TANTA UNIVERSITY FACULTY OF ENGINEERING
DEPARTMENT OF STRUCTURAL ENGINEERING
EXAMINATION (THIRD YEAR) STUDENTS OF CIVIL ENGINEERING هندسة مدنية

COURSE TITLE: DESIGN OF REINFORCED CONCRETE STRUCTURES (2) a			COURSE CODE: CSE3110
DATE: January - 2022	TERM: FIRST	TOTAL ASSESSMENT MARKS: 85	TIME ALLOWED: 4 hours

Systematic arrangement of calculations and clear neat drawings are essential. Any missing data can be reasonably assumed. The exam consists of FOUR problems in two pages.

For all problems consider: f_{cu}= 30MPa, fy= 400MPa for all RFT. **TRY ALL PROBLEMS**

Problem # One (24Marks)

i) What is the meant by primary torsion? Why is it also called equilibrium torsion and statically determinate torsion? **(3Marks)**

ii) Explain failure modes of beams that subjected to each of the following actions: pure shear, pure torsion, and combined shear and torsion. **(4Marks)**

iii) Drive the equation of internal torsional moment in rectangular RC solid section. What is your opinion if the internal torsional moment greater than two times external torsional moment? **(3Marks)**

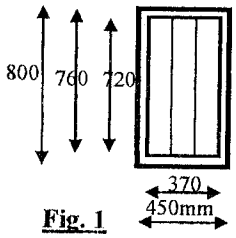


Fig. 1

iv) Figure 1 shows critical section of a beam designed to resist the following actions: flexure M_u, shear Q_u, and torsion M_{tu}. It's required to make a complete design (design + reinforcement detailing) of the section considering the following data: **(7marks)**
Cross – section = **450 × 800mm**, Area of the tension steel= **2055mm²**, Ultimate shear stress, q_{su}= **1.6MPa**, Ultimate torsional moment, M_{tu}= **160kN.m**

v) Figure 2 shows plan of a beam with cantilever ABC. The beam carries cantilever beams **AE** and **CD**. An ultimate load **Pu= 60kN** is applied at points **D, E** and **F**. The support **B is only** restrained against rotation about z axis. Neglect own weight of all beams. **It is required** to draw B.M.D, S.F.D and T.M.D of the beam ABC. Find reactions at columns **A** and **B**. **(7marks)**

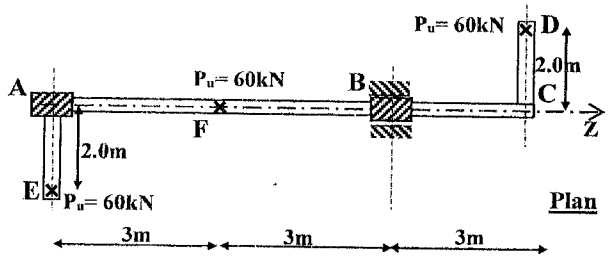


Fig. 2

Problem # Two (31Marks)

i) What is the importance of studying ribbed slab systems? **(2Marks)**

ii) Explain how to choose type of slabs in negative moment regions in hollow – slab systems. **(4Marks)**

iii) Figure 3 shows structural plan of a roof panel **ABCD** with cantilever slabs at corners **A** and **C**. The cantilever slabs at C are dropped 0.1m. The roof is supported on projected beams **AB, BC, CD** and **DA** of cross-section 0.25×0.8m and on four columns **A, B, C** and **D**. The roof is subjected to live load= **5kN/m²** and flooring cover= **2kN/m²**. It is required to carry out the following:

- **i.** Suggest the suitable structural systems of all slabs. Determine the carried loads by critical strips for all slabs and draw B.M. and S.F. diagrams for all critical strips. **(10Marks)**
- **ii.** Design critical sections for all strips and determine the load carried by the projected beam **AB**. **(10Marks)**
- **iii.** Draw on plan and needed cross-sections the reinforcement details of all slabs. **(5Marks)**

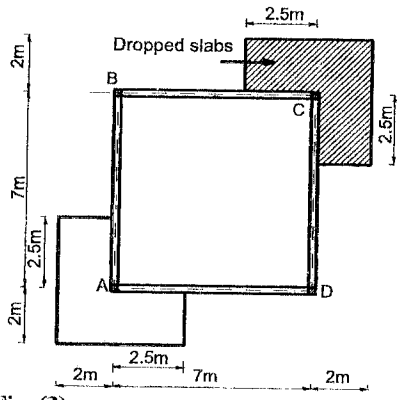


Fig. (3)

Problem # Three (36Marks)

A) **Figure 4** shows the layout of panelled beams covering an area of 12.0 x 21.20 m. The slab is subjected to L.L. = 5kN/m² and cover= 2.5kN/m². The slab thickness is 100mm. The internal paneled beams have 250mm width and 700mm depth, where the external marginal beams have 300mm width and 1000mm depth. It is required to make complete design (design + reinforcement

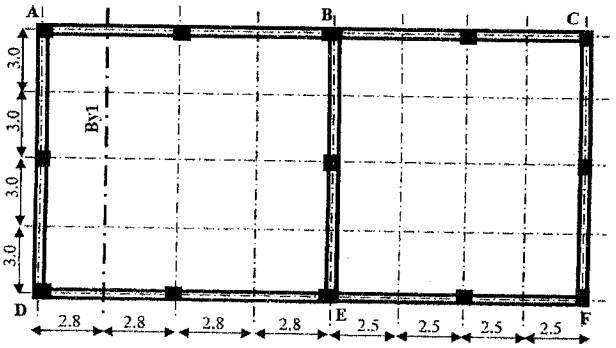


Fig. (4)

P.T.O

detailing) for the beam B_{y1} only. Determine the loads carried by the beam **AB.** **(7Marks)**

B) i- As for ECP-203 Code, what are conditions of using punching shear reinforcement? **(1Mark)**

ii- Sketch the possible punching shear cracks around an interior column in a flat slab floor. **(1Mark)**

iii- Why are marginal beams recommended to use at outer edges of RC flat slabs? **(1Mark)**

C) **Figure 5** shows plan of a typical floor of RC flat slab with panel 7.5x6.5 m and **without column head**. The flat slab is subjected to uniformly live load and floor cover of 5 and 2kN/m^2, respectively. It is required to carry out the following:

i. Estimate the concrete dimensions of the following elements: slab, marginal beams, and columns to satisfy the minimum requirements of ECP-203 Code. **(3Marks)**

ii. Using the empirical method of ECP 203-2018, determine the critical bending moment in column and field strips **in X-direction only.** **(3Marks)**

iii. Design the critical sections due to bending moment of strips **in X-direction only.** **(5Marks)**

iv. Calculate the moment transferred from the flat slab to column **C1** by torsion only. **(3Marks)**

v. Check the punching shear stresses for the **interior column C1** for case of total loads only. **(3Marks)**

vi. Draw on plan the reinforcement details of the column and field strips **in a long direction (X) only.** **(3Marks)**

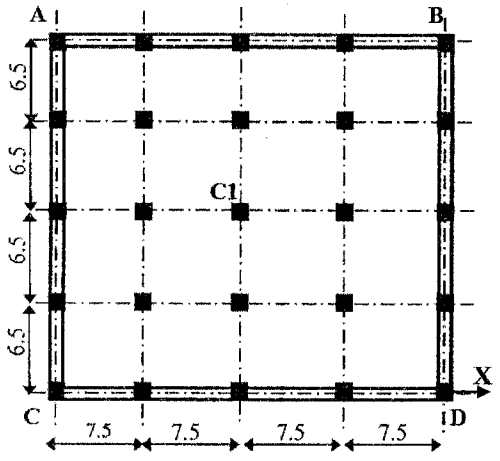


Fig. (5)

vii. Calculate the loads and internal straining actions acting on the beam **AC.** **(3Marks)**

D) If the RC flat slab shown in **Figure** 5 is reinforced with symmetrical top and bottom steel meshes of 6φ16/m, without adding any additional reinforcement, calculate the maximum allowed live load that can be carried by the slab. **(3Marks)**

Problem # Four (6Marks)

Figure 6 shows structural plan of a staircase. The slabs of the staircase are rested on the floor beam (at levels 3, 6m) and on the cantilever beams that are fixed to the RC wall at level 4.50 m. **It is required to** sketch **without any calculations** the suggested statical system; loads; shape of B.M.D and details of reinforcement for critical strips of the stair slabs and for the supporting elements. **(6 Marks)**

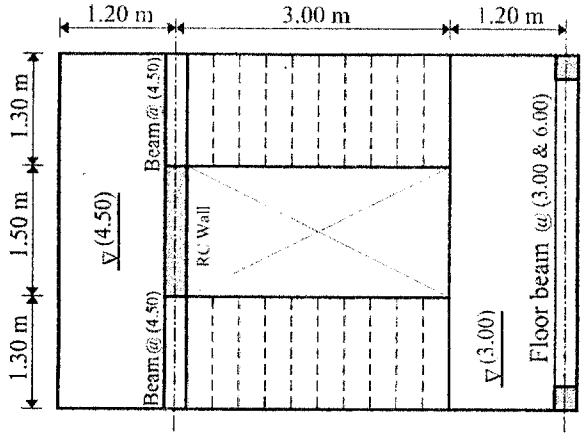


Fig. (6)

With best wishes

Prof. Dr. Tarek Fawzy El-Shafiey **Dr. Ali Hasan** **Dr. Mohamed Ellithy**

Tanta University — Civil Engineering Department — Faculty of Engineering

Total Marks: 70 Marks

Course Title: Transportation Traffic Engineering	Course Code: CPW3103	Year: 3rd
Date: 1st February 2022	Allowed Time: 3 hrs	No of Pages: (4)

Remarks: (Answer all the following questions, assume any missing data), (Answers should be supported by sketches)

Problem (1): (30 Marks)

a) Complete the following Sentences: [10 Marks]

1. _____ take place in adapted spaces linked by communications through channels.
2. Intersection conflict points' types are _____& _____&_____
3. The factors governing trip generation are income, car ownership. Family size and composition. and _____
4. The future trip productions can be estimated through _____ technique, however. _____ technique is used for estimation the future attractions.
5. The origin /destination surveys include home surveys &_____ &_____&_____

b) Choose the correct answer from the following: [10 Marks]

1. Where can you collect transportation planning data?
   a) At home — b) during the trip
   c) at the destination end of the trip — d) a,b,c
2. Estimated percentage of nonhome based trips is
   a) 90% — b) 10%
   c) 60% — d) 40%
3. All of the following are socioeconomic parameters except_____
   a) Housing statistics — b) Car ownership
   c) Income — d) Travel pattern data
4. One of the basics for choice of external cordon
   a) Compatible with previous studies — b) Curved
   c) Nonuniform — d) Straight
5. A basic requirement of a traffic control device is_____
   a) Color — b) Height
   c) Distance — d) It fulfills a need
6. The mathematical study of the movement of vehicles over road network is definition of_____
   a) Transportation planning — b) Traffic planning
   c) Transportation engineering — d) Traffic flow theory
7. Base conditions of capacity analysis include _____
   a) Undivided highway — b) Divided highway
   c) Interrupted flow — d) Mixed traffic
8. Multi-nomial logit function is used in _____ phase of transportation planning.
   a) Traffic assignment — b) Model split
   c) Trip generation — d) Trip distribution
9. Separation or regulation of conflicting movements is called _____
   a) At grade intersection — b) Separate grade intersection
   c) Interchange — d) Channelization
10. Different levels of transportation planning include the following except_____
    a) Urban — b) Regional
    c) National — d) International

c) State True or False and Correct the Wrong Sentences: [10 Marks]

1. Zone centroid should not be chosen in the center of movements of the zone.
2. The evaluation stage is the second to phase in the comprehensive urban transport process.
3. Cars are the vehicle of the pipelines transportation system.
4. Traffic signals decrease average travel time and increase capacity through an intersection
5. Vehicle per HH data is needed to calculate trip attractions
6. Traffic signs are inserted in uncontrolled intersections to guide commuters
7. Vehicle running speed is measured based on the total movement time
8. Transportation facilities inventory includes accident data
9. Trip distribution using gravity models requires the existence of present trip distribution matrix,
10. Capacity restraints where all traffic will choose the route where the travel resistance is least

Problem (2): (25 Marks)

a) Draw the flow chart of the comprehensive urban transportation planning. [5 Marks]

b) The utility function of the model choice is as follows: [5 Marks]

$$U_k = a_k - 0.029\,X_1 - 0.03\,X_2 - 0.012\,X_3 + 0.002\,X_4$$

If the future number of trips between zones is 800 trip /person/ day. Considering two users choosing between two modes, passenger car (A) and a public bus (B). Also, considering the following situation:

Variable	X_1	X_2	X_3	X_4	a_k
Passenger car	6	0	20	200	-0.15
Public bus	10	15	40	50	-0.53

Determine the modal split ratios and number of future trips in PCUS for using passengers' cars and buses, knowing that (Occupancy rates for passenger car and public bus are 2.5 & 10 respectively. Also, one public bus = 3 PCU).

c) An urban area is consisting of four zones; the existing (O/D) is given below:

O\D	1	2	3	4	Future Trips
1		100	300	200	1200
2	100		200	100	2000
3	300	200		300	2400
4	200	100	300		600
Future Trips	900	1200	2600	900	

It is required:

1. Determine the future interchanges between the four zones using the Average Growth Factor method (Two iterations only are required). [10 Marks]
2. Determine the future interchanges between zones using the gravity model if it is known that the trips between any two zones are inversely proportional to the second power of travel time between zones, which is uniformly 20 minutes (Two iterations only are required). [5 Marks]

Problem (3): (15 Marks)

a) A fixed time 2-phase signal is to be provided only straight-ahead traffic is permitted. The design hour flows from the various arms and the saturation flows for these arms are given in the following table [5 Marks]

	North	South	East	West
Design hour flow (q) in PCU s/ hour	800	400	750	1000
Saturation flow (s) in PCU s/ hour	2400	2000	3000	3000

Calculate the optimum cycle time and green times for the minimum overall delay. The Inter-green time should be the minimum necessary for efficient operation. The time lost per phase due to starting delays can be assumed to be 2 seconds. Sketch the timing diagram for each phase and calculate the controller settings.

b) A small city consists of four zones (I, II, III, IV) as shown in Figure (1) where, the average running speed is 50 Km/hr. Assume that DHV = 0.15 A.D.T. and the lane capacity is 125 PCU/hr./lane. The future interchanges between zones represented as PCUS as resulted from the model split process and after applying the occupancy rate of all available modes of transportation in the city. It is required to find out the number of lanes for each link. [5 Marks]

c) An engineer has the following data for a highway segment. [5 Marks]

V (mph)	70	61	50	34	22
D (Veh/mi)	11	43	62	80	103

1. Applying Greenshield's assumptions estimate the mean free flow speed and jam density by fitting the above data.
2. What are the maximum flow and corresponding density?

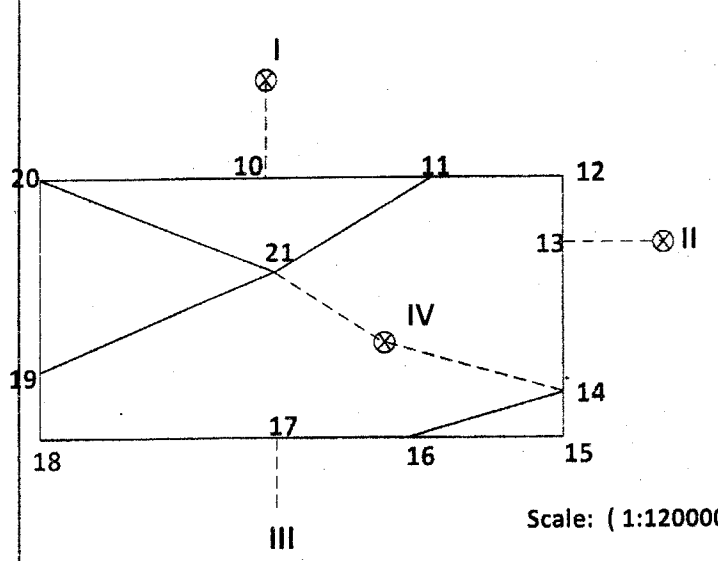
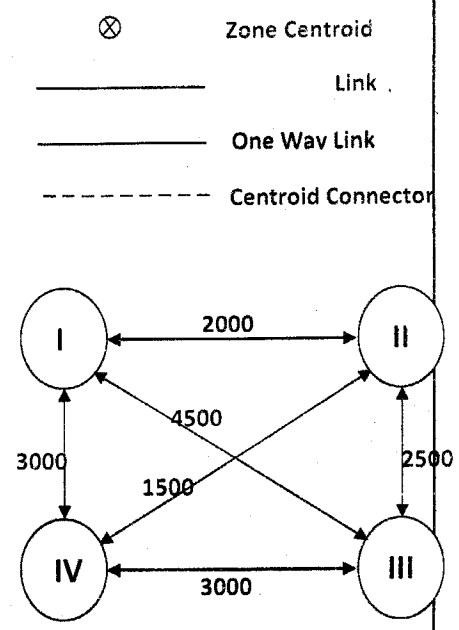


Figure (1)



مع خالص تمنياتي بالنجاح والتوفيق..... د. رجاء عبد الحكيم ولجنة الممتحنين

9. In conservation of energy,

a. useful when energy losses are known
b. losses due to conversion of turbulence to heat
c. useful when energy losses are small
d. all the above
e. a & b

10. Flow characteristics do not change with space but change with time.

a. Steady uniform flow
b. Steady non-uniform flow
c. Unsteady uniform flow
d. Unsteady non-uniform flow
e. Gradually varied flow

11. The minimum permissible velocity is the

a. non-silting velocity
b. the highest velocity that does not start sedimentation
c. the lowest velocity that does not cause erosion
d. non-erodible velocity
e. the silting velocity

12. In open channel flow, ...

a. the water has a free surface
b. flow takes place due to pressure gradient
c. the total energy line corresponds to the water surface line
d. a & b
e. a & c

13. What is the design approach for non-erodible channels?

a. Best hydraulic section
b. Tractive force
c. Maximum permissible velocity
d. a & b
e. b & c

14. The velocity distribution for turbulent flow has

a. The minimum velocity occurs at the boundary
b. The maximum velocity occurs at a certain depth below the surface
c. The maximum velocity occurs in the middle
d. all the above
e. a & b

15. Flow regime when $F_N > 1$ & $R_N > 2000$

a. Subcritical – Laminar
b. Supercritical – Laminar
c. Supercritical – Turbulent
d. Subcritical – Turbulent
e. Critical – Turbulent

16. ..... channel is used for large rates of discharge

a. Rectangular
b. Trapezoidal
c. Circular
d. Triangular
e. all the above

17. A rectangular channel has bottom width 6 m and water depth 1.5 m

a. The hydraulic mean depth = 1.0
b. The hydraulic mean depth = 1.5
c. The hydraulic mean depth = 2.5
d. The hydraulic mean depth = 6.0
e. The hydraulic mean depth = 3.5

18. A triangular channel has side slope 1 and water depth 1.5 m

a. The hydraulic radius = 0.5
b. The hydraulic radius = 1.0
c. The hydraulic radius = 0.3
d. The hydraulic radius = 1.5
e. The hydraulic radius = 0.1

B. Compare between each of the following items by using **only neat sketches**: (6 marks)

i. **Open** channel flow and **closed** conduit flow
ii. The shear stress distribution of **trapezoidal** and **triangular** open channel section
iii. **Backwater** curve and **drawdown** curve

Tanta University
Faculty of Engineering
Department of Irrigation and Hydraulics Engineering

Course Title: Hydraulics	**Course Code: CIH3105**	**Third Year Civil**
Academic Year 2021/2022	**Date: 29 January, 2022**	**Time allowed: 3 hours**
First Semester Exam	**Model No.: 4BP6DT8**	**No. of Pages: 4**

INSTRUCTIONS:

- The exam consists of **4 questions**, answer all questions.
- This is **a closed book exam**; no external material is permitted.
- The total value of the exam is **75 marks + 6 bonus marks**; the value of each question is indicated.
- Systematic arrangement of calculations and **clear neat drawings are essential**.
- Make suitable assumptions where necessary.

Question 1: (30 marks)

A. Choose the correct answer. [1 mark each for a total of 18 marks]

1. The conjugate depths of a hydraulic jump in a rectangular channel are 3 ft and 3.5 ft, the bed width is 3 ft.

a. The discharge = 10 cfs
b. The discharge = 50 cfs
c. The discharge = 300 cfs
d. The discharge = 200 cfs
e. The discharge = 100 cfs

2. The conjugate depths of a hydraulic jump in a rectangular channel are 3 ft and 3.5 ft.

a. The head losses = 5×10^{-3} ft
b. The head losses = 3×10^{-5} ft
c. The head losses = 3×10^{-3} ft
d. The head losses = 5×10^{-5} ft
e. The head losses = 7×10^{-3} ft

3. For a uniform critical flow in a rectangular channel of 5.0 m width at most economical section.

a. The discharge = 80 m^3/s
b. The discharge = 62 m^3/s
c. The discharge = 72 m^3/s
d. The discharge = 26 m^3/s
e. The discharge = 12 m^3/s

4. A trapezoidal channel 10 ft wide, 1:1 slope, the water depth is 2 ft, the specific energy is 8.7 ft.

a. The discharge = 400 cfs
b. The discharge = 500 cfs
c. The discharge = 550 cfs
d. The discharge = 600 cfs
e. The discharge = 350 cfs

5. The effect of viscosity on flow can be estimated by

a. Froude Number
b. Reynolds Number
c. Webber Number
d. a & b
e. b & c

6. They are generally regular in shape and alignment

a. Artificial channels
b. Prismatic channels
c. Natural channels
d. b & c
e. a & b

7. Subcritical flow is

a. what you usually see in rivers
b. deeper and slower than critical flow
c. what you see in mild channels
d. a & b
e. all the above

8. Critical flow has the following characteristics:

a. what you usually see in rivers
b. stable surface
c. easy to measure depth
d. series of standing waves
e. what you see in steep channels

B. Show that the general dynamic equation of **triangular** section using **Chezy** equation can be expressed as: (6 marks)

$$\frac{dy}{dx} = S_0 \frac{1 - \left(\frac{y_n}{y}\right)^5}{1 - \left(\frac{y_c}{y}\right)^5}$$

C. Water is flowing in along **trapezoidal** channel of side slopes 1:1, bed width = 12 m and Manning n = 0.03. The channel consists of two reaches of different longitudinal bed slopes. A hydraulic jump is formed in the first reach. The conjugate depths are 1.0 m and 1.36 m. A dam is constructed at the end of the second reach and the water depth just upstream the dam is 3.0 m. In the second reach, the flow is uniform for a distance of 2.0 km and the normal water depth is 2.5 m. Sketch the water surface profiles along the two reaches showing water depths at the beginning and end of UF, GVF, and RVF regions. Also, show values of bed slopes. (8 marks)

D. A **trapezoidal** channel has a width of 8.0 m and side slopes 2:1, bed slope 0.004, carries a discharge of 70.9 m^3/sec and Manning's coefficient = 0.027. If the channel has a **free over fall** at the downstream end, compute the **length** of the surface **profile** developed (use four strips, Δy). (6 marks)

Equations:

$F_N = \frac{v}{\sqrt{g y_h}}$ $\quad \rho Q(\vec{v_2} - \vec{v_1}) = \sum \vec{F}$ $\quad v = C\sqrt{RS}$ $\quad v = \frac{1}{n} R^{2/3} S^{1/2}$

$\tau_o = \gamma_w R S$ $\quad \frac{Q^2}{g} = \frac{A^3}{T}$ $\quad E_{min} = y_c + \frac{y_{hc}}{2}$ $\quad \frac{Q^2}{gA_1} + A_1\bar{y}_1 = \frac{Q^2}{gA_2} + A_2\bar{y}_2$

$h_j = \frac{(y_2 - y_1)^3}{4 y_1 y_2}$ $\quad L_j \cong 6h_j$ $\quad P_j = \frac{\gamma Q h_j}{75}$

$\frac{\Delta x}{\Delta y} = \frac{1}{S_0} \frac{1 - \left(\frac{Z_c}{Z}\right)^2}{1 - \left(\frac{K_n}{K}\right)^2}$ $\quad K = \frac{Q}{\sqrt{S_E}} = \frac{A}{n} R^{2/3}$ $\quad P = \frac{\gamma Q H_p}{C\eta}$ $\quad Z = \sqrt{A^3/T}$

$E = y + \frac{Q^2}{2gA^2}$

$\tau_{s\_max} = C_s \gamma_w y S$ $\quad \tau_{b\_cr} = C_1 d_s^{C2}$ $\quad \tau_{b\_max} = C_b \gamma_w y S$

$y_c = \sqrt[3]{\frac{q^2}{g}}$

$k = \frac{\tau_{s\_cr}}{\tau_{b\_cr}}$ $\quad k = \sqrt{1 - \frac{\sin^2\theta}{\sin^2\phi}}$ $\quad E_1 + E_2 = \Delta z$

$\frac{dy}{dx} = \frac{S_0 - S_E}{1 + \frac{d}{dy}\left(\frac{V^2}{2g}\right)}$ $\quad \frac{y_1}{y_2} = \frac{1}{2}\left(\sqrt{1 + 8F_{N_1}^2} - 1\right)$ $\quad \Delta x = \frac{E_2 - E_1}{S_0 - S_E} = \frac{\Delta E}{\Delta S}$

With my best wishes,

Dr. Tamer Gado & the committee

C. By using **neat sketch only, draw** the following: (6 marks)

i. The change in water surface in open channels due to a combined of a **hump** and **contraction** in channel bed (**subcritical** flow).

ii. How to estimate the length of the **downstream apron** of a **weir** constructed over a **mild** channel.

iii. Sketch all possible water surface profiles if the channel bed's slope is changed from **mild** to **horizontal** to **steep** to **brink**.

Question 2: (15 marks)

A. Show that the side slopes of the best hydraulic **triangular** section intersect at a right angel. (3 marks)

B. A **rectangular** open channel, 5.0 m wide and 1.5 m deep, has a slope of 1:1000 and is lined with rubble masonry (n = 0.017). It is required to increase the amount of water discharge as much as possible without changing the channel slope or the rectangular form of the section. The dimensions of the section may be changed but the amount of excavation must not change. Determine (6 marks):

i. The discharge of the original channel.

ii. The new dimensions of the channel to give maximum discharge.

iii. The ratio of the new discharge to the original discharge.

C. Applying the method of critical shear stress, find the dimensions of the **trapezoidal** channel to pass a discharge of 30 m^3/s. The longitudinal bed slope = 10 cm/km, $1/n$ = 50, z = 2, angle of repose = 30°, and the critical shear stress for the bed material = 3.885 Pa. [C_s = 0.77 and C_b = 1] (6 marks)

Question 3: (12 marks)

A. Show that the discharge through a **venturi-flume** is expressed by:

$$Q = 1.705\, C_d\, b_t\, E^{3/2} \quad m^3/s$$

In which b_t is the throat width and E is the U.S. specific energy. Estimate the discharge passing through a horizontal venturi-flume if the width of both channel and throat are 2.25 m and 1.5 m, respectively. The water depth U.S. the flume is 2.0 m and C_d = 0.98. (6 marks)

B. A discharge of 20 m^3/s is passing in a **rectangular** channel of bed width = 5.0 m, and water depth = 2.5 m. A smooth **hump** is placed in the channel in which the bed level is gradually **increased** by 0.5 m. Determine (6 marks):

i. The change in water levels.

ii. How much should the bed level be changed to have critical depth over the hump?

iii. If the water level is lowered by 10 cm, what is the rate of flow?

iv. How can you keep the water levels unchanged?

Question 4: (24 marks)

A. Show that the **specific force** before the hydraulic jump is equal to that after the jump. (4 marks)

Dept. Structural Eng.	Faculty: Engineering	University Tanta
Final-Term Exam **Date: 25/01/2022** **Time allowed: Three hours**	**Course: Steel structures** **Civil Department**	**3rd year**

Any missing data should be assumed.
It is allowed only to use the tables of the steel sections.

Question #1: It is required to cover an area of 50m*22m used as a roof covering for an industrial factory. The clear height of 10m is required. The cover is steel corrugated sheet. It is required to: suggest the main system as a framed-truss system. Then, draw with suitable scale different views showing the arrangement of bracing systems. **(15%)**

Question #2: For the shown main system which covers an industrial building, it is required to answer the following questions, knowing that the spacing between trusses S is equal to 6m. The roof cover is corrugated metallic sheets of 5kg/m^2 own weight. The live load is 60 kg/m^2 of the covered area. The own weight of the steel structure is 25 kg/m^2. Steel to be used is steel 52. The bolts used are M22 mm. Gusset plate thickness is 8 mm.

It is required to:

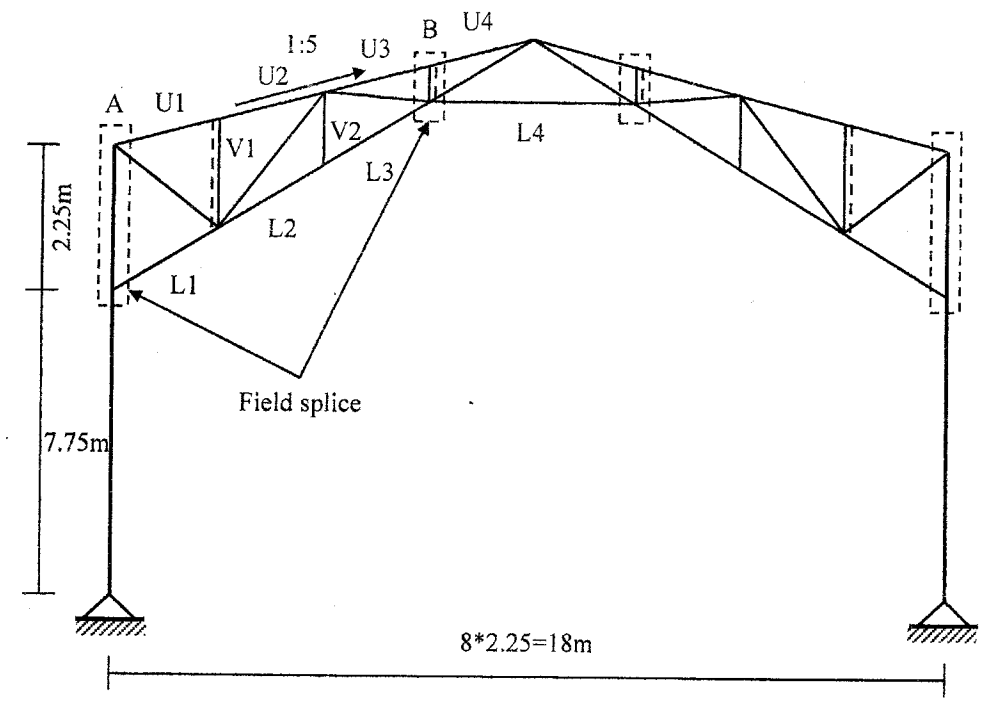
1- Calculate D.L, L.L and W.L acting on the upper chord joints. **(10%)**

2- Calculate the ultimate force of the member U4 if:

$F_{D.L}$= +15 t, $F_{L.L}$= +12 t and $F_{W.L,R}$ = -7 t, $F_{W.L,L}$ = +10 t. **(05%)**

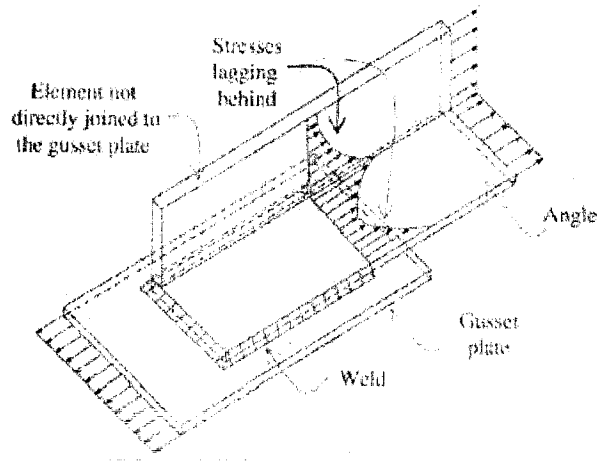
Question #3: For the same main system given for the previous question, it is required to:

1. In the positions of the field splices (A and B), it is required to suggest the types of the fasteners at each end of the members. **(05%)**
2. Based on the types of the fasteners of the previous point, design the members L4 (P_d=+25t), U3 (P_d=-20t), V1 (P_d=-12t) and V2 (P_d=?? - try one angle) as rolled steel sections. Note that transversal bracings are added at the members V1 and V2. **(25%)**

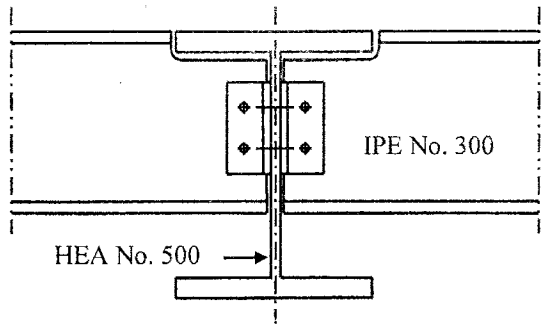


Question #4: With respect to the connections design:

1. How do you treat the shown uneven stress distribution shown at the connection of the shown tension member? **(05%)**



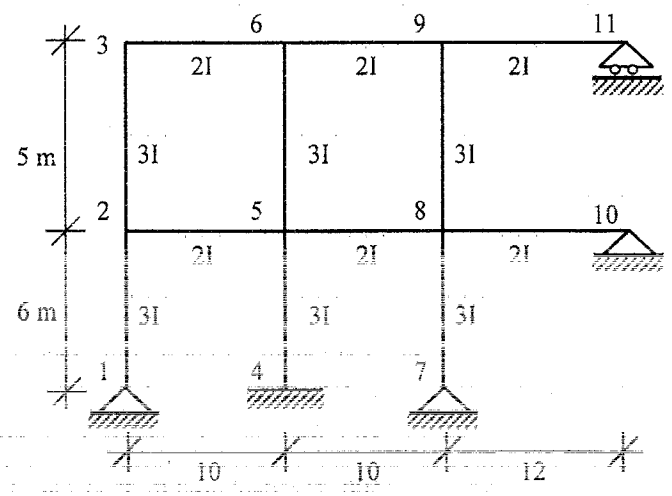
2. It is required to design the shear connection of Category (A) between the secondary and the main beams shown below. The reaction of the secondary on the main beam is 10 t. The secondary beam is an IPE No. 300 whereas the main beam is a HEA No. 500. The steel used for the beams is St 37. Use four framing angles of 100*100*10 of steel grade St 44. **(15%)**



Question #5: It is required to examine the following statements by choosing (√) or (×), ***giving the reason for each choice***. **(10%)**

1. The tension member fails by buckling.
2. For a short column ($\lambda_c < 1.1$) under compressive loading, increasing the steel grade reduces the cross-sectional area of the member.
3. The minimum effective length of fillet welds, designed on the basic of strength, shall be not less than two times the weld size (s) or 10 cm whichever is largest.
4. For a typical truss bolted bearing-type connection subjected to shear loading, the structural safety requirements for the connection are satisfied through checking the shear strength of the bolts only.
5. In the Egyptian LRFD specifications, the slenderness ratio of a compression member should not exceed 300.

Question #6: According to the Egyptian Code of Practice, compute the effective in-plane buckling lengths for columns 4-5 and 8-9 of the following frame. **(10%)**



Best wishes.....Examining committee

TANTA UNIVERSITY

FACULTY OF ENGINNERING

Theory of Structure | **Course Code: CSE 3109**

Third Year (هندسة مدنية) | **Jan. 2022 (First Term)**

Allowed time: 4 hrs | **Total Marks: 125 Marks** | **No. of Pages: (4)**

Solve all questions

Question (1) (16 Marks)

Using **moment-distribution method**, draw the B.M.D and S.F.D for the given frame of variable I shown in figure 1.

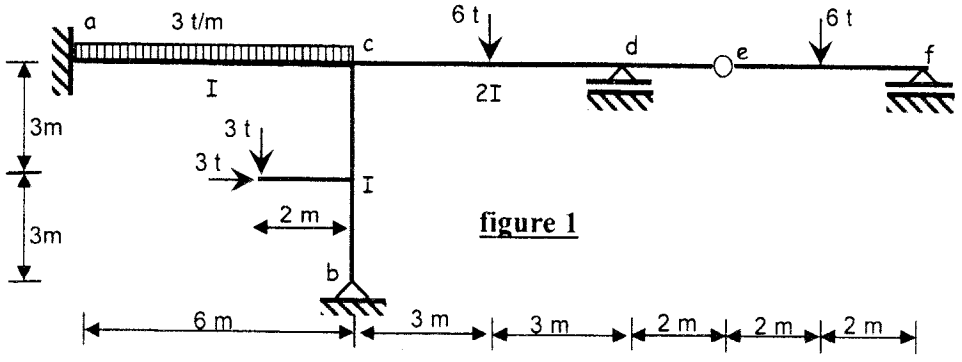


figure 1

Question (2) (20 Marks)

Using **the slope deflection method**, draw the B.M.D for the given frame of variable I shown in figure 2.

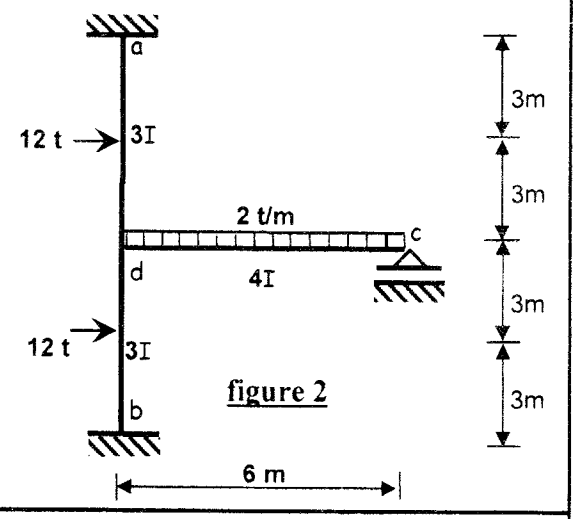


figure 2

Question (3) (15 Marks)

Using **the slope deflection method**, find the value of force P such that the maximum negative moment at b equals the maximum positive moment in span bc, further draw the B.M.D. and S.F.D for the given beam in figure 3. EI = constant

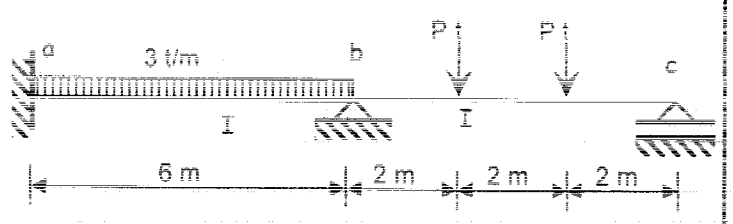


figure 3

Also, if EI=3000 t.m², find the rotation at joint b

Question (4) (16 Marks)

Figure 4 shows a plane truss subjected to a single concentrated load. It is required to

1. use symmetry to simplify the shown truss
2. use **the stiffness matrix method**, to determine the joint displacements and the force in members 1, 3 and 4.

EA= 1000t for all members

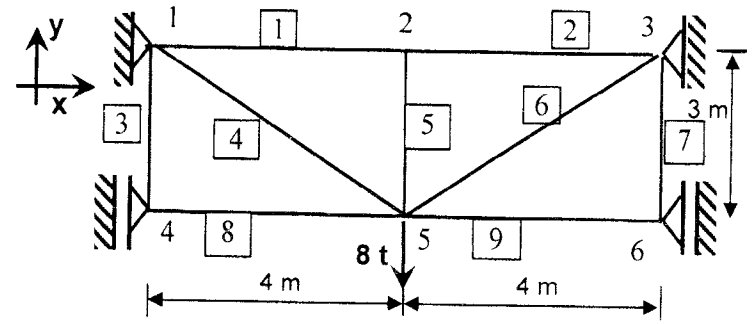


figure 4

Question (5) (12 Marks)

For the beam shown in figure 5, carry out **a complete stiffness analysis** to draw the shearing force and bending moment diagrams.

$EI = 3000\ t.m^2$.

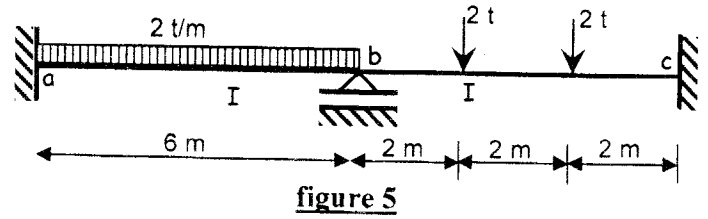


figure 5

Question (6) (20 Marks)

Figure 6 shows a frame is subjected to a concentrated loads (EI = 3000 t.m² and EA = 7500 t for all members). It is required to:

1. use symmetry to simplify the shown frame.
2. using **the stiffness matrix method**, determine the joint displacements and draw bending moment diagram.
3. without calculations, draw the bending moment diagram of the frame if the EA of the element 1:

   (a) Equals zero (b) Equals infinity.
4. if a **vertical roller support** is put at **joint f** and EA of the element 1 equals infinity, calculate the nodal displacements and then draw the bending moment diagram of the frame

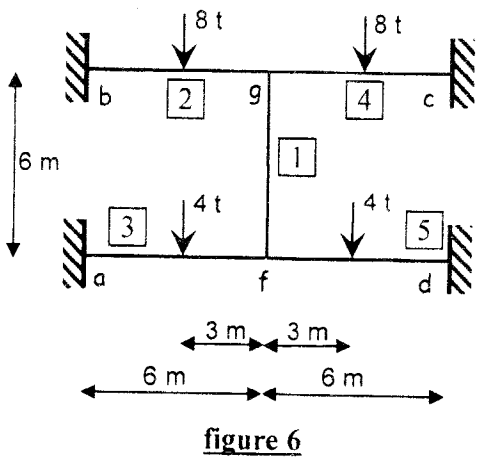


figure 6

Question (7) (14Marks)

a. Write the differential equation of undamped free body motion and solve that equation to find the undamped free vibration response (**u**) with initial displacement ($\mathbf{u_o}$) and velocity ($\mathbf{v_o}$).

b. For the frame shown in figure 7:

i. Calculate the natural frequency considering the horizontal girder to be infinity rigid.

ii. If the initial displacement and initial velocity are 2cm and 40 cm/sec, respectively, find the displacement, velocity, and acceleration after 2 seconds.(I=0.04m^4, E=200t/cm^2)

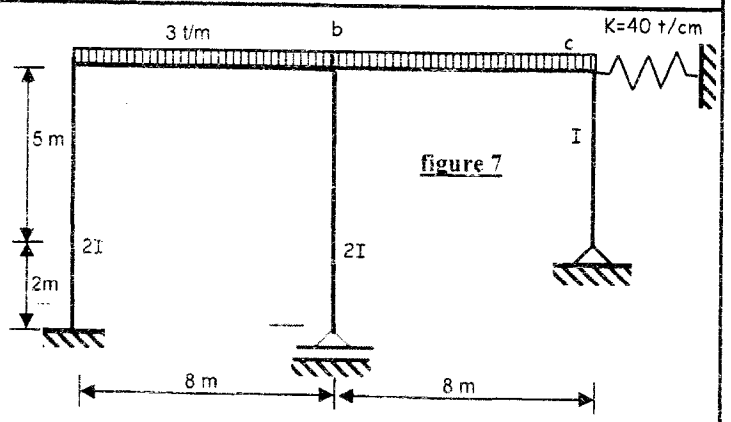


figure 7

Question (8) (12 Marks)

For the shown T- section in figure 8 find the plastic neutral axis and the plastic modulus of section Z_p and the plastic moment M_p about the axis perpendicular to the web of the section for the following two cases:

1. case of the yield stress in tension and compression are the same and equal 250 N/mm^2 and the upper flange in compression

2. case of the yield stress in tension equals 250 N/mm^2 and the yield stress in compression equals 300 N/mm^2 and the upper flange in compression

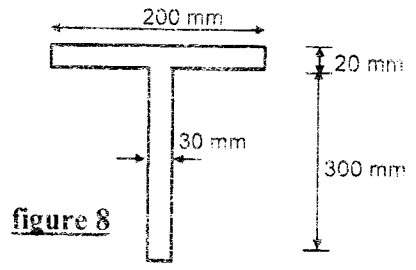
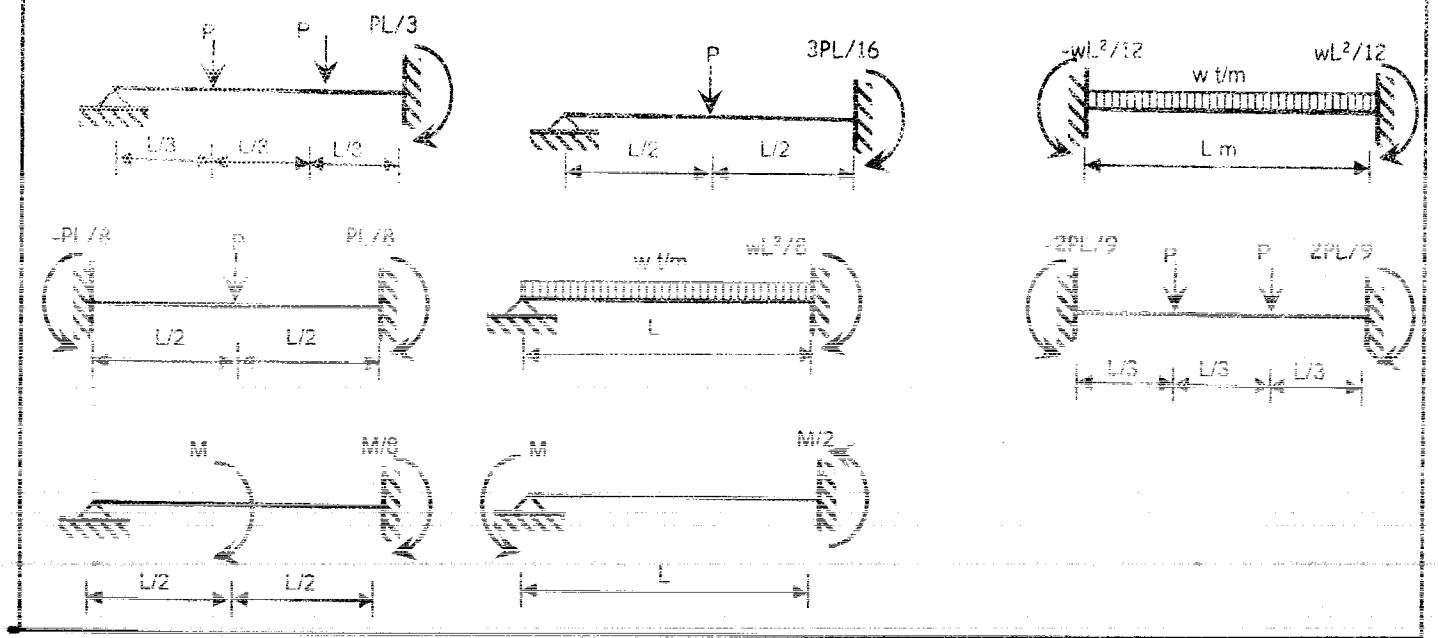


figure 8

Hints:



The Global Stiffness Matrix of a Truss Element

$$K = \frac{EA}{L}\begin{bmatrix} c^2 & cs & -c^2 & -cs \\ cs & s^2 & -cs & -s^2 \\ -c^2 & -cs & c^2 & cs \\ -cs & -s^2 & cs & s^2 \end{bmatrix} \quad c = \cos\theta \quad and \quad s = \sin\theta$$

The Local Stiffness Matrix for a Fixed-Fixed Beam Element-

$$k = \begin{bmatrix} \frac{12EI}{L^3} & \frac{6EI}{L^2} & \frac{-12EI}{L^3} & \frac{6EI}{L^2} \\ \frac{6EI}{L^2} & \frac{4EI}{L} & \frac{-6EI}{L^2} & \frac{2EI}{L} \\ \frac{-12EI}{L^3} & \frac{-6EI}{L^2} & \frac{12EI}{L^3} & \frac{-6EI}{L^2} \\ \frac{6EI}{L^2} & \frac{2EI}{L} & \frac{-6EI}{L^2} & \frac{4EI}{L} \end{bmatrix}$$

The Global Stiffness Matrix of a Fixed-Fixed Frame Element

$$K = \begin{bmatrix} a_1 & a_2 & -a_3 & -a_1 & -a_2 & -a_3 \\ & a_4 & a_5 & -a_2 & -a_4 & a_5 \\ & & a_6 & a_3 & -a_5 & a_6/2 \\ & & & a_1 & a_2 & a_3 \\ & & & & a_4 & -a_5 \\ & & & & & a_6 \end{bmatrix}$$

where

$a_1 = (EA/L)\,c^2 + (12EI/L^3)\,s^2$

$a_2 = (EA/L - 12EI/L^3)\,cs$

$a_3 = (6EI/L^2)\,s$

$a_4 = (EA/L)\,s^2 + (12EI/L^3)\,c^2$

$a_5 = (6EI/L^2)\,c$

$a_6 = 4EI/L$

$c = \cos\theta \quad and \quad s = \sin\theta$

The Global Stiffness Matrix for Fixed-Hinged Frame Element

$$K = \begin{bmatrix} a_1 & a_2 & -a_3 & -a_1 & -a_2 \\ & a_4 & a_5 & -a_2 & -a_4 \\ & & a_6 & a_3 & -a_5 \\ & & & a_1 & a_2 \\ & & & & a_4 \end{bmatrix}$$

$a_1 = (EA/L)\,c^2 + (3EI/L^3)\,s^2$

$a_2 = (EA/L - 3EI/L^3)\,cs$

$a_3 = (3EI/L^2)\,s$

$a_4 = (EA/L)\,s^2 + (3EI/L^3)\,c^2$

$a_5 = (3EI/L^2)\,c$

$a_6 = 3EI/L$

where $c = \cos\theta \quad and \quad s = \sin\theta$

Tanta University - Faculty of Engineering — Soil Mechanics (2) & (3)
Structural Engineering Department — Third Year Structural& civil Eng.
Final Term Exam 2021-2022 Time: 180 minutes Total Marks 75 Date: 18 January 2022

- The total Number of exam pages is 12 .
- Answer All Questions in the electronic answer form.
- Use the answer book for drafts only.

Very important Read carefully

Question No. 1: (60 Marks)
For the following questions, choose the correct answer:

1) A long natural slope of cohesion-less soil is inclined at 15° to the horizontal. What will be the factor of safety of the slope if φ = 30°?

(a) 1.73 (b) 1.52 (c) 2.12 (d) None of these

2) The stability of an infinite slope can be investigated by which of the following method?

a-) Taylor's chart method b-) Swedish method c-) Circular arc method d-) None of the mentioned

3) For a clay slope, the Taylor's stability number is 0.05, unit weight of clay = 20 kN/m^3, C = 0.25 kg/cm^2, the critical height of the slope of the soil (F.O.S. = 1), is ..... $\left[F.o.S = \frac{C_u}{N\,\gamma H}\right]$

a-) 4.0 m b- 12.5 m c- 25.0 m d- 15.0 m

4) Natural slopes may fail due to change of stress by ..... .

a-) adding loads at top of the slope b-) increasing the angle of the slope c-) excavation at the toe of the slope d-) All of the mentioned

5) The factor of safety in slope stability analysis is defined as ..... .

a-) the ratio between the sum acting shear stress to the resisting shear stress along the critical slip surface of the slope

b-) the ratio between resisting shear stress to the sum of the acting shear stress along the critical slip surface of the slope

c-) the ratio between the sum acting shear forces to the resisting shear force along the critical slip surface of the slope

d-) the ratio between resisting normal stress to the sum of the acting normal stress along the critical slip surface of the slope

6) The failure surface of the infinite slope is assumed to be ..... to the ground.
a-) None of them b-) All of them c-) perpendicular d-) parallel

7) The Bishop simplified method can be used to estimate the factor of safety of ..... soil slopes.
a-) (c-φ) only b-) (c) only c-) (φ) only d-) All of them

8) On designing retaining walls it is necessary to take care of ..... exerted by soil mass.

a-) Erosion b-) Surcharge c-) Lateral pressure d-) Vertical stress

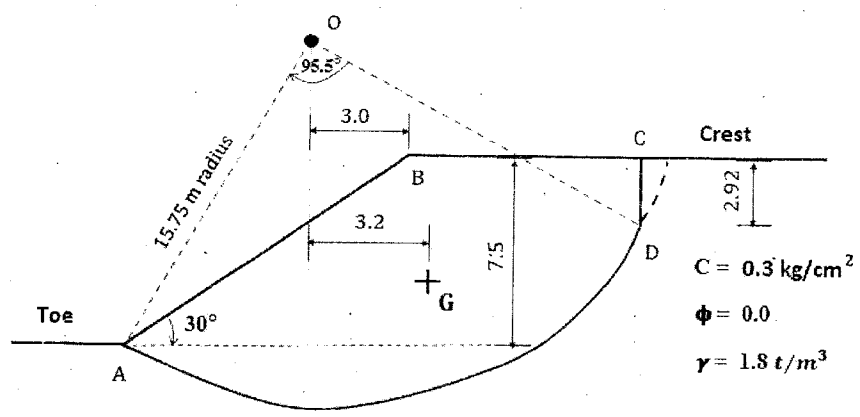
9) The shear key of the retaining walls is provided to .....

a-) Increase passive resistance b-) improve appearance
c-) avoid sliding of the wall d-) All of them

10) R.C Cantilever retaining walls can safely be used for a height not more than .....

a-) 2 m b-) 3 m c-) 5 m d-) 9 m

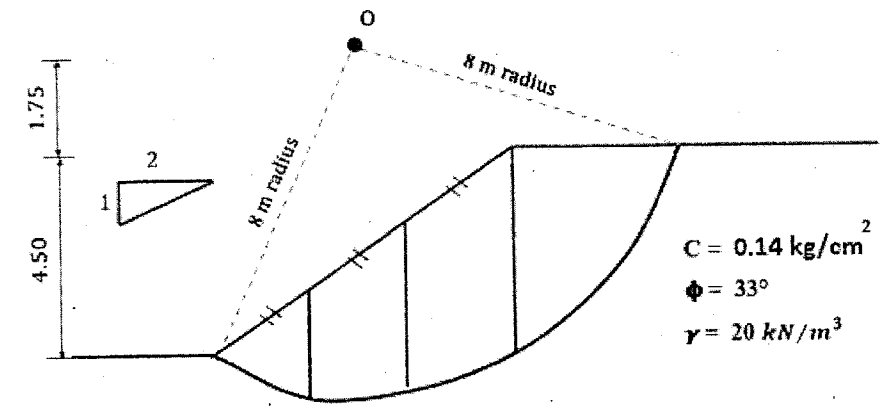
Consider a bank of canal has the profile shown in the following figure. For the trial slip circle shown the area (ABCDE) is 165 m^2 and the centered is at (G). Tension crack is (CD) for the question of NO. 11 only.



11) The factor of safety of the slope **using Circular Arc Method** will be ..... . If canal is empty.

a-) 0.31 b-) 1.29 c-) 1.26 d-) 2.93

An embankment has the profile shown in the following figure. Assuming that tension cracks do not develop. <u>Use Bishop solution Method (Use four strips). Take average pore water pressure ratio (ru) = 0.5</u> for the questions from <u>12 to 15</u>.



** The equation of the factor of the safety of the slope using **<u>Bishop solution Method is</u>**

$$F.O.S = \frac{1}{\Sigma W sin\alpha} * \Sigma\left(\frac{(C * b + W(1 - r_u)tan\phi)sec\alpha}{1 + \frac{\tan(\alpha) * \tan(\phi)}{F.O.S}}\right)$$

12) The value of the (Σ w * sin (α)) of the four slices will be .....
a-) 220.5 b-) 170.5 c-) 145.54 d-) 110.36

13) The value of the first trial of the factor of the slope from the equation will be .....
a-) 1.31 b-) 1.14 c-) 2.61 d-) 2.43

14) The value of the second trial of the factor of the slope from the equation will be .....
a-) 1.35 b-) 1.11 c-) 2.61 d-) 2.73

15) The final factor of safety of this slope with respect to shear strength failure along the slip circle will be .....
a-) 1.36 b-) 1.13 c-) 2.62 d-) 2.74

Consider the effective earth pressure on the base is assumed to vary linearly and N' is applied at the centroid of the pressure diagram. When the resultant falls within the middle one-third of the base, the effective base pressures q' are calculated by the following equation: (for the questions from <u>16 to 19</u>.

$$q' = \left(\frac{N'}{B}\right)\left(1 \pm \frac{6e}{B}\right)$$

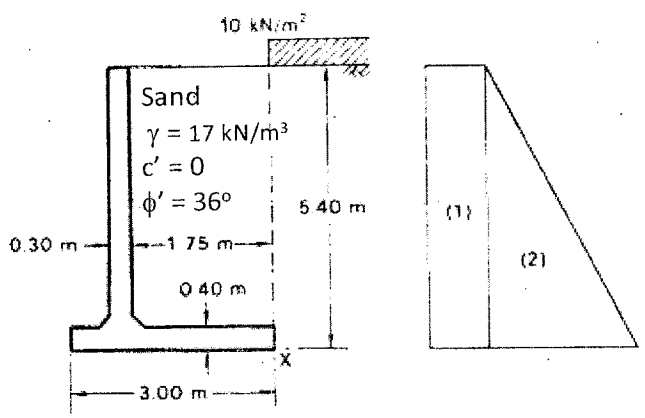
16) The mean of (N') in the previous equation is the .....
a-) effective normal stress c-) effective normal force
b-) effective shear stress d-) effective shear force

17) The mean of (e) in the previous equation is the .....
a-) eccentricity of B c-) eccentricity of N' from the edge of base
b-) Basic shear d-) eccentricity of N' from center of base

18) What does (B) stand for?
a-) Basic shear c-) 100 cm.
b-) Width of the base of structure d-) None of them

19) The maximum value of the (q') mustn't exceed ..... .
a-) Allowable load of the soil c-) No tension.
b-) Allowable stress of the soil d-) Zero.

Consider the R.C cantilever retaining wall and the following calculations for the questions from <u>from 20 to 28</u>.



The angle of friction between the soil and the base of the wall is 0.75 ϕ = 27°
The ground water table is well be low the base of the wall

(per m)	Force (kN)		Arm (m)	Moment (kN m)
(1)	0.26 × 10 × 5.40	= 14.0	2.70	37.9
(2)	$\frac{1}{2}$ × 0.26 × 17 × 5.40²	= 64.4	1.80	115.9
		H = 78.4		M_H = 153.8
(Stem)	5.00 × 0.30 × 23.5	= 35.3	1.10	38.8
(Base)	0.40 × 3.00 × 23.5	= 28.2	1.50	42.3
(Soil)	5.00 × 1.75 × 17	= 148.8	2.125	316.2
		V = 212.3		M_v = 397.3
				153.8
				ΣM = 243.5

20) The total horizontal frictional resistance for horizontal sliding is .....
a) 78.4 kN b) 108.2 kN c) 212.3 kN d) 208.2 kN

21) The factor of safety against sliding is .....

a) 1.38 b) 2.7 c) 3.18 d) 1.83

22) The driving moment in kN.m is .....

a) 243.5 b) 397.3 c) 153.8 d) 212.3

23) The resisting moment in kN.m is .....

a) 153.8 b) 397.3 c) 243.5 d) 212.3

24) The factor of safety against overturning is .....

a) 2.58 b) 1.00 c) 1.63 d) 1.87

25) The lever arm of base resultant is .....

a) 0.72 m b) 1.87m c) 1.15m d) 1.00m

26) The eccentricity of base reaction, e, is .....

a) 0.78 m b) 1.87 m c) 0.35 m d) 0.50 m

27) The minimum base pressure in kPa at the heal is .....

a) 120 b) 21 c) 70 d) 90

28) The maximum base pressure in kPa at the toe is .....

a) 120 b) 21 c) 70 d) 90

29) With the increase in the amount of compaction energy, ...

(a) Optimum water content increases but maximum dry density decreases (b) Both optimum water content and maximum dry density decrease (c) Both optimum water content and maximum dry density increase (d) Optimum water content decreases but maximum dry density increases

30) Pick up the correct statement from the following:

(a) A maximum value of dry density is obtained at optimum water content (b) At low value of water content most soils tend to be stiff (c) At high water content, the dry density decreases with an increase of water content (d) All of these

31) Which of the following tests is used for compaction?

(a) Dynamic cone test (b) Unconfined compression test (c) Sand cone test (d) All of these

32) Higher density and a lower optimum water content is easily achieved for .....

a-) Coarse grained soil b-) Fine grained soil c-) Dry soil d-) Saturated soil

33) In standard compaction test, the hummer falls from a height of .....cm.

a-) 30.5 b-) 35.0 c-) 40.5 d-) 45.0

34) The water content corresponding to the maximum density in compaction curve is called .....

a) Compaction water content b-) Optimum water content c-) Ultimate water content d-) All of the these

35) Select the correct statement

a) In a direct shear box test, the plane of shear failure is not predetermined. b) In a triaxial compression test there is no control on soil drainage. c) Unconfined compression test can be carried out on clay soil only d) All the above

36) The angle that shear failure envelope makes with the horizontal is called

a) Cohesion. b) Angle of internal friction. c) Angle of dilatancy d) None of the above

37) For testing a saturated clay for shear strength in a simplest way, the test recommended, is

a) Direct shear test. b) Triaxial compression test. c) Unconfined compression test d) All the above

38) The angle of internal friction is maximum for .....

a) angular-grained loose sand. b) angular-grained dense sand. c) round-grained dense sand d) round-grained loose sand

39) The shear strength in plastic undrained clay, is due to .....

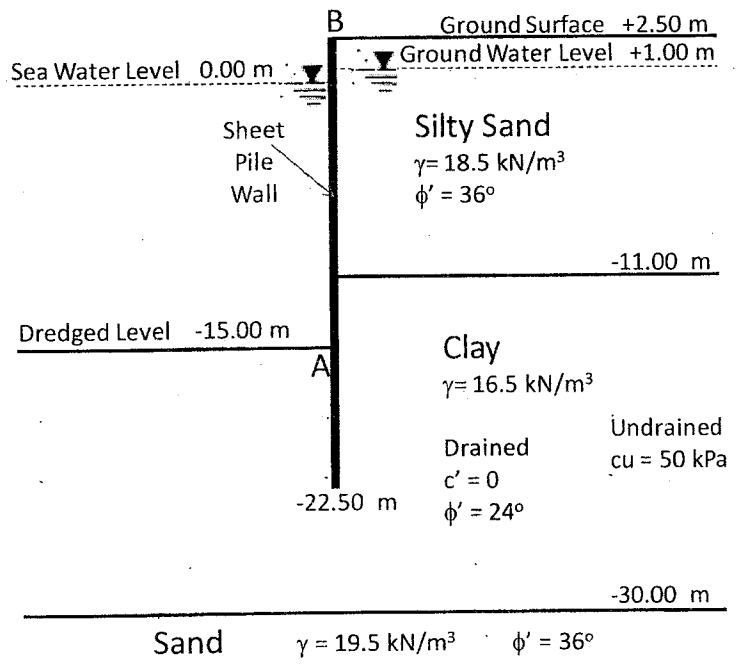
a) Inter-granular friction. b) Internal friction. c) Cohesion d) None of these

40) The width of the base of a cantilever type retaining wall might equal .....

a) 0.5 the wall height b) 0.8 the wall height

c) 0.35 the wall height d) 0.75 the wall height

Assume the segment AB of the wall in the following Figure is a vertical wall which can rotate about its base a sufficient amount to produce a state of plastic equilibrium in the soil behind the wall for the questions <u>from 47 to 51</u>.



47) The coefficient of earth pressure to be used to calculate earth pressure of the clay on the wall from **<u>the land side</u>** after one week is.....
a) 1.00 b) 0.59
c) 0.42 d) 2.37

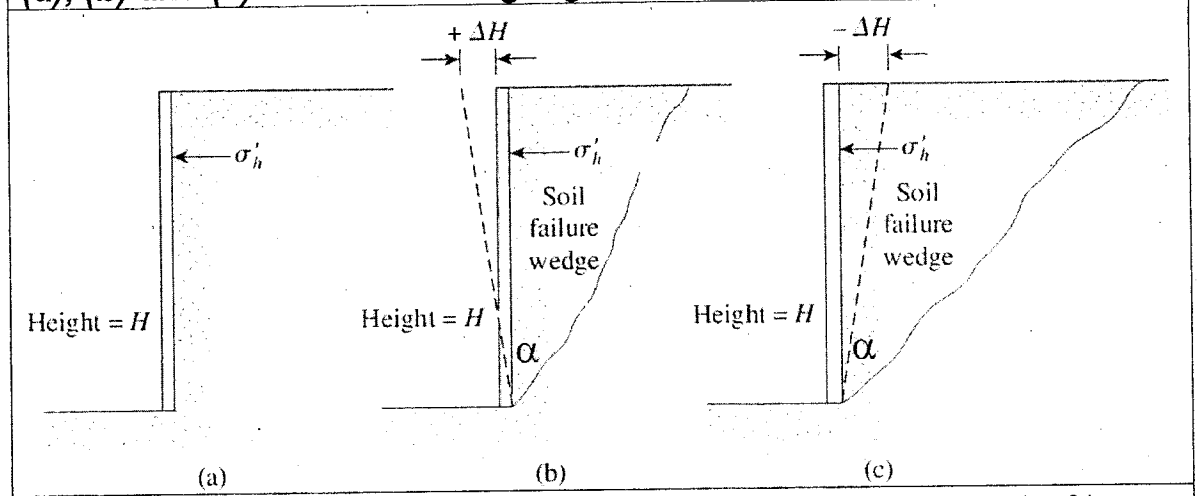
48) The coefficient of earth pressure to be used to calculate earth pressure of the clay on the wall from **<u>the land side</u>** after 30 years is.....
a) 1.00 b) 0.59
c) 0.42 d) 2.37

49) The water pressure on the wall from **<u>the land side</u>** at point A is.....
a) 150 kPa b) 160 kPa
c) 175 kPa d) 10 kPa

50) The net water pressure on the wall from **<u>the landside</u>** at point A is.....
a) 110 kPa b) 120 kPa
c) 135 kPa d) 10 kPa

51) If the allowable pressure for a footing to avoid shear failure in the soil under the footing is 170 kPa, the allowable pressure on footing to avoid exceeding the tolerable settlement is 120 kPa, and the effective overburden pressure at foundation level is 30 kPa, then allowable pressure to be used in sizing the footing is.....
a) 30 kPa b) 120 kPa
c) 150 kPa d) 170 kPa

Solve the following questions <u>from 41 to 46</u> considering three walls (a), (b) and (c) in the following Figure:



The soil behind the wall has cohesion intercept = 0 and internal friction angle of ϕ

41) The coefficient of earth pressure to be used to calculate earth pressure on the wall **(a)** is .....
a) At rest b) Active
c) Passive d) 0.5 of passive

42) The coefficient of earth pressure to be used to calculate earth pressure on the wall **(b)** is .....
a) At rest b) Active
c) Passive d) 0.5 of passive

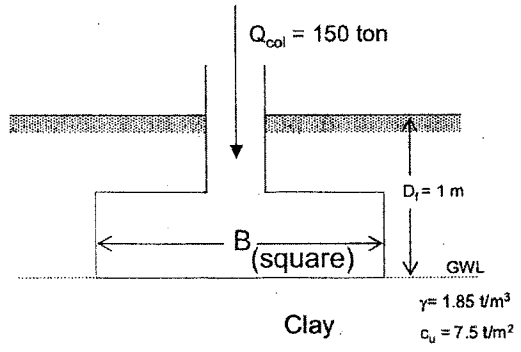
43) The coefficient of earth pressure to be used to calculate earth pressure on the wall **(c)** is .....
a) At rest b) Active
c) Passive d) 0.5 of passive

44) The angle from vertical of the wedge behind the wall **(a)** is .....
a) 45+ ϕ/2 b) 45- ϕ/2
c) zero d) None of the above

45) The angle from vertical of the wedge behind the wall **(b)** is .....
a) 45+ ϕ/2 b) 45- ϕ/2
c) zero d) None of the above

46) The angle from vertical of the wedge behind the wall **(c)** is .....
a) 45+ ϕ/2 b) 45- ϕ/2
c) zero d) None of the above

Consider the footing and soil in the Figure in solving the following 3 questions <u>from 52 to 54</u>.



52) The net ultimate bearing capacity of the footing is.....

a) 48.75 ton/m² b) 16.25 ton/m²
c) 1.85 ton/m² d) none of the above

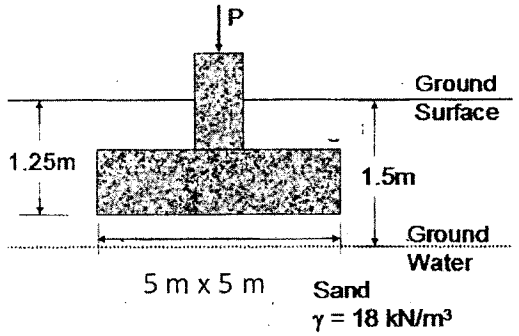
53) If factor of safety is 3, the net allowable bearing capacity of the footing is.....

a) 48.75 ton/m² b) 16.25 ton/m²
c) 1.85 ton/m² d) none of the above

54) If the footing is sized only to avoid shear failure only, the width of the footing is (Ignore difference in γconc & γsoil).....

a) ~3m b) ~1.8m c) ~ 9m d) none of the above

Consider the footing and soil in the Figure in solving the following 6 questions <u>from 55 to 60</u>. <u>If the allowable column load P is 4875 kN for footing settlement of 25 mm.</u>



55) The average SPT N values of the sand layer under the footing are.....

a) 20 b) 15 c) 25 d) none of the above

56) An estimate of the friction angle of the sand under the footing is.....

a) 33.5° b) 31.5°
c) 35° d) none of the above

57) The unit weight of the sand to be used in bearing capacity calculations is.....

a) 18 kN/m³ b) 8 kN/m³ c) 9.3 kN/m³ d) none of the above

58) The bearing capacity factor Nq is.....

a) 26.4 b) 22.2 c) 33 d) none of the above

59) The bearing capacity factor N_γ is.....

a) ~16.6 b) ~12 c) 23 d) none of the above

60) The ultimate bearing capacity of the footing is.....

a) 1315 kPa b) 1050 kPa c) 1715 kPa d) none of the above

<u>Question No. 2: (15 Marks)</u>

<u>For the following phrases, choose True (T) or False (F) in the electronic answer form:</u>

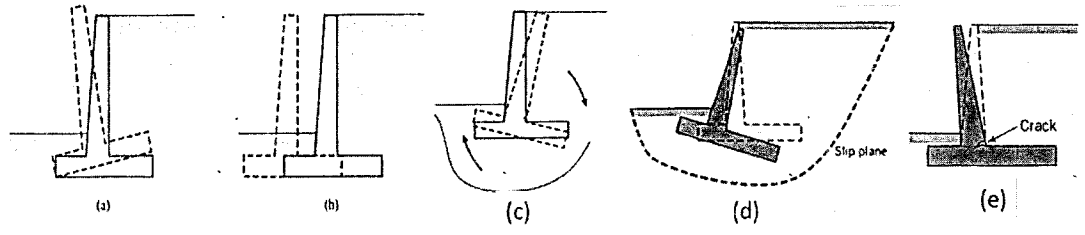
[1] Artificial finite slopes include earth dams and unsupported excavations.

[2] The Taylor's stability number can be used to determine the stability of sand slopes.

[3] The failure surface of a finite slope is assumed to be parallel to the ground level.

[4] In the limiting case of Sand soil slope stability, the angle of slope equals the Angle of repose.

Consider the following Figure to answer the following questions from <u>5 to 9</u>



[5] The mode of failure of the retaining wall in (a) in the figure above is Sliding

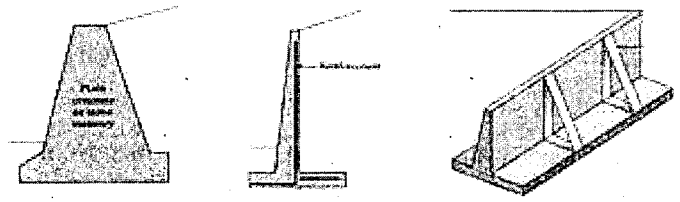
[6] The mode of failure of the retaining wall in (b) in the figure above is Sliding

[7] The mode of failure of the retaining wall in (c) in the figure above is overturning

[8] The mode of failure of the retaining wall in (d) in the figure above is Over all (deep seated)

[9] The mode of failure of the retaining wall in (e) in the figure above is structural

Consider the following Figure to answer the following questions from <u>10 to 12</u>



[10] The retaining wall (A) in the figure above is of the type gravity.

[11] The retaining wall (B) in the figure above is of the type cantilever.

[12] The retaining wall (C) in the figure above is of the type semi-gravity.

[13] The factor of safety of the slope in Finite Element Method (FEM) can be defined in two ways: Force Equilibrium and Moment Equilibrium.

[14] In Shear Strength Reduction Method of the slope stability, the shear strength of the soil slope was increased in steps until the soil mass falls.

[15] One of the main methods to increase the stability of the slopes is to excavate the soil at the slope toe.

[16] The location of the sip surface is the location that slip surface has a maximum factor of safety of the slope.

[17] The increase of the embedded piles length in the slope below the slip surface causes decrease of passive resistance pressure, which cause equilibrium state with the acting lateral pressure.

[18] The factor of safety of sand slopes ((φ) soil) always affected by the existing or not existing of Ground water level.

[19] The tension crack depth (Z_o) in (cu-soil) can be estimated using the following equation: $Z_0 = 2*C/\gamma * H$.

[20] The process in which soil particles are packed together into a closer state by squeezing out water in order to improve its behavior is known as compaction.

[21] The modified proctor test consists of compacting soil in 5 equal layers, each layer given 15 blows of hammer.

[22] In the standard Proctor test, soil is compacted in 3 layers.

[23] The dynamic cone test is used for evaluating the compaction of soil in field.

[24] The efficiency of soil compaction can be defined as the ratio of the field bulk density of a compacted soil to the maximum density of the same soil.

[25] Loose sand or soft clay layer with a thickness higher than 50 cm can be improved by compaction in one layer.

[26] Pneumatic tire rollers are used to compact wet sand and wet clay only.

[27] Sheep's foot rollers are most suitable for compacting dry sand.

[28] Standard Proctor test can be used to evaluate the maximum dry density of soils that are compacted for small roads with very low traffic.

[29] The minimum factor of safety against rotational failure for permanent slopes under non-seismic conditions is closest to 2.

[30] The method of slices for the slope stability is called Taylor stability chart method.

[31] As the shear strength of the soil increases the active earth pressure increases

[32] As the shear strength of the soil increases the passive resistance increases

[33] As the shear strength of the soil increases the at rest earth pressure stays constant

[34] For a retaining wall that is 5 m in height, retaining sand with a friction angle of 35°, the width of the active wedge behind the wall according to Rankine theory is 5m.

[35] In case of clay with undrained shear strength of 20 kPa and unit weight of 20 kN/m^3, then the depth of 0 active pressure is 2 m.

[36] In case of sand with friction angle of 30o and unit weight of 20 kN/m^3, then the depth of 0 active pressure is 2 m.

[37] Considering only the shear failure in sand, the net allowable pressure increases with the increase in footing width.

[38] Considering only the allowable settlement in sand, the allowable pressure increases with the increase in footing width.

[39] The net allowable bearing capacity (shear failure) in clay with undrained parameters, increases with the increase in footing width.

[40] As SPT N values of sandy soils increase, the bearing capacity (shear failure) increases

[41] As SPT N values of sandy soils increase, the compressibility of the soil increases.

[42] If a square footing that is 2 m in width is loaded with an average pressure of 100 kPa then the zone of influence under the footing shall be 1.7m.

[43] If the soil under the footing above has SPT N values of 15, then the settlement of the footing shall be less than 1 cm.

[44] The failure of slopes may take place due to Action of gravitational force.

[45] Net ultimate bearing capacity of a footing embedded in a clay layer increases with width of the footing.

$Z_I = B^{0.75}$ Units meter

Calculate average N over Z_I below foundation level

$$E_s = \frac{\overline{N}^{1.4}}{1.7}$$ Units MPa

$$S = qB^{0.75}\frac{1.7}{\overline{N}^{1.4}}\left(\frac{1.25\,L/B}{L/B+0.25}\right)^2$$ Units

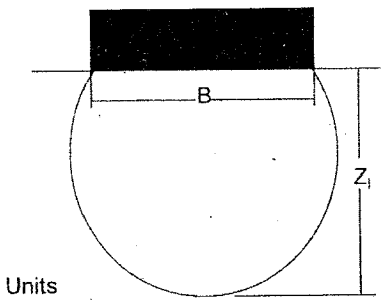
S: Settlement in mm,

q in kPa or kN/m^2

Z_I in m

L : Length of Footing

B: Width of Footing



----------End of Questions----------

With our Best wishes .....

Prof. Dr. Marwan Shakir *Asc. Prof. Dr. Ahmed Farouk*

Dr. Mohamed Ahmed Sobhy