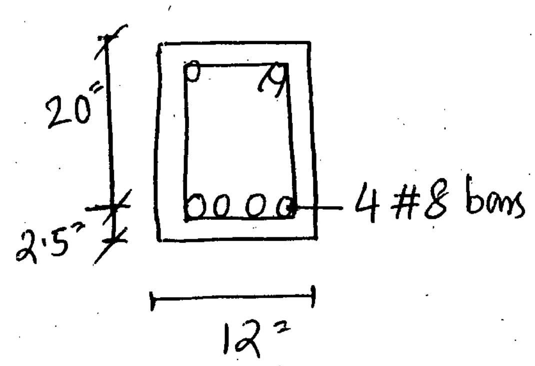


Fig. 9

26.12.2011

L-3/T-1/WRE **Date : 22/02/2012**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B. Sc. Engineering Examinations 2010-2011

Sub : **CE 335** (Environmental Engineering VI)

Full Marks: 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this Section. Answer any **THREE**.

1. (a) Write down some merits and demerits of different types water distribution pipe layout options. **(10)**

(b) List the methods commonly used for population projection. The population data of a town is shown below. Using the data, estimate population of the town in year 2020 and 2025 by least square parabola method. **(12)**

Year	1950	1970	1980	1990	2010
Population (Thousands)	55	70	85	105	160

(c) Draw a neat sketch showing different modes of tubewell operated in Bangladesh. What are the difficulties associated with using groundwater as a drinking water source in Bangladesh? **($11\frac{2}{3}$)**

(d) What is the working principle of reverse osmosis process? What are the forms of activated carbon used in water treatment process? Discuss their applicability. **(13)**

2. (a) Calculate the head losses and corrected flows in the pipes of a distribution network shown in Figure-1(a), Compute the corrected flow after one iteration. Using the Figure – 1(b). **($12\frac{2}{3}$)**

(b) Differentiate between MPN method and membrane filter method of bacteriological examination of water. Discuss the major functions involved in source water assessment in water supply system. **(13)**

(c) How velocity gradient for a flocculator can be calculated? What are the removal mechanisms involved in filtration process? Describe briefly. **(9)**

(d) What are the methods of handling treatment plant residuals? What are the transfer mechanisms of dissolved impurities in water? Show diagrammatically. **(12)**

3. (a) "Rainwater is a potential source of water supply in Bangladesh" – explain. Write down a short note on major sectors of Environmental Engineering. **(12)**

(b) What is an intake? What are the factors to be considered while selecting the location of intake? **(6)**

CE 335

Contd ... Q. No. 3

(c) Calculate the dimension of a rectangular setting tank to treat 1.8 million litre of water per day. The overflow rate is 0.64 m/hr and detention time is 3 hr. **($12\frac{2}{3}$)**

Also calculate the smallest size (diameter) of particle that will be removed with 100% theoretical efficiency in the tank at 20° C (Assume Laminar flow, at 20° C, ρ_w = 998.2 kg/m^3, $\mu = 1.002 \times 10^{-3}$ kg/m-sec; specific gravity of particle = 2.65.

(d) What is the procedure of getting environmental clearance from Department of Environment in Bangladesh for an industry under category – 'Red'? **(9)**

(e) How the volume of a storage reservoir can be graphically estimated? **(7)**

4. (a) Discuss briefly the steps in EIA process. **(12)**

(b) A 100 mm diameter tubewell has been sunk to withdraw water from a 10 m thick confined aquifer. The depth of water below piezometric level is 28 m and it falls by 2 m in the well during pumping. Calculate the co-efficient of permeability of the aquifer (in m/sec) if the pumping rate is 15 is 15 lps and the diameter of the circle of influence is 60 m. **(11)**

(c) Draw a flow diagram of treatment unit processes to treat water from a groundwater source. The Laboratory analysis shows that the water consists considerable amount of CO_2 and organic matter. Arsenic and iron concentrations exceed the guideline values in ECR'97 for the respective parameters. Alkalinity is about 100 mg/L as C_aCO_3. Also mention why each unit is being used. **($11\frac{2}{3}$)**

(d) Write short note on the following water quality parameters – **(12)**

(i) Taste and odor (ii) sodium (iii) Hardness

SECTION – B

There are **FOUR** questions in this Section. Answer any **THREE**.
Assume Reasonable value for missing data (if required)

5. (a) Draw a schematic diagram to show the air pollution system. Also Explain. **(7)**

(b) What is Air Quality Index (AQI)? Following information about the air quality of Dhaka on December 20, 2011 are available. Calculate the AQI of Dhaka and report the air uality of that day. Attached table-1 can be used for calculation. **($17\frac{2}{3}$)**

8-hr O_3	: 0.03 ppm
24-hr $PM_{2.5}$	: 52 $\mu g/m^3$
24-hr PM_{10}	: 141 $\mu g/m^3$
8-hr CO	: 8.0 ppm
24-hr SO_2	: 200 $\mu g/m^3$
Temperature 21° C	

Contd P/3

CE 335

Contd ... Q. No. 5

(c) Define sanitary landfill. Schematically show typical methods for venting landfill gases. **(10)**

(d) What are the design considerations that should be followed in designing a pour-flush latrine? List the advantages and disadvantages of pour-flush pit latrine. **(12)**

6. (a) Categorize the pollutants that pollute the water body. What are the adverse impacts of heavy metals? **(8)**

(b) Define criteria pollutants? Explain the importance of considering particle size in air quality standards. **(7)**

(c) Deduce the first order BOD equation using BOD kinetics. Explain the effect of temperature on BOD exertion from that equation. **($16\frac{2}{3}$)**

(d) Define solid waste management. List the important properties regarding the chemical composition of solid wastes. **(10)**

(e) How do $H_2O - H_2SO_4$ droplets form in the atmosphere? **(5)**

7. (a) Draw a figure and describe the relative growth of microorganisms in a batch culture. **(10)**

(b) Design a septic tank for a 6-storied residential building where a total of 70 people stay. Wastewater flowrate is 80 Lpcd and design period is 20 years. **($16\frac{2}{3}$)**

(c) What are the fundamental elements of solidwaste management system? Briefly explain different methods of solid waste collection methods. **(12)**

(d) What is eutrophication? How can eutrophication be controlled? **(8)**

8. (a) Compare the advantages and disadvantage of different types of wastewater collection systems. **(15)**

(b) With a schematic diagram, explain the biological process that takes place in the Trickling Filter Process. **(8)**

(c) Describe the two-stage anaerobic digestion process of sludge. **(10)**

(d) Briefly explain the health effects of carbon monoxide. **(7)**

(e) Briefly describe grit chamber with a schematic diagram. **($6\frac{2}{3}$)**

L-3/T-1/EEE **Date : 15/02/2012**

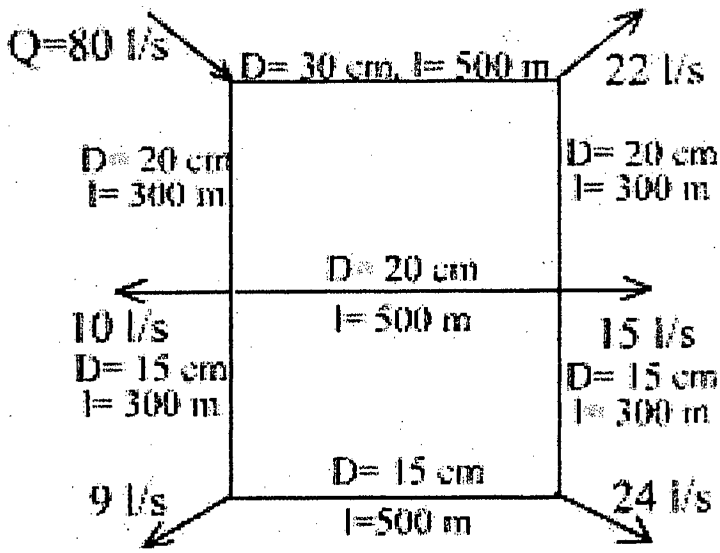


Figure-1(a)

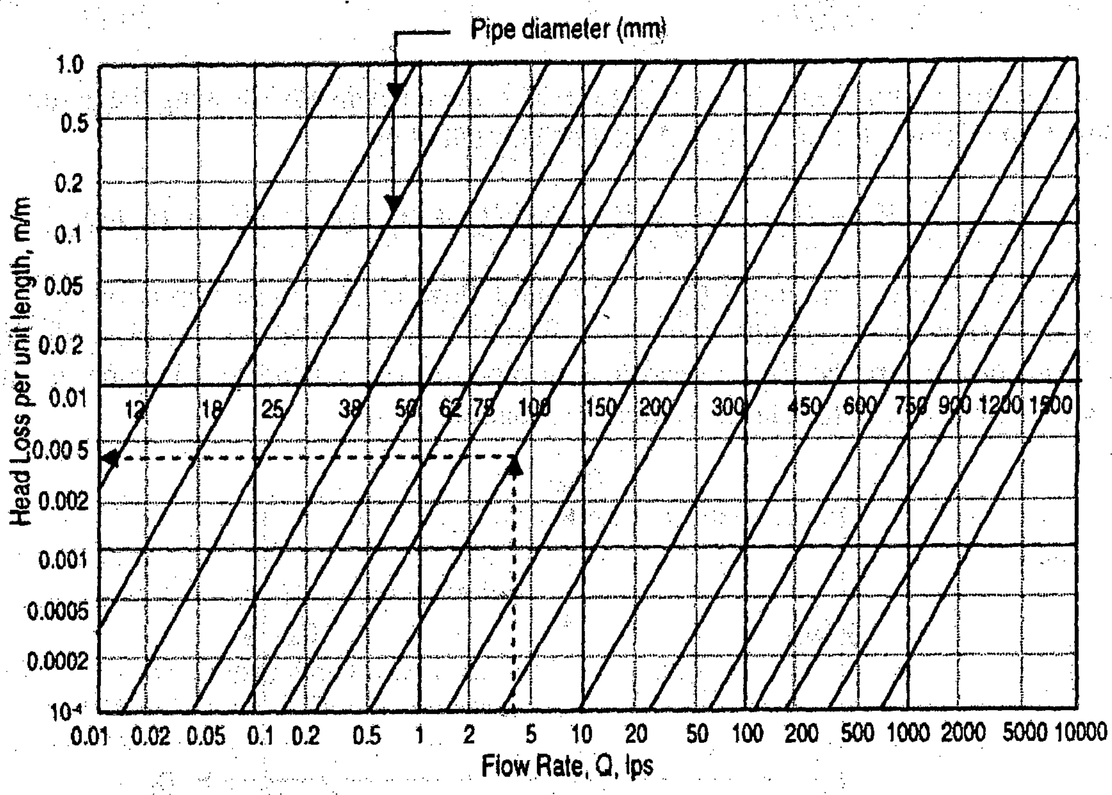


Figure-1(b)

Figures for question no. – 2(a)

Table 1: (for question no. 1(b))

Breakpoints								
O_3 (ppm) 8-hr	O_3(ppm) 1-hr (i)	$PM_{2.5}$ ($\mu g/m^3$) 24-hr	PM_{10} ($\mu g/m^3$) 24-hr	CO (ppm) 8-hr	SO_2 (ppm) 24-hr	NO_2 (ppm) Annual	AQI	Category
0.000-0.064	--	0.0-15.4	0-54	0.0-4.4	0.000-0.034	(ii)	0-50	Good
0.065-0.084	--	15.5-40.4	55-154	4.5-9.4	0.035-0.144	(ii)	51-100	Moderate
0.085-0.104	0.125-0.164	40.5-65.4	155-254	9.5-12.4	0.145-0.224	(ii)	101-150	Unhealthy for Sensitive Groups
0.105-0.124	0.165-0.204	65.5-150.4	255-354	12.5-15.4	0.225-0.304	(ii)	151 -200	Unhealthy
0.125-0.374	0.205-0.404	150.5-250.4	355-424	15.5-30.4	0.305-0.604	0.65-1.24	201-300	Very Unhealthy
(iii)	0.405-0.504	250.5-350.4	425-504	30.5-40.4	0.605-0.804	1.25-1.64	301-400	Hazardous
(iii)	0.505-0.604	350.5-500.4	505-604	40.5-50.4	0.805-1.004	1.65-2.04	401-500	Hazardous

(i) In some cases, in addition to calculating the 8-hr ozone index, the 1 -hr ozone index may be calculated, and the maximum of the two values reported
(ii) NO_2 has no short-term air quality standard and can generate an AQI only above 200
(iii) 8-hr O_3 values do not define higher AQI values (≥301). AQI values of 301 or higher are calculated with 1-hr O_3 concentrations

T. Ahmed

Att. Table for Question No- 1(b)

L-3/T-1/WRE **Date : 01/02/2012**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B.Sc. Engineering Examinations 2010-2011

Sub : **CE 341** (Geotechnical Engineering)

Full Marks : 280 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this Section. Answer any **THREE**.

1. (a) Draw the Plasticity chart and briefly discuss Unified Classification System for Fine-Grained Soils. **($16\frac{2}{3}$)**

   (b) Briefly discuss Unified Classification System for Coarse-Grained Soils. **(10)**

   (c) For a soil in natural state given, e = 0.8, w = 24%, G_s = 2.68 **(20)**

   (i) Determine the moist unit weight, dry unit wt and degree of saturation.

   (ii) If the soil is made saturated by adding water what would be the water content and the saturated unit weight?

   (iii) Draw weight volume relationship for the above two cases [(i) and (ii)]

2. (a) Describe briefly direct Shear test. **($10\frac{2}{3}$)**

   (b) Given : Data from direct shear test. **(16)**

Test No.	Normal Force (kg)	Shear force (kg)	Area of Sample (s.q. cm)
1	4	5.8	25
2	12	8.1	25

   Find c and Φ.

   (c) Given : Data from Triaxial Test **(20)**

Test No.	Confining stress (kN/m^2)	Deviator Stress at failure (kN/m^2)
1	30	57
2	60	79

   Find c and Φ.

3. (a) Draw a Triaxal Test apparatus. Discuss φ = 0 concept for a Saturated Clay sample subjected to UU Test. **($20\frac{2}{3}$)**

   (b) A rectangular footing 4 m by 6 m carries a total load of 480 metric ton uniformly distributed. Find stress 5 m below the footing under one corner, and under the center. Use Teble 1. **(16)**

   (c) Describe a method for approximate estimates of the average vertical stress under uniformly loaded area. **(10)**

Contd P/2

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4. (a) Draw a figure and show the relationship between lateral earth pressure and wall movement. **(10)**

(b) Using Rankine's Theory draw Mohr's circles for active and passive cases of stress in cohesionless back fill, level surface, and depth h. **($16\frac{2}{3}$)**

(c) For a retaining wall 4 m height draw active pressure diagram and calculate the total force, Given $\varphi = 30°$, $\varphi = 35°$, $\gamma = 18$ kN/m^3 (use Rankine's theory). **(20)**

SECTION – B

There are **FOUR** questions in this Section. Answer any **THREE**.

5. (a) Explain sensitivity and thixotropy. **($6\frac{2}{3}$)**

(b) Discuss structure of soil aggregate with neat sketches. **(10)**

(c) Write short notes on the following: **(18)**

(i) Mica

(ii) Bentonite

(iii) Kaolinite

(d) Explain Basic Structural Units of soil minerals with examples. **(12)**

6. (a) Explain factors affecting compaction with neat sketches. **($16\frac{2}{3}$)**

(b) Discuss specification of field compaction. Also discuss Sand Cone method for the estimating of field density. **(15)**

(c) The laboratory test results of a Modified Proctor test are given below: **(15)**

Wright of moist soil in mold (lb)	Moisture content (%)
3.71	10
3.79	12
3.85	14
3.89	16
3.83	18
3.78	20

Volume of mold = $\frac{1}{30}$ cft.

(i) Estimate the maximum dry unit weight of compaction and the optimum moisture contact.

(ii) Calculate and plot γ_d versus the moisture content for degree of saturation = 87% and $G_s = 2.71$.

7. (a) Explain one-dimensional consolidation with spring analogy. **($10\frac{2}{3}$)**

(b) Explain Casagrande's method for estimation of preconsolidation (σ_c') pressure. What are the advantages over-consolidated soil. **(15)**

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Contd ... Q. No. 7

(c) The soil profile at a site for a proposed office building is shown in Fig. 1. The clay layer is overconsolidated with OCR = 1.5, W = 38%, $C_c = 0.4$ and $C_e = 0.07$. $G_s = 2.65$ for all soils and $\gamma_{sat} = 17$ kN/m^3. The building will impose a vertical stress increase of 160 kPa at the middle of the clay layer. Estimate consolidate settlement. **(21)**

8. (a) Explain critical hydraulic gradient and boiling. **(7)**

(b) Derive the equation for seepage calculation, $q = K\frac{N_f}{N_d}H$ from a flownet where q = total rate of flow through N_f number of flow channels; H = head difference between the upstream and downstream side; N_d = number of potential drops. **(15⅔)**

(c) For the weir shown in Fig. 2, draw the flownet and calculate the uplift force at the base of the weir per meter length. **(24)**

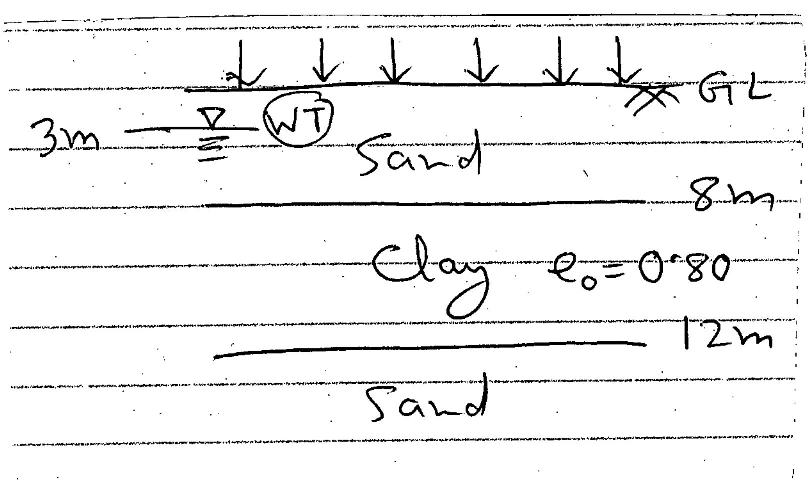


Figure 1

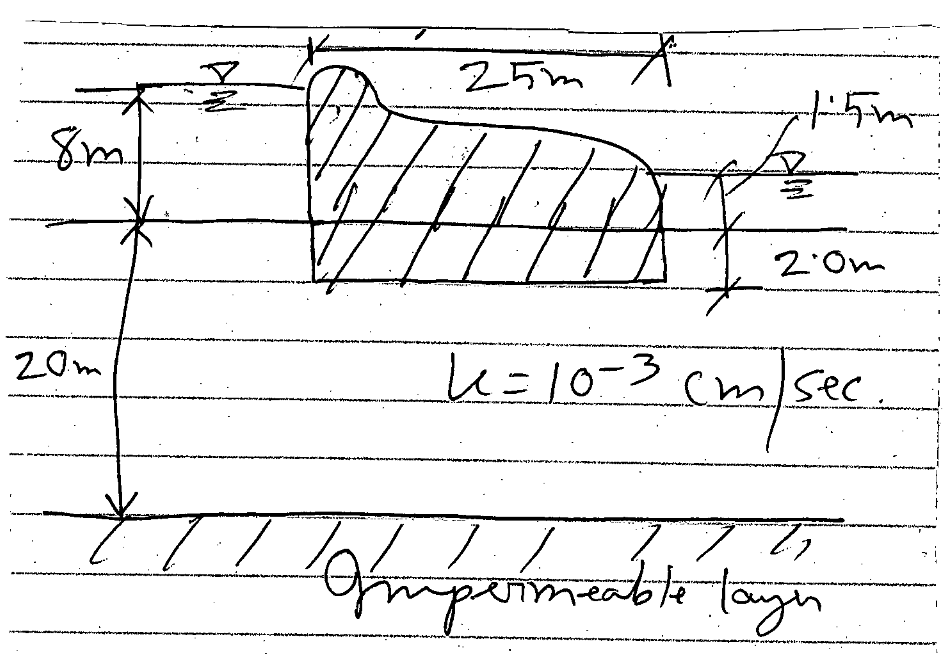


Figure 2

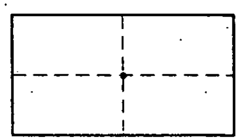
TABLE. 1

Influence Values $f_z(m, n)$ for Case of Rectangular Area Uniformly Loaded (Boussinesq Solution)

m	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.4
0.1	0.00470	0.00917	0.01324	0.01678	0.01978	0.02223	0.02420	0.02576	0.02698	0.02794	0.02926	0.03007
0.2	0.00917	0.01790	0.02585	0.03280	0.03866	0.04348	0.04735	0.05042	0.05283	0.05471	0.05733	0.05894
0.3	0.01324	0.02585	0.03735	0.04742	0.05593	0.06294	0.06859	0.07308	0.07661	0.07938	0.08323	0.08561
0.4	0.01678	0.03280	0.04742	0.06024	0.07111	0.08009	0.08735	0.09314	0.09770	0.10129	0.10631	0.10941
0.5	0.01978	0.03866	0.05593	0.07111	0.08403	0.09472	0.10340	0.11034	0.11584	0.12018	0.12626	0.13003
0.6	0.02223	0.04348	0.06294	0.08009	0.09472	0.10688	0.11679	0.12474	0.13105	0.13605	0.14309	0.14749
0.7	0.02420	0.04735	0.06859	0.08735	0.10340	0.11679	0.12772	0.13653	0.14356	0.14914	0.15703	0.16199
0.8	0.02576	0.05042	0.07308	0.09314	0.11034	0.12474	0.13653	0.14607	0.15370	0.15978	0.16843	0.17389
0.9	0.02698	0.05283	0.07661	0.09770	0.11584	0.13105	0.14356	0.15370	0.16185	0.16835	0.17766	0.18357
1.0	0.02794	0.05471	0.07938	0.10129	0.12018	0.13605	0.14914	0.15978	0.16835	0.17522	0.18508	0.19139
1.2	0.02926	0.05733	0.08323	0.10631	0.12626	0.14309	0.15703	0.16843	0.17766	0.18508	0.19584	0.20278
1.4	0.03007	0.05894	0.08561	0.10941	0.13003	0.14749	0.16199	0.17389	0.18357	0.19139	0.20278	0.21020
1.6	0.03058	0.05994	0.08709	0.11135	0.13241	0.15027	0.16515	0.17739	0.18737	0.19546	0.20731	0.21509
1.8	0.03090	0.06058	0.08804	0.11260	0.13395	0.15207	0.16720	0.17967	0.18986	0.19814	0.21032	0.21836
2.0	0.03111	0.06100	0.08867	0.11342	0.13496	0.15326	0.16856	0.18119	0.19152	0.19994	0.21235	0.22058
2.5	0.03138	0.06155	0.08948	0.11450	0.13628	0.15483	0.17036	0.18321	0.19375	0.20236	0.21512	0.22364
3.0	0.03150	0.06178	0.08982	0.11495	0.13684	0.15550	0.17113	0.18407	0.19470	0.20341	0.21633	0.22499
4.0	0.03158	0.06194	0.09006	0.11527	0.13724	0.15598	0.17168	0.18469	0.19540	0.20417	0.21722	0.22600
5.0	0.03160	0.06199	0.09014	0.11537	0.13736	0.15612	0.17185	0.18488	0.19561	0.20440	0.21749	0.22632
6.0	0.03161	0.06201	0.09016	0.11541	0.13741	0.15617	0.17191	0.18496	0.19569	0.20449	0.21760	0.22644
8.0	0.03162	0.06202	0.09018	0.11543	0.13744	0.15621	0.17195	0.18500	0.19574	0.20455	0.21767	0.22652
10.0	0.03162	0.06202	0.09019	0.11544	0.13745	0.15622	0.17196	0.18502	0.19576	0.20457	0.21769	0.22654
∞	0.03162	0.06202	0.09019	0.11544	0.13745	0.15623	0.17197	0.18502	0.19577	0.20458	0.21770	0.22656

Table 1 (*Continued*)

m	n: 1.6	1.8	2.0	2.5	3.0	4.0	5.0	6.0	8.0	10.0	∞
0.1	0.03058	0.03090	0.03111	0.03138	0.03150	0.03158	0.03160	0.03161	0.03162	0.03162	0.03162
0.2	0.05994	0.06058	0.06100	0.06155	0.06178	0.06194	0.06199	0.06201	0.06202	0.06202	0.06202
0.3	0.08709	0.08804	0.08867	0.08948	0.08982	0.09006	0.09014	0.09016	0.09018	0.09019	0.09019
0.4	0.11135	0.11260	0.11342	0.11450	0.11495	0.11527	0.11537	0.11541	0.11543	0.11544	0.11544
0.5	0.13241	0.13395	0.13496	0.13628	0.13684	0.13724	0.13736	0.13441	0.13744	0.13745	0.13745
0.6	0.15027	0.15207	0.15326	0.15483	0.15550	0.15598	0.15612	0.15617	0.15621	0.15622	0.15623
0.7	0.16515	0.16720	0.16856	0.17036	0.17113	0.17168	0.17185	0.17191	0.17195	0.17196	0.17197
0.8	0.17739	0.17967	0.18119	0.18321	0.18407	0.18469	0.18488	0.18496	0.18500	0.18502	0.18502
0.9	0.18737	0.18986	0.19152	0.19375	0.19470	0.19540	0.19561	0.19569	0.19574	0.19576	0.19577
1.0	0.19546	0.19814	0.19994	0.20236	0.20341	0.20417	0.20440	0.20449	0.20455	0.20457	0.20459
1.2	0.20731	0.21032	0.21235	0.21512	0.21633	0.21722	0.21749	0.21760	0.21767	0.21769	0.21770
1.4	0.21509	0.21836	0.22058	0.22364	0.22499	0.22600	0.22632	0.22644	0.22652	0.22654	0.22656
1.6	0.22025	0.22372	0.22610	0.22940	0.23088	0.23200	0.23235	0.23249	0.23258	0.23261	0.23263
1.8	0.22372	0.22736	0.22986	0.23336	0.23496	0.23617	0.23656	0.23671	0.23681	0.23684	0.23686
2.0	0.22610	0.22986	0.23247	0.23613	0.23782	0.23912	0.23954	0.23970	0.23981	0.23985	0.23987
2.5	0.22940	0.23336	0.23613	0.24010	0.24196	0.24344	0.24392	0.24412	0.24425	0.24429	0.24432
3.0	0.23088	0.23496	0.23782	0.24196	0.24394	0.24554	0.24608	0.24630	0.24646	0.24650	0.24654
4.0	0.23200	0.23617	0.23912	0.24344	0.24554	0.24729	0.24791	0.24817	0.24836	0.24841	0.24846
5.0	0.23235	0.23656	0.23954	0.24392	0.24608	0.24791	0.24857	0.24886	0.24907	0.24914	0.24919
6.0	0.23249	0.23671	0.23970	0.24412	0.24630	0.24817	0.24886	0.24916	0.24939	0.24946	0.24952
8.0	0.23258	0.23681	0.23981	0.24425	0.24646	0.24836	0.24907	0.24939	0.24964	0.24972	0.24980
10.0	0.23261	0.23684	0.23985	0.24429	0.24650	0.24841	0.24914	0.24946	0.24972	0.24981	0.24989
∞	0.23263	0.23686	0.23987	0.24432	0.24654	0.24846	0.24919	0.24952	0.24980	0.24989	0.25000



Self Study/~~CE~~-WRE **Date : 01/02/2012**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

B. Sc. Engineering Examinations

Sub : **CE 213** (Mechanics of Solids II)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FIVE** questions in this section. Answer any **FOUR**.

1. Find the maximum downward deflection of the small aluminum beam shown in Fig. 1. Given EI = 60 $N.m^2$. (Use moment area method). **($26\frac{1}{4}$)**

2. Using method of integration determine the equation of elastic curve for the beam shown in Fig. 2. **($26\frac{1}{4}$)**

3. Using elastic load method calculate maximum downward deflection of the beam shown in Fig. 3. **($26\frac{1}{4}$)**

4. Using conjugate beam method calculate maximum upward and downward deflection of the beam shown in Fig. 4. **($26\frac{1}{4}$)**

5. Determine the allowable axial load for a 15′ W 14 × 159 steel column using AISC ASD formulas when one end of the column is fixed and the other end is pinned. Given that for the column section $A = 46.7\ in^2$ and $r_{min} = 4.00''$ and $\sigma_{yp} = 36$ ksi. **($26\frac{1}{4}$)**

AISC ASD column formulas:

$$C_c = \sqrt{\frac{2\pi^2 E}{\sigma_{yp}}}$$

when $Le/r \geq C_c$

$$\sigma_{allow} = \frac{12\pi^2 E}{23\,(Le/r)^2}$$

when $Le/r < C_c$

$$\sigma_{allow} = \frac{\left[1 - (Le/r)^2 / \left(2C_c^{\,2}\right)\right]}{F.S.}\sigma_{yp}$$

where $$F.S = \frac{5}{3} + \frac{3}{8}\frac{Le/r}{C_c} - \frac{(Le/r)^3}{8C_c^{\,3}}$$

Contd P/2

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

6. Determine the bending stress at the corners in the cantilever loaded, as shown in Fig. 5 at a section 500 mm from the support. Also locate the neutral axis. **(35)**

7. For the beam shown in Fig. 6, find the value and direction of principal stresses and maximum shear stress for the location A using Mohr's circle and for the location B using equation. **(35)**

8. Compare the maximum shear stress and angle of twist for member of equal length and cross-section area for a square section, a rectangular section, and circular section. All members are subjected to same torque. The circular cross section is 200 mm in diameter and the rectangular section is 50 mm wide. **(35)**

9. A shaft having the cross section shown in the Fig. 7 is subjected to a torque of T = 200 N.m. **(35)**

   (a) Estimate the percentage of torque carried by each of the two cross sectional components.

   (b) Calculate the maximum shear stresses in each part.

   (c) Find the angle of twist per unit length caused by the applied torque.

   Let G = 85 GPa.

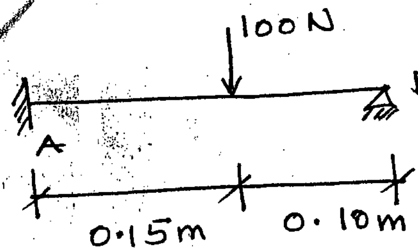


Fig-1.

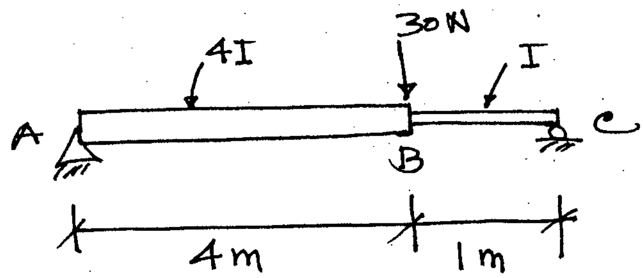


Fig-2

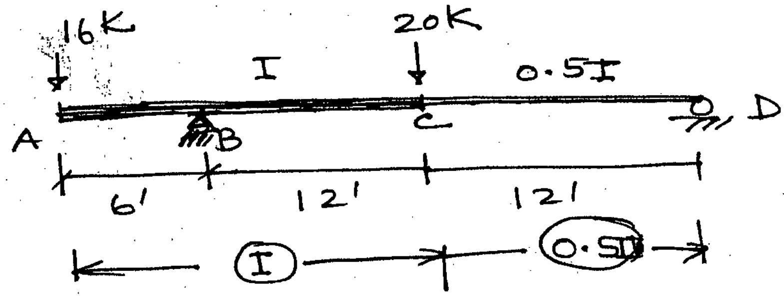


Fig-3

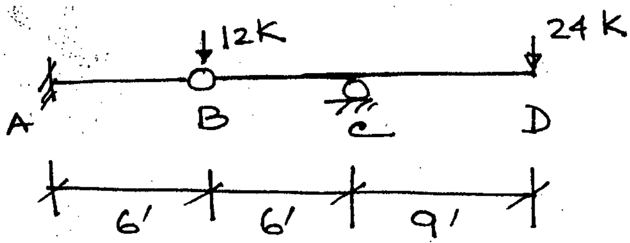


Fig-4

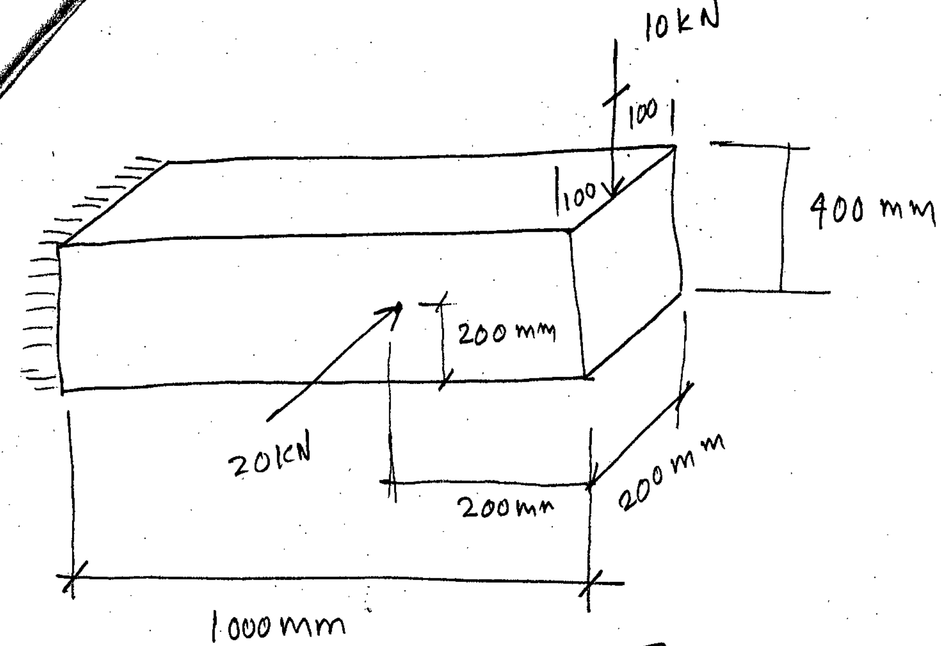


Figure 5 ~~for Q.1~~

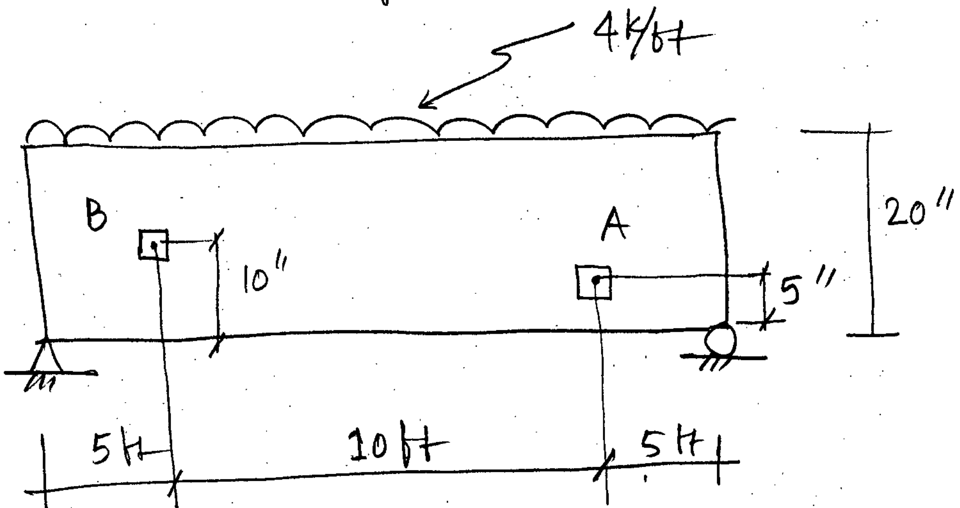


Figure 6 ~~for Q. 2~~

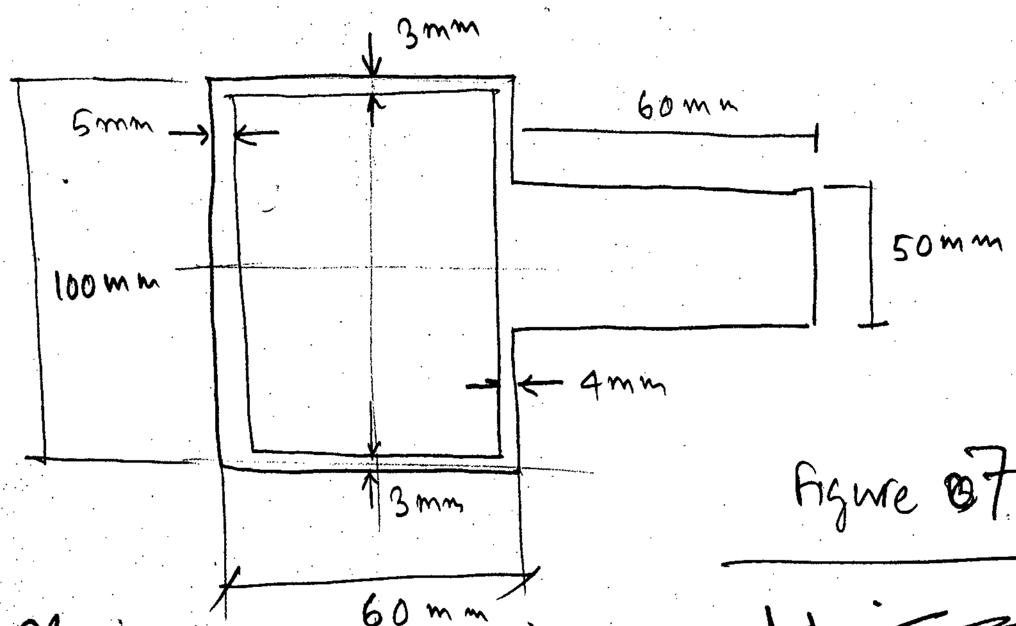


Figure 7 ~~for Q.4~~

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