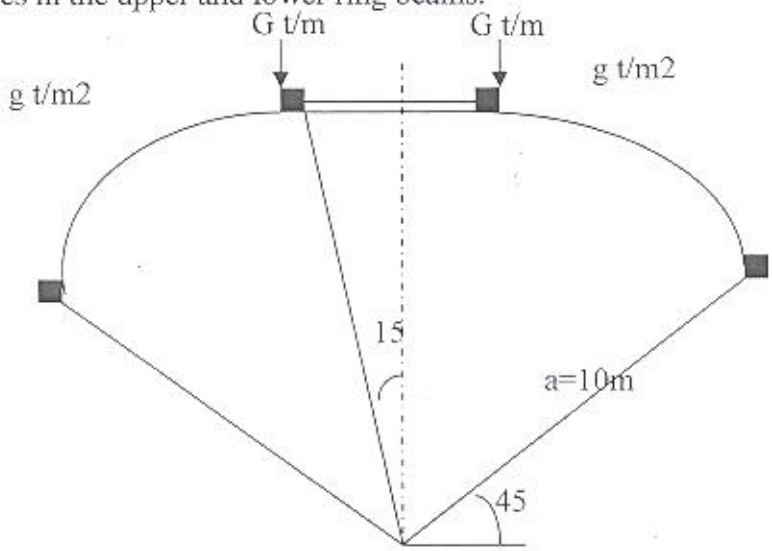
Q5) a) Drive the expression of $N_\phi = \frac{-1}{r_2 \sin^2 \emptyset}\left[\int \; r_1 r_2 (P_r \cos \emptyset + P_\emptyset \sin \emptyset) \sin \emptyset \, d\emptyset + C \right]$

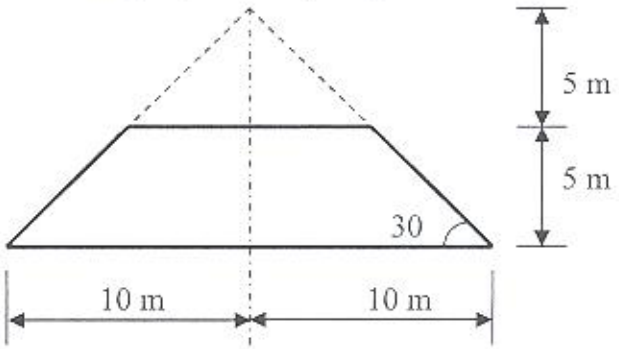
b) The hall shown in Figure (1) is covered by opened spherical shell of radius of 10.0 m with the *dimensions shown in the Figure.*

١- Calculate and draw the stress resultants in the spherical shell (Nϕ and Nθ) due to own weight g = 0.5 t per square meter of surface area and the load G=2 t/m.

٢- Calculate the forces in the upper and lower ring beams.



Q6) For the conical shell shown in Figure, it is required to calculate and draw the stress resultants in the spherical shell (Ns and Nθ) due to own weight g = 0.5 t per square meter of surface area



$$N_\phi = \frac{-1}{r_2 \sin^2 \emptyset}\left[\int \; r_1 r_2 (P_r \cos \emptyset + P_\emptyset \sin \emptyset) \sin \emptyset \, d\emptyset + C \right]$$

$$\frac{N\phi}{r_1} + \frac{N\theta}{r_2} = -P_r \qquad N_s = \frac{-1}{S \sin \emptyset}\left[\int (P_r \cos \emptyset + P_\emptyset \sin \emptyset) S \, ds + c\right]$$

هندسة مدنية حديث + قديم
٢٠١١/١/٢٧

Tanta University Faculty of Engineering Public Works Dept.	Transport planning and Traffic Engineering Final Exam (طلاب حديث& قديم)	3rd Year Civil Time: 3 Hours 2010-2011

Try all questions & Max. Grade = 7 0 Marks

- **Problem (1):** (20 Marks)

A)Define the following terms عرف الآتى مع ذكر العناصر الاساسيه

Transport system components & Net residential density & Employment& A.D.T& Home Interview & Traffic Density& Parking Index & Saturation Flow & Inter-green Time & P.H.F

Sketch Only ارسم فقط

Saturation flow –Green time relationship & Speed, Flow, density relationships & Desire Line Diagram, On street parking layouts

B) State whether these sentences is True or False and Correct the False Sentences:

i. The aim of Transport and traffic engineering discipline is to provide safe, economic, efficient and cheap movement of freights and people

ii. The urban transportation planning process consists of **Five** main models.

iii. Roadside interview O/D survey method measures the largest amount of movements within the urban areas, it is recommended for comprehensive transport study.

iv. Trip attraction model depends on employment and accessibility, and land use type

v. Cycle time is the time taken for complete sequence of signal indications for all served approaches

vi. . Modal split is used for distributing the inter-zonal trips between different transport modes

- **C)State the warrants for traffic signals installation**
- **Problem (2):** (15 Marks)

A user with annual income of 3000 Pounds is choosing between two modes; a taxi and a public bus for a specific journey of distance 7

miles, If the utility function of the model choice is on the following form: $U_m = k_m - 0.03\ tm - 0.34\ (X_m/d) - 50\ (Cm/y)$

Where: t_m = in vehicle time (minutes) , X_m = out vehicle time(minutes), d = distance (miles), Cm = Cost in piasters, y = annual income, km = mode specific constant

Considering the following situation:

Taxi: k_t=-0.11 t = 11 min. , X_m = 5 min , C_t = 150 Piasters Public

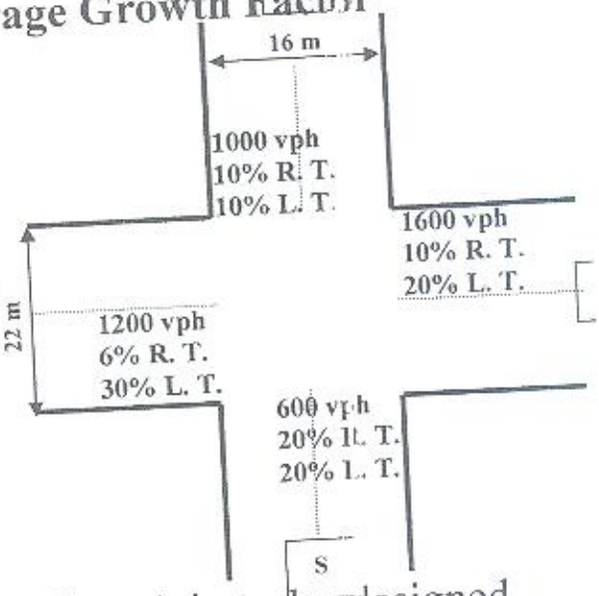
Bus: t_b = 14 min. , X_b = 8 min , C_b = 50 Piasters , k_b=0.0

Determine the probability of choosing each mode. [5 Marks]

Problem (3): (20 Marks)

An urban area is consisting of four zones 1,2,3,and 4, the existing (O/D) trip matrix is given as shown below. The future productions and attractions are calculated **from Trip Generation Model. It is required to:** Determine the future inter-zonal trips between the four zones for the design year 2020. **Average Growth Factor** method (**Two iterations only is enough**)

O\D	1	2	3	4	Future Prodns.
1		200	600	400	2400
2	200		400	200	4000
3	600	400		600	4800
4	400	200	600		1200
Future Attracts	1800	2400	5200	1800	



Problem (4): (15 Marks)

A two phase traffic signal (in the shown figure) is to be designed for peak hour condition. Design hourly volumes are given below. Assume starting delay of two second per phase. Also assume 10% truck (3.0 pcus) in each approach volume. It is required to make a full design for the traffic signal in this intersection.

With my best wishes

Dr: Sayed Shawaly

Tanta University

Structural Engineering Department
Total Marks: 70 Marks

Faculty of Engineering

Course Title: Soil-Structure Interaction	Course Code: CS	Year: 3rd
Date: January 13th 2011 (First term)	Allowed time: 3 hrs (Term Exam)	No. of Pages: (3)

Answer the following questions … answers should be supported by sketches

Problem number (1) **(12.0 Marks)**

(a) What is the meant by reinforced earth retaining walls

(b) For the retaining wall shown in figure (1) calculate the followings:-

1) The minimum length of the tie rod, L_t, to provide stability.
2) The required cross section of the steel tie rod.
3) check the stability of the wall against sliding

Data :

The allowable stress of steel is 2000 kg/cm^2

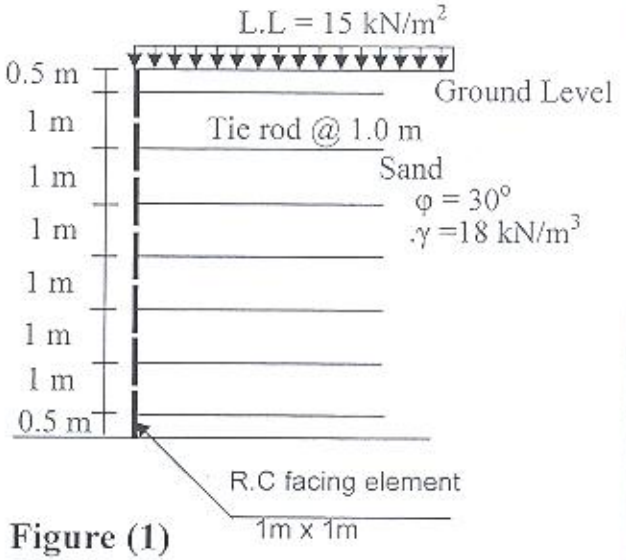


Figure (1)

Problem number (2) **(12.0 Marks)**

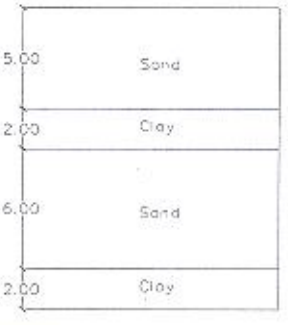
a) what are the different types of foundation settlement?

b) – The soil profile of a site consists of a clay layer of 2.00 m thickness between two layers of sand as shown in the figure,if the clay is normally consolidated and has the following properties :-

Compression index, $C_c = 0.22$ Initial void ratio, $e_o = 0.90$

The ground water level at the ground level is locted at 5 m from the exsisting ground level.

Compute the total consolidation settlement under a uniform distributed load of 100 kN/m2 on raft 10 x 10 m assuming that the clay is fully



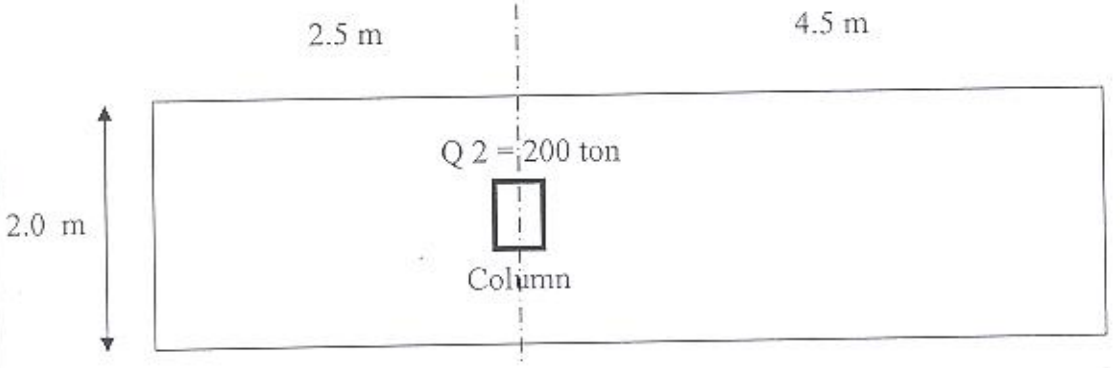
Problem number (3) **(11.0 Marks)**

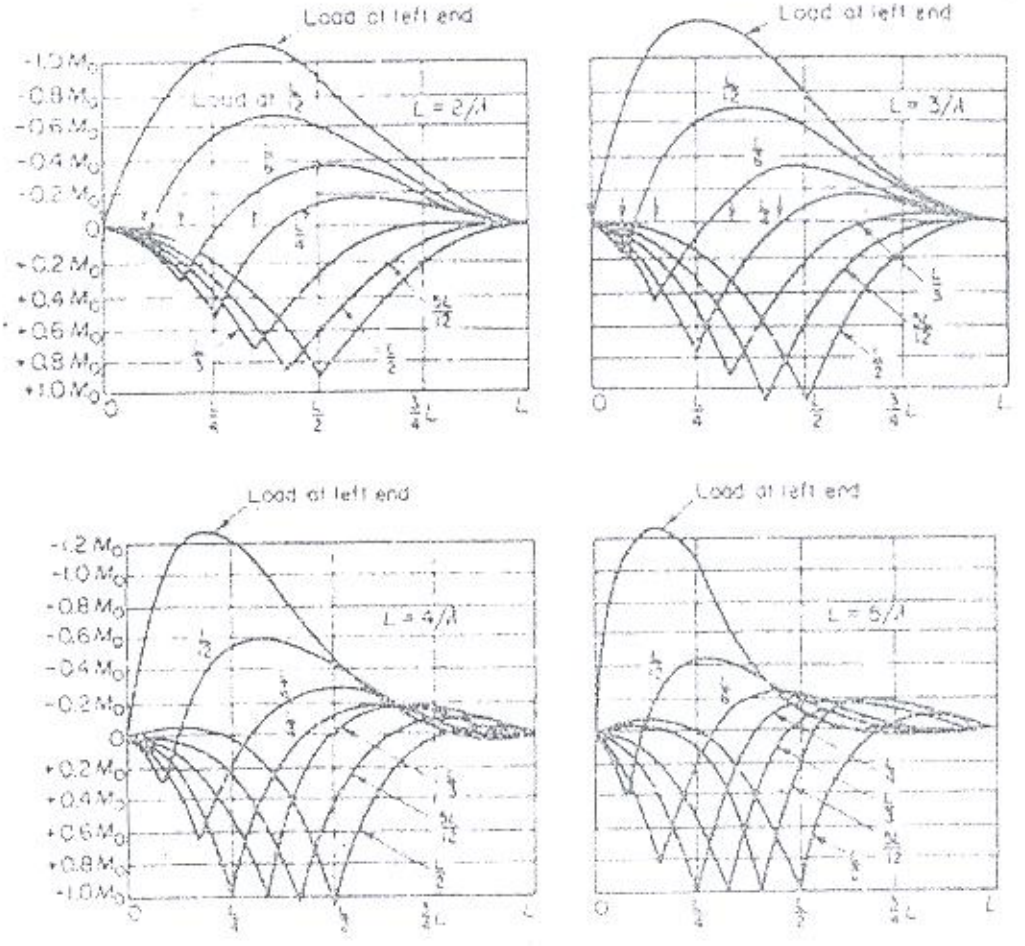
(A) State using short terms the corrections should be done for the coefficient of sub grade reaction.

(B) Using clear sketches discus the plate loading test, and give the reason of using this test.

(C) For isolated footing shown in the figure, estimate the bending moment acts on the footing using the concept of elastic line.

If the footing thickness is 0.65 m, the in corrected sub grade reaction is 2.0 kg/cm^3, and the modulus of elasticity of concrete is 2x 10^6 t/m^2





Note: $\lambda = \sqrt[4]{\frac{Bk}{4EI}}$

Problem number (4) **(17.5 Marks)**

a) Draw the stress distribution under isolated footing due to vertical and lateral loads. State how to check the stability of such footing. (2.5 Marks)

b) Figure 1 shows the dimensions of a raft foundation over piles for a residential building. The total load of the structure = 2000.0 t acting in the left bottom quarter with e_x = 0.2 m and e_y = 0.25 m. The acting moment on the raft due to considering the lateral loads in y direction = 1200 tm. If the pile diameter and spacing are 0.80 m and 2.0 m respectively.

(i) Determine the maximum and minimum loads in the piles due to vertical loads only. (6.0 Marks)

(ii) Determine the maximum load in the piles due to both vertical and lateral loads. (6.0 Marks)

(iii) State only without calculations how to determine the maximum and the minimum loads in the piles if the black pile was broken during the construction. (3.0 Marks)

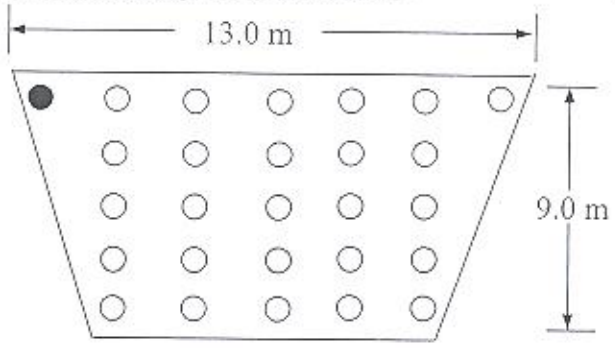


Figure 1

Problem number (5) **(17.5 Marks)**

a) Using clear sketches, discuss the difference between strap footing and smells. (3.5 Marks)

b) The figure shows the dimensions of the raft foundation for a residential building. The total load of the structure = 6000.0 t acting in the left bottom quarter with e_x = 0.20 m and e_y = 0.30 m. The acting moment on the raft due to considering the lateral loads in y direction = 800 tm. Determine the maximum and minimum stresses under the raft foundation:

(i) under vertical loads only (7.0 Marks)

(ii) under both vertical and lateral loads (7.0 Marks)

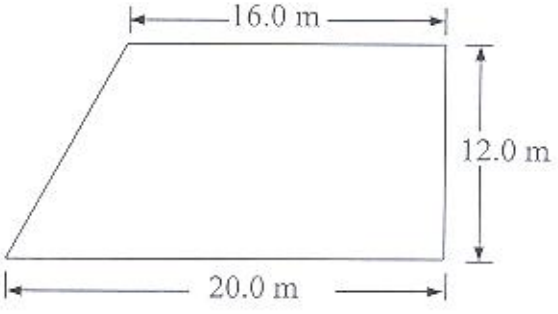


Figure 2

TANTA UNIVERSITY
FACULTY OF ENGINEERING
DEPARTMENT OF STRUCTURAL ENGINEERING
EXAMINATION (THIRD YEAR) STUDENTS OF STRUCTURAL ENGINEERING هندسة الإنشاءات-لائحة قديمة

COURSE TITLE: DESIGN OF REINFORCED CONCRETE STRUCTURES (2) a			COURSE CODE: CS 3102
DATE: January - 2011	TERM: FIRST	TOTAL ASSESSMENT MARKS: 70	TIME ALLOWED: 3 hours

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

Problem # One (20Marks)

TRY ALL PROBLEMS

a. Proof the code equation $q_{tu} = M_{tu}/2Ao \times te$ for the nominal ultimate torsional shear stress. What is the meaning of the terms "Equivalent thin-walled tube" in torsional analysis? (4Marks)
b. Compare between shear and torsion with regard to: stress distribution, mode of failure, code requirements. (3Marks)
c. Why the primary torsion is more dangerous than the secondary torsion? How the primary torsion generated in beams carried a pre-cast slabs. (3Marks)
d. Draw the B.M.D, S.F.D and T.M.D for the beams shown in Fig.(1-a) under the given loads. (4Marks)
e. Check design the section shown in Fig. (1-b) subjected to the following actions: M_u= 400kN.m, Q_u= 400kN, M_{tu}= 150kN.m.
Materials: f_{cu}= 40MPa, f_y= 400MPa. (6Marks)

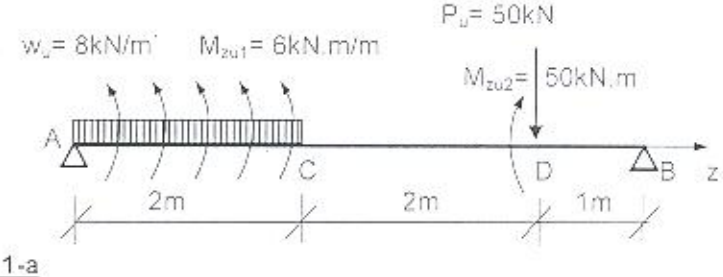


Fig. 1-a

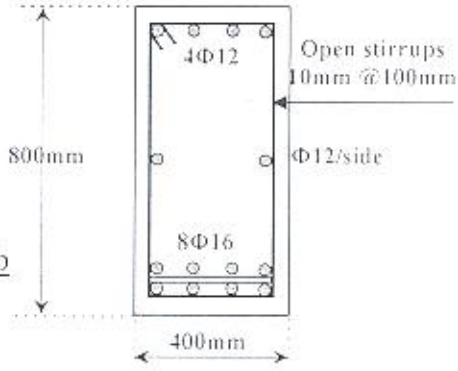


Fig. 1-b

Problem # Two (8Marks)

Fig. 2 shows layout of a first floor resting on eight columns with area of 8×9.6m. The panelled beams system is required to cover the floor using the beam modules shown in figure. The slab is subjected to L.L= 5kN/m^2 and cover= 1.5kN/m^2. The slab thickness is 100mm. It is required to make a complete design (design + drawing details) of the panelled beam By1 only. Materials: f_{cu}= 25MPa, f_y= 360MPa

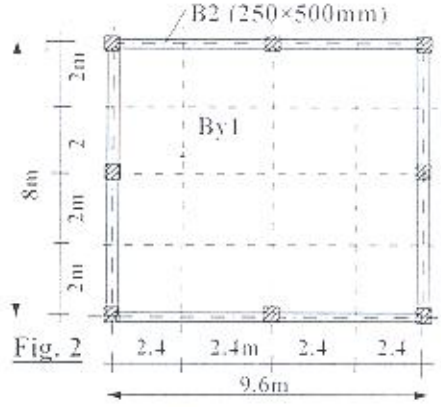


Fig. 2

Problem # Three (26Marks)

a. Explain the concept of using the hollow-block slab systems? (5Marks)
b. Compare between the solid slabs, hollow block slabs, waffle slabs and flat slabs, with regard to: load transfer, economy and advantages. (4Marks)
c. Fig. 3 shows a structural plan of roof ABCD. The roof is resting on the beams (AD and EF) and on the frames (EB and FC). The slab AEFD is dropped 100mm. The hollow-block slab system is required. The slabs is subjected to live load = 6kN/m^2 and flooring cover= 1.8kN/m^2. The cross section of all beams is 250×600mm. Materials: f_{cu}= 40MPa, f_y= 400MPa. It is required to carry out the following:
   i- Draw the B.M.D and S.F.D of critical strips. (6Marks)
   ii- Design the slabs at critical sections. Compute the width of the solid parts due to the S.F and B.M. (6Marks)
   iii- Draw on plan the reinforcement details and the arrangement of hollow blocks. (5Marks)

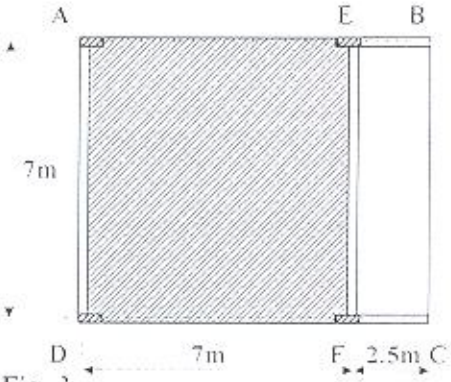


Fig. 3

P.T.O

Problem # Four (24Marks)

(A) Fig. (4-a) shows part of a plan of a typical floor of RC flat slab 36 × 40m consists of 25 panels each side 5 panels 7.2×8m each panel and slab thickness 0.25m (t_s= 250mm) without drop panel and with column head 1.50m×1.50m. The flat slab is resting on square columns 0.5mx0.5m. The marginal beams 0.3mx0.9m are used at the outer edges of the flat slab. The flat slab is subjected to a uniformly ultimate (factorized) load, Wu= 20kN/m^2. Materials: f_{cu}= 25MPa, f_y= 360MPa

Using the empirical method of the Egyptian code of practice ECP203-2007 for design of flat slab, it is required to carry out the following:

i- Determine the critical bending moment in column and field strips in long direction only. (5Marks)

ii- Design the critical sections due to bending moment in column strip and field strips for the intermediate panel C1 C2 C3 C4 only. (5Marks)

iii- Check one-way and two-way shear stresses for the interior column C1 considering the case of the total load only. (5Marks)

iv- Draw on plan the reinforcement details of the column and field strips in the intermediate panel C1 C2 C3 C4 only. (5Marks)

(B) What will be the punching shear stresses if a large opening exists at a distance 0.4m from the edge of column head of the interior column C1 in the previous problem, as shown in Fig. (4-b), and considering the case of total load only? (4Marks)

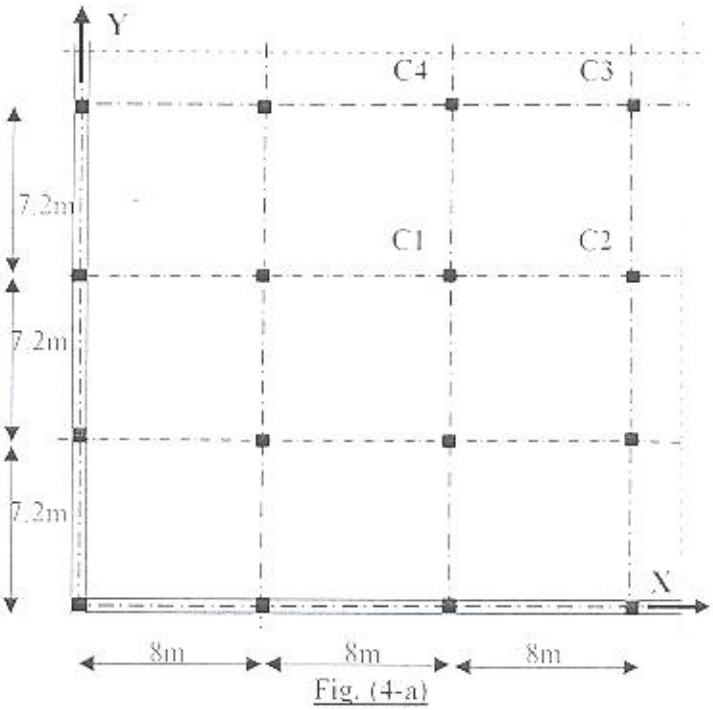


Fig. (4-a)

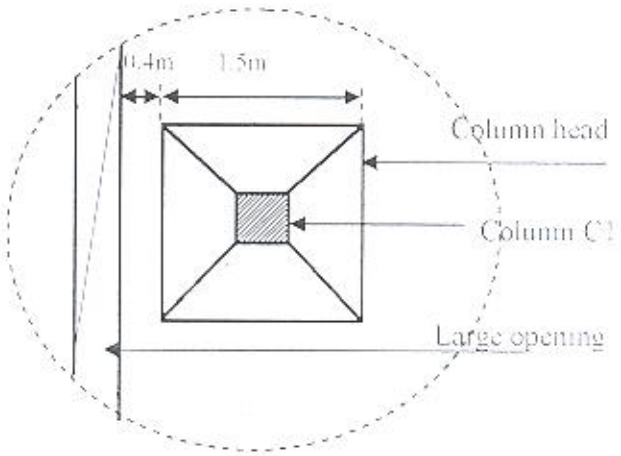


Fig. (4-b). Internal column C1 with large opening at 0.4m from the edge of the column head

All the Best

Prof. Dr. Mohamed Kasem Prof. Dr. Tarek El-Shafiey

Tanta University

Department: Structural Engineering
Total Marks: 90 Marks

Faculty of Engineering

Course Title: Structure Analysis (3) Course Code: CS3101 Year: Third Year (هندسة الانشاءات – لائحة قديمة)
Date: January, 2011 (First term) Allowed time: 3 hrs No. of Pages: (2)

Remarks: (**a** .answer the following questions. - **b.** assume any missing data.)

1- Problem (1) 16 Marks:

Using the force method, draw the B.M.D. for the given frame of constant I shown in **Fig. (1)**.

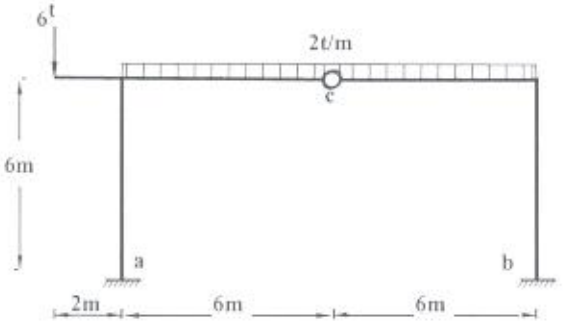


Fig. 1

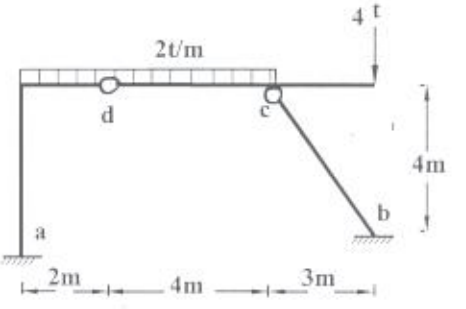


Fig. 2

2- Problem (2) 16 Marks:

Using the force method, draw the B.M.D. for the given frame of constant I shown in **Fig. (2)**.

3- Problem (3) 20 Marks:

Using the force method, draw the B.M.D. for the given frame of constant I which hinged at **a** and roller at **b** shown in **Fig. (3)**.

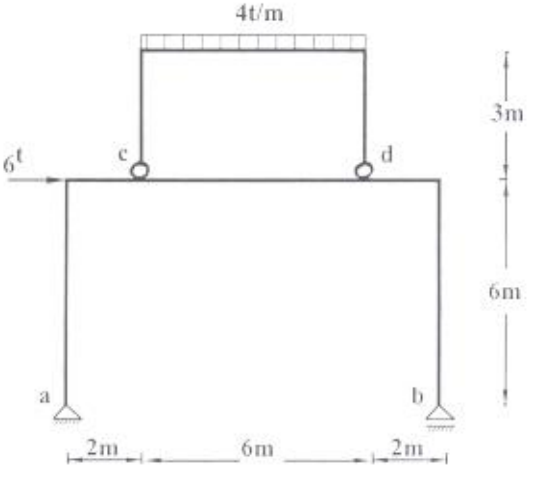


Fig. 3

P.T.O.

4- Problem (4) 16 Marks:

Using the slope-deflection method, draw the B.M.D. for the given frame of variable I shown in **Fig.(4)**.

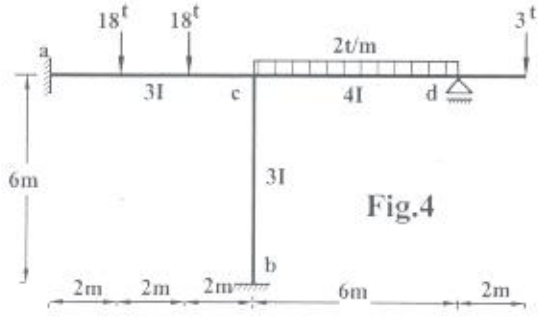


Fig.4

5- Problem (5) 16 Marks:

Using the slope-deflection method, draw the B.M.D. for the given frame of constant I shown in **Fig.(5)**.

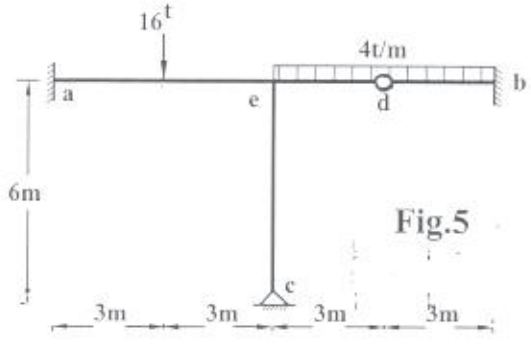


Fig.5

6- Problem (6) 16 Marks:

Using the moment distribution method, draw the B.M.D. for the given frame of variable I shown in **Fig. (6)**.

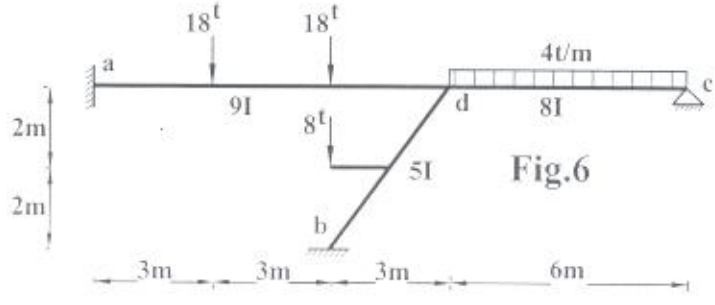


Fig.6

With the best wishes

Course Examination Committee

Prof. Dr. Mohamed A. Kasem & Assist. Prof. Tarek Mohamady Khalifa

Dept.: Structural Engrg.	**Faculty:** Engineering	**University** : Tanta
Time allowed: ٣ hr. **Date:** January 20١١	**Course:** Design of steel structures (a)	**Course code:** CSE3124

Note:

- It is allowed to use any tables or Egyptian Code of Practice books.
- Any missing data may be reasonably assumed.
- Attempt all questions. Max. Credit 100 % only.
- Number of examination pages: (4).

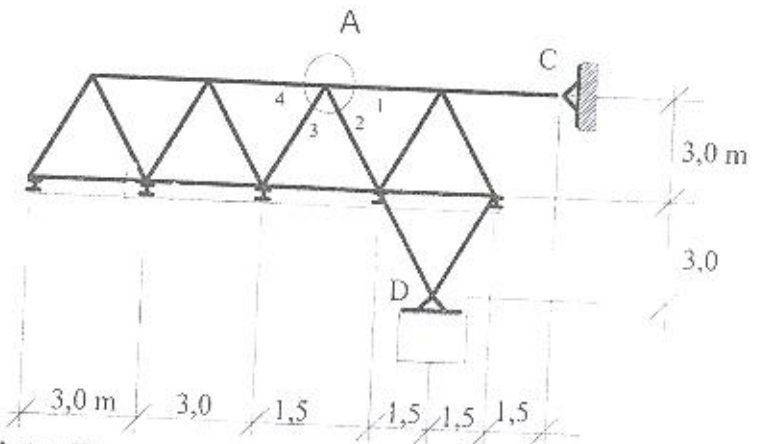
Question 1:

(25 %)

The steel skeleton of a vehicles-shed is built up of trusses type shown below. The system shown is **two-hinged truss** at points C and D.
Given the following data, answer the required questions.

Data:

- Spacing between trusses = 4.0 m
- Own weight of steel structure = 30 kg/m² of covered area.
- Live load = 60 kg/m²
- Weight of cover = 20 kg/m²
- **Neglect the effect of wind pressure.**
- Use steel grade **St37.**



Note: The cover is fixed at the bottom chord

Required:

1) Draw to sketch different views showing the arrangements of bracing system. The length of the covered area is 20.0 m. (10%)
2) Calculate the design forces in marked members at joint A. (5%)
3) Design an intermediate purlin as rolled steel section. (10%)

Question 2:

(30 %)

Table (1) shows data given for truss members. By Using **St. 52**:

a- It is required to design these separate members (consider their connections as welded ones).

b- Calculate the required welded lengths.

Table (1)

Member	F_u [t]	L [m]	L_{bx} [m]	L_{by} [m]	Type
1	+20	5	-	-	Top chord
2	-15	5	5	2.5	Top chord, Unequal angles
3	+30	4	-	-	Bottom chord
4	0	6	-	-	Diagonal member
5	±12	4	4	4	Bottom chord

Question 3:

(12 %)

Fig. (2) shows the statical system of a part of an industrial building. According to the Egyptian Code of Practice, compute the effective buckling lengths for columns 1-2, 2-3, 4-5, 6-7 and 7-8.

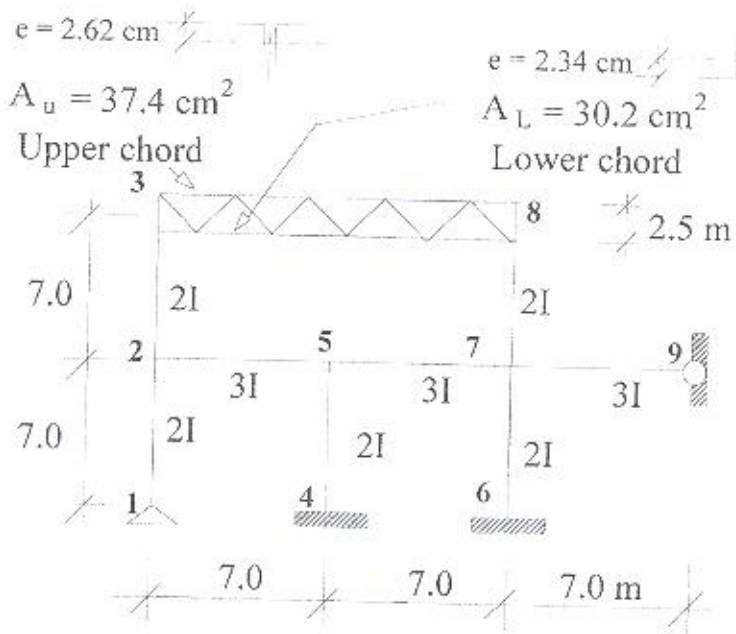


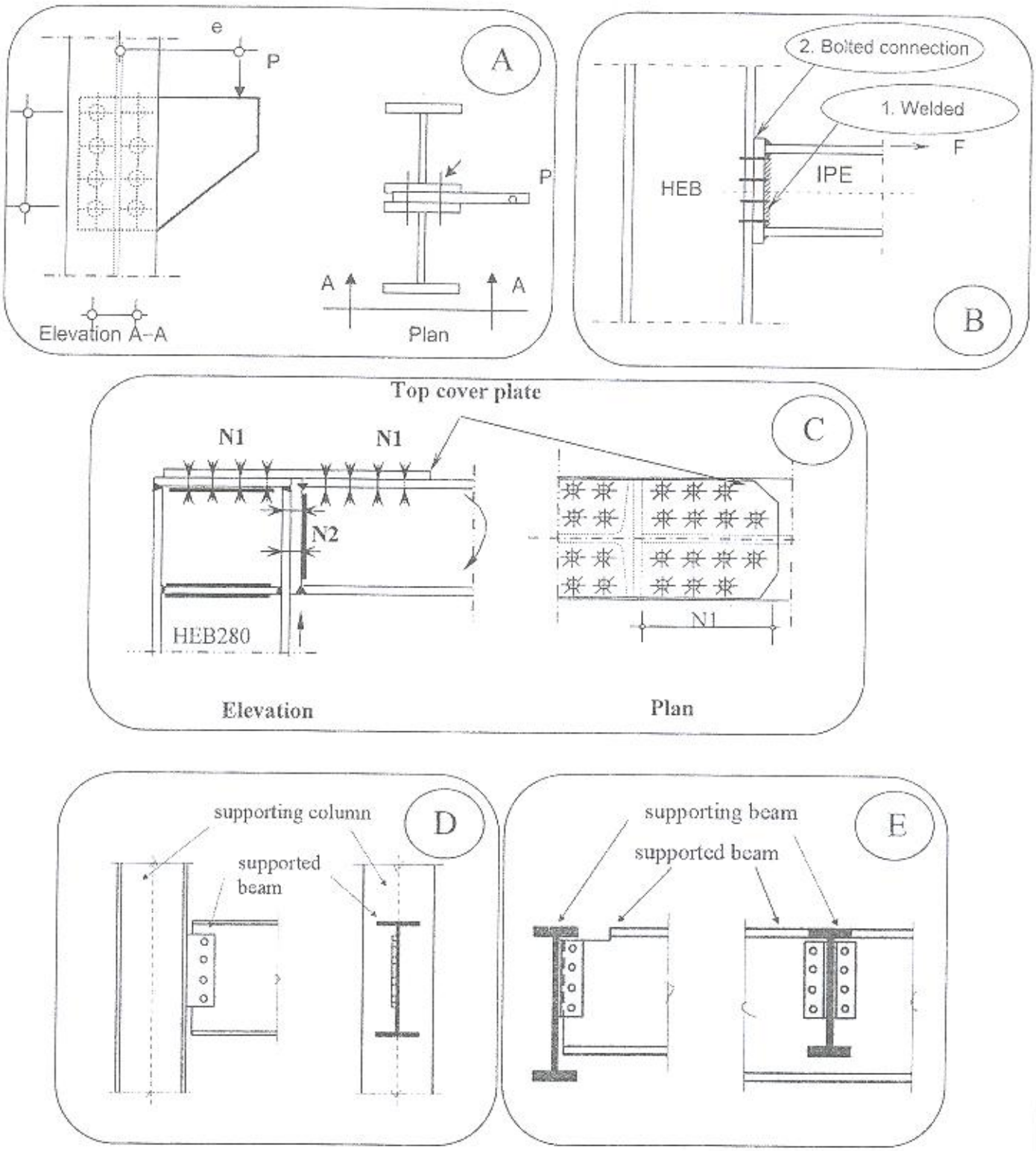
Fig. (٢)

$I = 4000\ cm^4$

Question 4:

(25 %)

Describe, **with net sketches and without any calculations**, the straining action of the following steel connections at Figures A, B, C, D and E:



Question 5: (20 %)

it is required to examine the following statements by choosing (√) or (×), ***giving the reason for each choice***.

1. The theoretical value of the factor (G) for the *fixed support* is 0.0, while its practical value in design equals to 1.0.
2. The effective buckling length factor (K) for columns in *sidesway prevented* rigid frames is always greater than 1.0.
3. Among the SIB, IPE and HEB, the best suitable cross-section to be used with columns and as beams subjected to double bending moments is the *SIB*.
4. Using LRFD method, the strength is considered to equal the nominal or theoretical strength of the member multiplied by a resistance factor, which is nominally *less* than unity.
5. The vertical and horizontal loads in the plane of the main system are carried by the *bracing systems*, while the lateral loads are carried by the *main system*.
6. A tension member with holes can possibly fail by *yielding* at the net section through holes.
7. For a *diagonal* zero member with a length of 3ms with a bolted connection (ϕ=16mm), the best design cross-section is one angle $75\times75\times8$.
8. The *unfactored yielding* strength of the tension member which composed of two back-to-back angles $100\times100\times10$, given that the steel is St44, is 107.52t.
9. The *minimum angle leg* that can be connected using the bolt M24 is $60\times60\times6$.
10. The maximum slenderness ratio (λ_{max}) for a *long* compression member made of St 37 which has a critical buckling stress (F_{cr}) of 0.497t/cm2 is 143.95.

Best wishes, Prof. Dr. Mohamed Dabaon and Exam. Committee

الامتحان قديم CS3104

Tanta University | Department: Structural Engineering | Faculty of Engineering

Total Marks: 85 Marks

Course Title: Soil Mechanics لائحة قديمة	Course Code: CS3104	Year: 3rd Civil Eng.
Date: 23 January 2011 (First term)	Allowed time: 3 hrs	No. of Pages: (4)

- Assume any missing data
- Answers should be supported by sketches

Question Number (1) *(17 Marks)*

a) What is the main goal of soil exploration? (3 Marks)

b) What are the different steps of a soil exploration program? (3 Marks)

c) What are the methods adopted for measuring the field density of soil. (5 Marks)

d) Discuss with clear sketches the penetration testing of the soil in the field, what are the applications of such tests in engineering practice. (6 Marks)

Question Number (2) *(17 Marks)*

a) What are the main differences between consolidation and compaction of soil? (2 Marks)

b) State the main differences between the standard and the modified proctor tests. (2 Marks)

c) Summarize with clear sketches some of the geotechnical applications in which the surface compaction can be used. (2 marks)

d) Describe briefly using clear sketches how to assess the maximum dry density of compacted sand in the field using the sand cone device. (2 Marks)

e) The following results were obtained from a Proctor test: (6 Marks)

Wc %	4	5	6	8	10	12
γ t/m^3	1.77	1.79	1.88	1.95	1.91	1.85

It is required to:

- Plot the moisture-dry density curve, and then determine the optimum moisture content "O.M.C" if the specific gravity of the tested soil equals 2.65.
- Comment on the curve behaviour using the interpretation of the compaction theory.
- On the same axes, plot the curves of 80% and 90% degrees of saturation.

f) For the previous problem predict the expected field density of a sub-base layer of the same soil if the supplied field water content is 18% and the required compaction efficiency must not be less than 96%. (3 Marks)

Question Number (3) *(17 Marks)*

a) The following Figure (1) shows two cases of retaining walls that are retaining approach fill of a bridge. The approach fill is sand with γ = 2.0 t/m^3 and ϕ' of 33^0. Calculate the earth pressures distributions on vertical line AB in cases 1 and 2. (5 Marks)

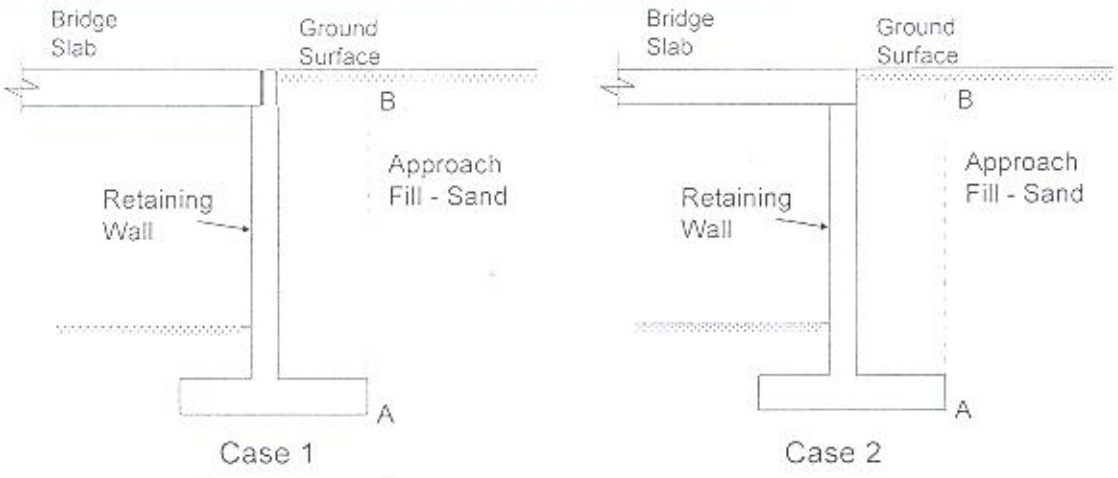


Figure (1)

b) For the given retaining wall channel (Figure 1), **calculate**: (12 Marks)

(I) Factor of Safety against sliding in case of the channel is empty (5 Marks)
(II) Factor of safety against overturning in case the channel is full of water (5 Marks)
(III) The stress under the base in case the channel is full of water. (2 Marks)

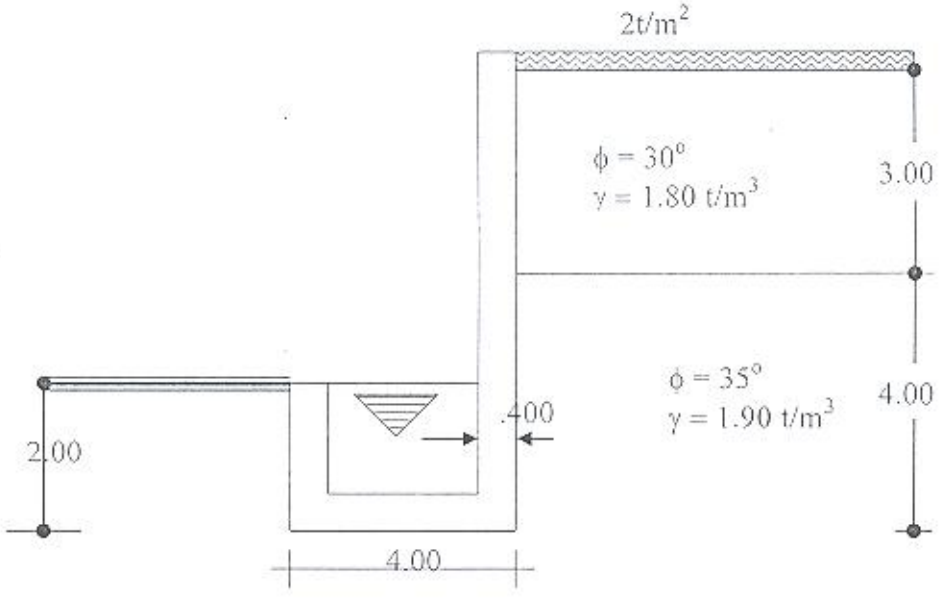


Figure (2)

Question Number (4) *(17 Marks)*

a) An infinite slope exists at an angle "β" to the horizontal in a clay soil having a unit weight "γ" and effective strength parameters "c' " and "φ' ". Derive an expression for the factor of safety against failure along a shallow slip plane parallel to the ground surface. (3 Marks)

b) Re-derive the previous expression for the case if a ground water surface exists at the slope surface. (3 Marks)

c) Use the expression derived in (a) to find the maximum stable slope where $c' = 0$, $\varphi' = 20°$ and $\gamma = 19\ kN/m^3$. (3 Marks)

d) The factor of safety of the clay cutting shown in Figure (3) is considered inadequate. Hence, in order to increase it, the cross section is to be altered by removing part of the soil as shown. Determine the percentage increase in the factor of safety. (Neglect the tension crack zone). (5 Marks)

e) If the slope described in (d) is still unsafe, show, using clear sketches, how to protect this slope against failure. (3 Marks)

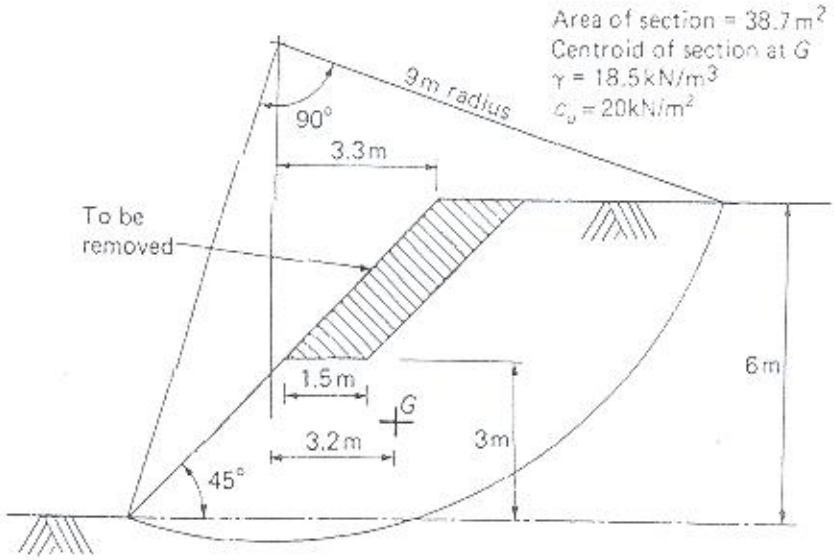


Figure (3)

Question Number (5) *(17 Marks)*

a) Explain the effect of the ground water table on bearing capacity of soil in cases of (i) sand (ii) clay (3 Marks)

b) Explain using sketches the concept of floating foundations (4 Marks)

c) Consider the site shown in Figure (4). The soil in the site is characterized as sand with unit weight of 18 kN/m^3. The groundwater level is at 1.5 m below ground surface. A footing load test is carried out on Footing A (1mx1m) at the ground surface. Based on the test, the ultimate load on Footing A is 290 kN. Calculate the maximum allowable load (P) in kN on Footing B (2.5mx2.5m) in the same site using factor of safety of 3. (10 Marks)

P.T.O.

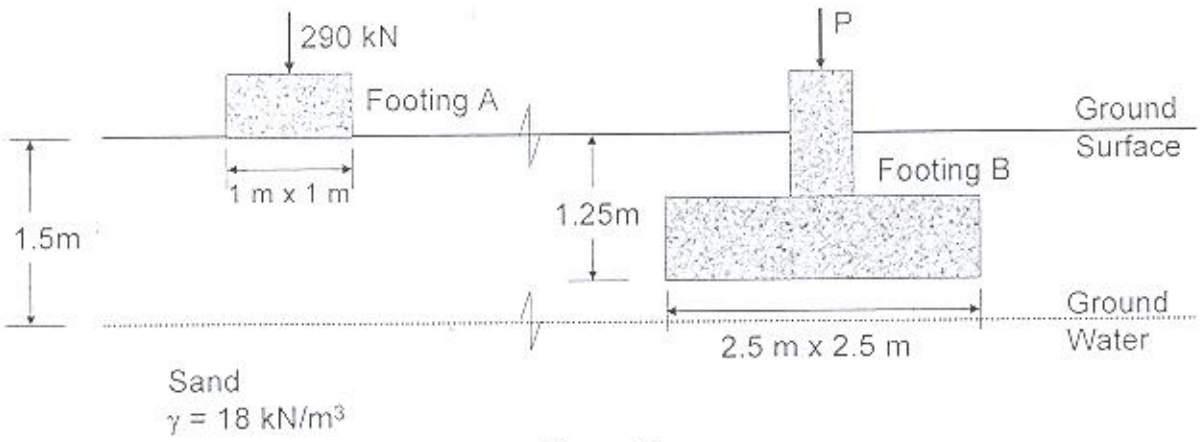


Figure (4)

ϕ °	N_c	N_q	N_γ		ϕ °	N_c	N_q	N_γ
0	5.0	1.0			27.5	25.0	14.0	7.0
5	6.5	1.5			30	30.0	18.0	10.0
10	8.5	2.5	0.5		32.5	37.0	25.0	15.0
15	11.0	4.0	1.0		35	46.0	33.0	23.0
20	15.0	6.5	2.0		37.5	58.0	46.0	34.0
22.5	17.5	8.0	3.0		40	75.0	64.0	53.0
25	20.5	10.5	4.5		42.5	99.0	92.0	83.0

Bearing Capacity Factors from the Egyptian Code of Practice – Shallow Foundations

Best Wishes.....

Course Examination Committee

Prof. Dr. Mohamed A. Sakr *Ass. Prof. Dr. Marawan M. Shahien*

Dr. Ahmed Farouk A. E. K.

Tanta University

Department: Structural of Engineering
Steel Structures

Faculty of Engineering

Course Title: **Theory of plates and shells**	Course Code: **CSE3130**	Year: 3rd year structures
Date: **25/1/ 2011 (First term)**	**Term Exam**	**Three hours**

Answer All questions *(Assume any missing data and use neat sketches)*:

Q1)

a) What are the main assumptions of small-deflection theory?. Explain briefly each assumption?

b) Write down the strain curvature relationships of plate elements?

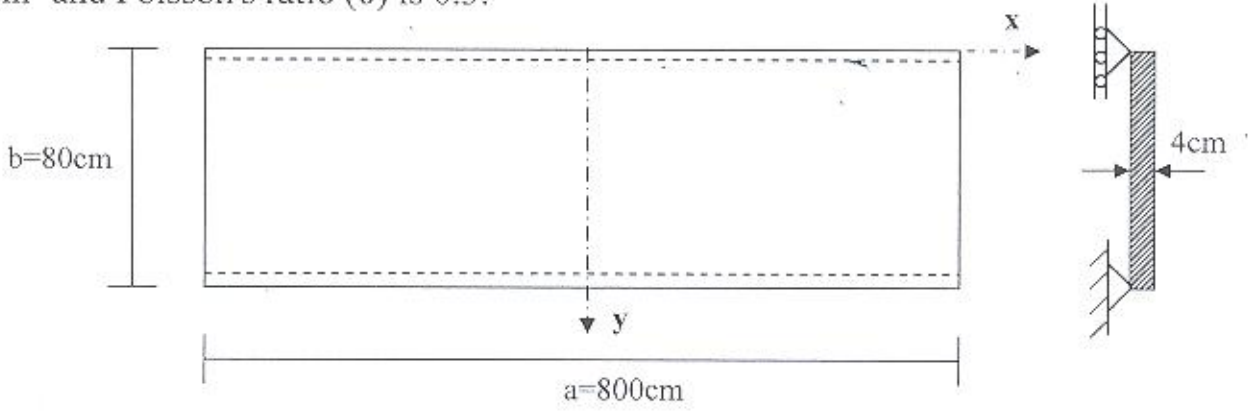
c) Write down the relationships used to calculate the stresses ($б_x$, $б_y$ and τ_{xy}) in plate elements?

Q2)

a) What are the main stress resultants acting on plate elements? Draw a sketch showing these stress resultants?

b) Derive the equations used to calculate the stress resultants acting on a plate element using the stresses ($б_x$, $б_y$ and τ_{xy})?

Q3) Determine the deflection, maximum deflection and maximum bending stresses ($б_x$, $б_y$) in the shown simply supported plate along the long directions only. The plate is subjected to uniform a sign curve pressure $p = p_o \sin(\pi y/b)$, where p_o is the peak stress at mid-plate that is equal to 1.2t/cm^2. Assume that the plate is narrow (a>>>b). The plate Young's modulus (E) is 2000t/cm^2 and Poisson's ratio (υ) is 0.3.



Q4) Using the approximate solutions of rectangular plates, determine the maximum uniformly distributed load that can be carried by a fully fixed-ended rectangular plate (2m×3m). The plate has a Young's modulus (E) of 2000t/cm^2, Poisson's ratio (υ) is 0.3, yield stress ($б_y$) of 3.6 t/cm^2 and has a thickness of 5cm. Determine the maximum deflection corresponding to that load?

Given: $M_{bc}=(-1/12)pb^2/(1+\alpha^4)$, $M_{bc}=(1/8)pb^2/(3+4\alpha^4)$, $M_{ac}=(-1/24)pb^2$, $M_{ac}= 0.009pb^2(1+2\alpha^2+\alpha^4)$ and $w_{max}=0.032(1-\upsilon^2)pb^4/[(1+\alpha^4)(Et^3)]$