Tanta University
Faculty of Engineering
Public Works Engineering Dept.

First Term Exam
Jan. 2022
Time: 3 hrs.

4th Year Civil Engineering
Sanitary Engineering
CPW4105

**Answer the following questions and assume any missing data**
**Maximum marks :85** **No. of pages: 2** **Date: 30 Jan. 2020**

## Question (1)

**(17 points)**

1-a) - What are intakes ? Mention the different type of intake structure, state the cases of using each type.
- Draw a flow diagram in surface water purification plant and discuss the purpose of each step of treatment. **(4 points)**

1-b) ) A city has population of 135,000 and 95,000 for the years 2020 and 2006 respectively. The water source to the city is a navigable canal with width about 40 m , H.W.L. at (9.50), L.W.L. at (8.00), Bed level at (3.50), G.L. at (10.50), Road level at (11.50), The canal about 4000 meters away from the city, and water level in the rapid mixing tank at (25.00). The water treatment plant collection works for the city is designed to serve the year 2070 Considering arithmetic growth rate of increase and water consumption of 220 L/cap./day. It is required to :

a- Determine the future population and average discharge at year 2070. **(4 marks)**

b- Choose and design a suitable type of intake and delivery pipes taking into consideration :
- Pumps works 16 hrs at a day
- Number of delivery pipes = 1 , with velocity 1.67 m/s **(7marks)**

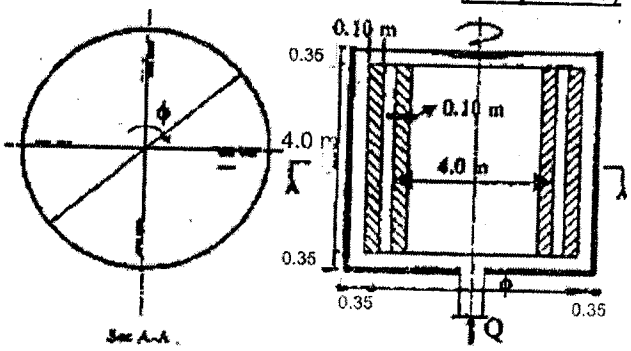
c- Draw a neat sketch showing the main elements of the intake **(2 points)**

## Question (2)

**(10 points)**

2-a) Write short notes on the following :- Jar test. Tapered flocculation. G-value in rapid and slow mixing tanks. **(4 points)**

2-b) A flocculator basin illustrated in figure is rotated through water with velocity of outer paddles, $V_p$= 0.5 m/s. How much power is dissipated into water, if the flow is 8,600 $m^3$/d. Determine the G value , if the retention time is 30 min. **(6 points)**




## Question (3)

**(16 points)**

3-a) - Name the various chemical coagulants which are commonly used in coagulation process. **(2 points)**

3-b) Design a horizontal flow baffled channel flocculator which serve a rectangular sedimentation tank if the common wall shared between flocculator and sedimentation tank have 10.0 m width, with design flow of 55,000 $m^3$/d. The flocculation basin is to be divided into three sections of equal volume, each section having constant G of 45, 35, 25 $S^{-1}$ respectively. The total flocculation time is 42 min. and the baffles roughness coefficient of 0.3, , with a depth of 2.0 m is considered. **(7 marks)**

3-c) For the discharge in (b), and with alum dose is 25 mg/l, it is required to determine :
- Amount of alum added per month in tons
- The capacity and dimension of square cross section concentrated alum solution tanks if (d = 2.25 m)
- The dimension and power required for circular cross section rapid mixing tank if ( d = 2.75 m, T = 60 sec, G =700 $sec^{-1}$, and $\mu = 1.02 \times 10^{-3}$ N.S/$m^3$ ) **(7 marks)**

## Question (4)

**(17 points)**

4-a) Discuss briefly the following:- **(5 marks)**
- The purposes of ground storage tank.
- The operation steps of rapid sand filter. Draw sectional elevation of the filter showing all pipe and valves.

4-b) A city with population of 205,000 capita and average daily water consumption 220 L/cap./day. It is required to determine the capacity of the ground and elevated storage tanks, if the working hours per day of the plant are 16 hours, (6 AM – 10 PM). The consumption characteristic data during the day are given as follows:- **(8marks)**

| Time | Lit./2hr | Time | Lit./2hr |
|---|---|---|---|
| 12 M.N - 2 A.M | 3 | 12 N - 2 P.M | 38 |
| 2 - 4 | 5 | 2 - 4 | 34 |
| 4 - 6 | 8 | 4 - 6 | 28 |
| 6 - 8 | 16 | 6 - 8 | 12 |
| 8 - 10 | 32 | 8 - 10 | 8 |
| 10 - 12 N | 40 | 10 - 12 M.N | 6 |

4-c) A rapid sand filter consist of 7 filter bed $6 \times 8$ m. After filtering 50,000 $m^3$ in 24 hr period, the filter is backwashed at a rate of washing = 6 the average rate of filtration for 12 min. Calculate the average rate of filtration, the quantity and percentage of treated water used in washing. **(4 marks)**

## Question (5) **(18 points)**

5-a) - Draw a flow diagram for the primary treatment units briefly discussing the functions of each unit. **(4 points)**

5-b) Design and checks all dimensions of the following treatment units in wastewater treatment plant for a city of average flow 65,000 $m^3/d$ and design maximum flow 125,000 $m^3/d$.

**a.** The inlet(deceleration) chamber. ( T = 30 sec, V = 0.8 m/s at maximum flow) **(3 marks)**

b. The approach channel.( V = 0.9 m/s at average flow ) **(3 marks)**

**c.** The grit removal tanks designed to remove particles with a diameter of 0.2 mm with settling velocity in grit chamber 0.022 m/s. A flow through velocity of 0.3 m/s will be maintained by a proportional weir, d = 1.5 W. **(5 marks)**

d. The primary sedimentation tank to remove approximately 65%, 35% of suspended solids and BOD respectively, with retention period of 2.5 hrs. ( over flow rate = 0.0004 m/s at max. flow) **(3 points)**

## Question (6) **(14 points)**

6-a) - Find the recirculation ratio in the activated sludge process.

- What are the difference between Completely mixed and Extended aeration according to the component. **(5 points)**

6-b) Design a conventional Activated sludge system to to treat a waste flow of 16,000 $m^3/d$ of municipal wastewater. With $BOD_5$ of 380 mg/l before primary treatment and it is desired to have not more than 20 mg/l of soluble $BOD_5$ in the effluent. A completely mixed reactor is to be used, and pilot plant analysis has established the following kinetic values Y= 0.6 kg/kg, $K_d$=0.05 $d^{-1}$. Assume a MLSS concentration of 2500 mg/l and an underflow concentration of 12,000 mg/l from secondary clarifier and $\Theta_c$=10 day. Its required to determine:- Volume of the reactor – Volume of solids to be wasted daily – Mass of solids wasted – Sludge recycle ratio. – F/M ratio, volumetric loading. **(8 marks)**

- It is also required to design the secondary clarifiers required (over flow rate = 24m/d). **(2 marks)**

***End of questions.....***

**Hints:-**

$V = 0.355\ C\ D^{.63}\ S^{0.54}$ $HP = \gamma\ Q\ H_t / 75\ \eta_1\eta_2$ $\eta_1\eta_2 = 0.7$ $P = G^2\mu V$ $\rho_w = 999.1\ kg/m^3$

$P = C_d\ \rho_w\ A_p\ V_p^3/2$ $\mu = 1.02 \times 10^{-3}\ N.s/m^2$ $V = \dfrac{QY\theta_c(S_o - S_e)}{X(1 + K_d\theta_c)}$ $P = G^2\mu V$

$$Q_R = \frac{Q\,X - Q_W\,X_U}{X_U - X} \qquad n = \left\{\left(\frac{2\,\mu\,T}{\rho(1.44 + f)}\right)\left(\frac{H\,L\,G}{Q}\right)^2\right\}^{\frac{1}{3}}$$

Good luck and best regards, **Dr/ Abdelaziz El-sayed**

Tanta University

Civil Engineering Department

Faculty of Engineering

| | | |
|---|---|---|
| **Course Title: Geodesy and Satellite Surveying** | **Academic Year 2021/2022**<br>**First Term Exam** | **Course Code: CPW4106** |
| **Year: Fourth** | | **Total Marks: 70 Marks** |
| **Date: 26- January -2022** | **No. of Pages (3)** | **Allowed time: 3 hrs** |
| **Remarks:** (answer all the following questions, and assume any missing data)<br>(answer should be supported by sketches) | | |

## السؤال الأول (٢٠ درجة)

**أ- اشرح ما يلي مع التوضيح بالرسومات الدقيقة والمعادلات كلما أمكن ذلك:** **(١٢ درجة)**

١. الفرق بين نظام GPS ونظام GNSS وأيهما تفضل ولماذا؟

٢. خطأ ساعة المستقبل وتأثيره على دقة تحديد إحداثيات النقطة (اكتفي برسم ٣ أقمار صناعية فقط).

٣. طريقة الرصد المتحرك باللاسلكي RTK، مع التوضيح باختصار لماذا تعتبر أكثر طرق القياس شيوعا.

٤. خطأ التوزيع الهندسي للأقمار الصناعية مع رسم حالة توزيع جيد وحالة توزيع سيء.

**ب- المطلوب توقيع نقطة إحداثيات مرجعية عالية الدقة في الموقع، اجب عن الاتي:** **(٨ درجات)**

١. اشرح خطوات توقيع النقطة باستخدام جهاز GNSS ثنائي التردد مع ذكر عدد الأقمار الصناعية، زمن الرصد، ومعامل دقة الأقمار DOP اللازمين للحصول على دقة عالية للإحداثيات (١ سم أو اقل). **(٦ درجات)**

٢. في حالة أن المتاح للاستخدام فقط كان مستقبل GPS أحادي التردد، وضح باختصار كيف يمكن الوصول لنفس الدقة العالية والتغلب على الأخطاء الناتجة عن مرور الموجات في الغلاف الجوي؟ **(٢ درجات)**

## السؤال الثاني (١٥ درجة)

أ- اذكر مفهوم جيوديسيا الأقمار الصناعية مع بيان الأقسام المختلفة للمساحة الجيوديسية وأهمية كل قسم. **(٣ درجات)**

ب- وضح بالرسم فقط نصف قطر الأنحناء في مستوي الزوال ونصف قطر الأنحناء في الاتجاه العمودي علي مستوي الزوال عند نقطة علي سطح الالبسويد. **(٣ درجات)**

ت- اذكر أهم خصائص إسقاط ميركاتور المستعرض مع توضيح طريقة تقسيم سطح الأرض في ميركاتور المستعرض العالمي (UTM). **(٣ درجات)**

ث- إذا علمت أن الإحداثيات الكارتيزية للنقطة (ب) هي كما يلي:

الإحداثي (X) = ٤٧٦٣,٦٠٥ كم

الإحداثي (Y) = -٢٨٠٥,٩٧٨ كم

الإحداثي (Z) = ٣١٧٠,٥٧٣ كم

أوجد الإحداثيات الجغرافية للنقطة (ب) علماً بان الألبسويد المرجعي هو WGS 84
(نصف طول المحور الأكبر =٦٣٧٨١٣٧ متر و نسبة الانبعاج =١/٢٩٨,٢٥٧). **(٦ درجات)**

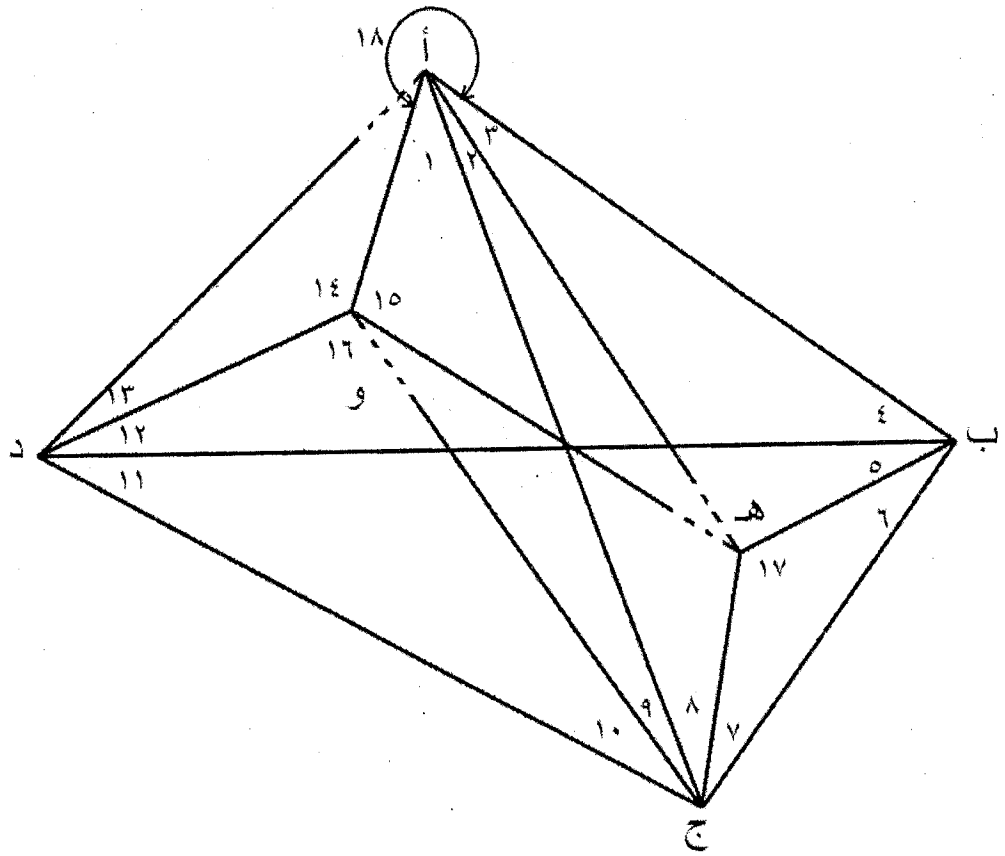
## السؤال الثالث (١٥ درجة)

أ- من الاعتبارات التي يجب مراعاتها عند اختيار نقط رؤوس شبكة المثلثات الجيوديسية تجنب بناء الأبراج وأن تكون الزوايا بين أضلاع الشبكة بين ٣٠° و ١٥٠°. اذكر السبب. **(٣ درجات)**

ب- حدد مع التوضيح بالرسم الأنواع المختلفة للشبكات الجيوديسية. **(٢ درجات)**

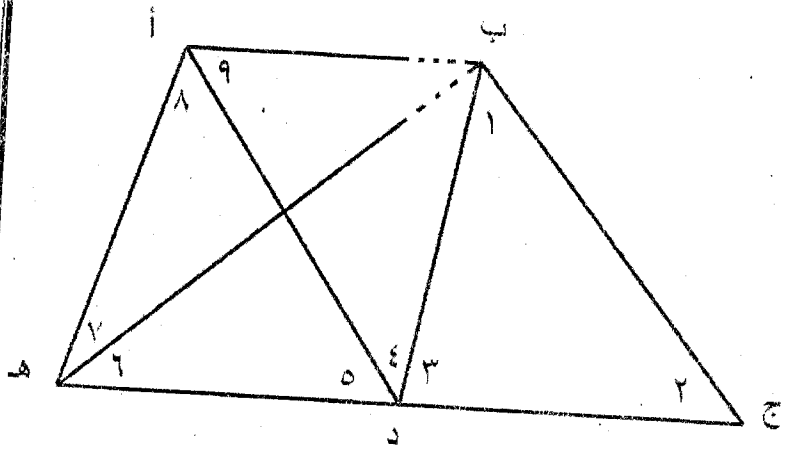
ت- ما المقصود بالضبط الشكلي لشبكات المثلثات الجيوديسية؟ **(٢ درجات)**

ث- عين عدد ونوع الاشتراطات الهندسية الداخلية لشبكة المثلثات الجيوديسية الموضحة بالشكل مع كتابة جميع معادلات الشروط المثلثية والمحلية ومعادلة شرط ضلعي واحد. **(٨ درجات)**



## السؤال الرابع (٢٠ درجة)

يوضح الشكل جزء من شبكة مثلثات جيوديسية عبارة عن شكل رباعي ذو مركز والمطلوب ضبط الزوايا المرصودة وايجاد قيمها المصححة بطريقة المعادلات الشرطية إذا علم أن قيم الزوايا المرصودة كالتالي:




| رقم الزاوية | قيمة الزاوية | | |
|---|---|---|---|
| | " | ' | ° |
| ١ | ٤٥ | ٢٤ | ٦٢ |
| ٢ | ١٠ | ١٠ | ٥٩ |
| ٣ | ١٥ | ٢٥ | ٥٨ |
| ٤ | ٣٩ | ٤٤ | ٦٨ |
| ٥ | ٤١ | ٠١ | ٣٩ |
| ٦ | ٤١ | ٥٣ | ٣٠ |
| ٧ | ٣١ | ٠٢ | ٦٨ |
| ٨ | ٢٧ | ٠٢ | ٤٢ |
| ٩ | ٥٦ | ١٥ | ٣١ |

انتهت الأسئلة

**مع تمنياتنا بالتوفيق والنجاح**

TANTA UNIVERSITY
FACULTY OF ENGINEERING
DEPARTMENT OF STRUCTURAL ENGINEERING
FINAL EXAM – FIRST SEMESTER 2021/2022
(STUDENTS OF STRUCTURAL ENGINEERING)

| COURSE TITLE: DESIGN OF REINFORCED CONCRETE STRUCTURES (3)A | | CORSE CODE: CSE 4137 |
|---|---|---|
| DATE: WEDNESDAY 12/1/ 2022 | FINAL TERM EXAM | TIME ALLOWED: 4 HOURS |

**Notes:** Systematic arrangement of calculations and neat sketches are essential. Any missing data should be reasonably assumed and unless otherwise specified, you may use; concrete characteristic strength $f_{cu} = 32$ N/mm$^2$. grade of reinforcing steel is 400/600 N/mm$^2$ and for shear reinforcement is 240/350 N/mm$^2$, low relaxation-stress relieved strands with $f_{py}$=1400 MPa, $f_{pu}$=1700 MPa.

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## Problem (1) (15%):

**(a) Choose the correct answer for the following questions then shade the selected number in the electronic correction sheet in the specified place**

1. A material is ..... if, when it subjected to stress, it breaks without significant plastic deformation.
   *(a) brittle (b) plastic (c) elastic (d) ductile (e) limited ductile*
2. According to ECP, the seismic load-resistant structural system must ....
   *(a) have sufficient ductility (b) have Limited ductility (c) be elastic (d) answers a &b (e) answers a &c*
3. All the following are source of later loads except ....
   *(a) Wind loads (b) Earthquake loads (c) Blast loading (d) lateral shock of cranes (e) Permanent loads*
4. One of the basic design requirements when designing the building to resist earthquakes is to reduce the cracks of the structures after the forces exceeds the value of the design forces with:
   *(a) 5% (b) 10% (c) 15% (d) 20% (e) 25% •*
5. Phenomenon cause soil to behave like a liquid and this occurs when a cohesionless saturated or partially saturated soil substantially loses strength and stiffness in response to an earthquake.
   *(a) Soil liquefaction (b) Soil erosion (c) Soil contamination (d) soil effervescence (e) soil dryness*
6. The value of the transmitted load from earth to the structures due to earthquakes can be reduced by using
   *(a) shear link (b) dampers (c) base isolation (d) answers a &b (e) answers b &c*
7. All of the following factors affect wind load except
   *(a) building height (b) building shape (c) Wind speed (d) region terrain (e) foundation type*
8. ..... is the point on the Earth's surface directly above a hypocenter. (hypocenter is the point where an earthquake or an underground explosion originate)
   *(a) The epicenter (b) the focus (c) surface trace (d) answers a &b (e) answers b &c*
9. ..... is a surface wave having a horizontal motion that is transverse or perpendicular to the direction the wave is traveling
   *(a) Love wave (b) Rayleigh wave (c) P wave (d) S wave (e) N wave*
10. All of the following factors affect earthquake load except
    *(a) building rigidity (b) soil type (c) building mass (d) region humidity (e) foundation type*
11. A structural system is .....when the designed shear strength of the walls is greater than half the shear strength of all structural systems at the foundations level.
    *(a) bi-equivalent to walls (b) bi-equivalent to frames (c) Frames (d) wall (e) answers c &d*
12. The meridian force at crown in case of conical shell with central support is equal to ...
    *(a) zreo (b) ∞ (c) No (d) answers a &c (e) support load*
13. Long Cylindrical shell has .....
    *(a) L/b≤2 (b) L/a≤3 (c) L/b›2 (d) L/a≤5*
14. The arch action reinforcement works as .....
    *(a) Shear RFT (b) Torsion RFT (c) Flexural RFT (d) a& c*
15. The buckling of the cylindrical shell is safe when its compressive stress is less than.....
    *(a) 6.5/(1+a/200t) (b) 6.5/(1+b/200t) (c) 0.75*6.5/(1+a/200t) (d) 0.75*6.5/(1+b/200t)*
16. Membrane theory can be used to analyze all the following RC structures except:
    *(a) Dome (b) Short cylindrical shell (c) Long cylindrical shell (d) Cone*
17. The initial pre-stressing force is transferred to concrete for pretensioned prestressed beam by
    *(a) Shear stress (b) Bond (c) Flexure (d) Friction*



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18. The deflection due to prestressing only at end of cantilever is expected to be:
    *(a) Upward (b) Downward (c) Zero (d) a or b*

**(b) Determine whether the following statements are true or false then shade the selected choice in the electronic correction sheet in the specified place**

1. In case of resisting both wind and earthquake loads, the resisting system must be stiff and elastic.
2. The buildings are classified according to their importance to ensure the functioning of vital facilities during earthquakes.
3. The use of hanging passive mass or use water tanks on the top of the buildings can reduce the deformations caused by the wind.
4. According to Egyptian Code for Loads, it is clear that the location of center of rigidity must be moved in all directions by ±0.5L (L is the dimension of the floor perpendicular to the direction of calculation) so that we get the largest force on each resisting elements.
5. Dimensions only determine if the shear walls are of limited ductility or of sufficient ductility, while in the case of framing system, there are requirements for reinforcement detailing in addition to dimensions.
6. Two adjacent walls are considered coupled shear wall system, if the earthquake moment acts on the walls together decreased by 25% of the earthquake moment acts before the presence of the coupling beam.
7. Coupling beam must be reinforced by using two packs of diagonal reinforcement if the thickness of the beam to its clear span ratio is less than 2.
8. To ensure that the structural elements resisting seismic loads have sufficient ductility, the structural elements are designed to withstand a design force 25% higher than the calculated seismic force.
9. There is no need for horizontal beams if the dome is a half-sphere.
10. The value of max torsional moment in ring beams located directly at supports.
11. The sign of ring forces in conical shells depends on the location of the supports.
12. The ring force at lower edge in case of half-sphere dome with central support is equal to zero.

## Problem (2) (15 %):

*Fig. 1* shows a multi-story residential building located in center of Tanta. The building consisted of ground floor with height 3.5 m and eight typical floors with height 3.00 m for each story. The foundation level is located at (-1.5) m from the road level, the foundation consisted of 0.5 m plain concrete raft and 1.0 m reinforced concrete raft (soil type D). The soil was characterized as 8.0 m normal clay over 15 m loose sand. The finishing level of the ground floor is located at +0.45 m from the road level. The average working dead load for the structural and nonstructural elements is 13 kN/m$^2$. Assume that the average working live load is 3 kN/m$^2$.

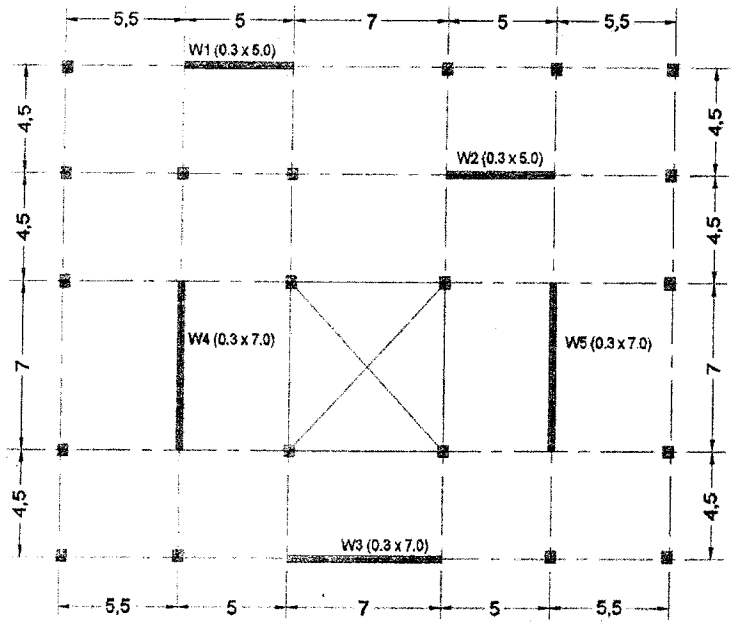


Fig. (1)

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You may use the simplified formula when calculating the earthquake moment. neglect the off-axis eccentricities, it is required to:

1. ***Classify*** the shear wall no. 5 according to Egyptian Code of Practice.
2. ***Calculate*** the total shear force due to wind load in x-direction.
3. ***Calculate*** the total overturning moment due to wind load in y-direction (moment around axis x-x) at the foundation level.
4. ***Locate*** the center of mass and center of rigidity then, ***calculate*** the design eccentricities.
5. ***Calculate*** the ultimate design shear force and moment acting on wall no. 1 and 5.
6. **Design** wall no. 1 to resist all straining actions then, ***draw*** the reinforcement details in cross section.

## Problem (3) (15 %):

1. ***Fig. 2*** shows a statical system of RC frame intended to be constructed with post-tensioned full pre-stressed technique. It is required to carry out the followings:
   a) ***Sketch*** the expected B.M.D for the acting distributed loads.
   b) ***Suggest*** the suitable cable profile.

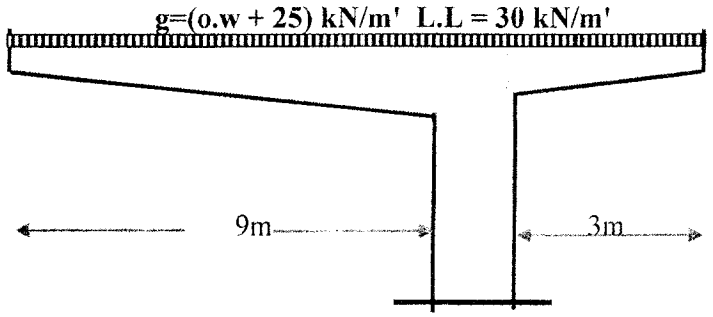


Fig. 2

2. For a simply supported pre-tensioned pre-stressed concrete beam of 21 m span having rectangular cross-section of 300 mm x 1000 mm with the cable profile as depicted in ***Fig. 3***, it is required to carry out the following:
   a) ***Draw*** the N.F.D and the B.M.D due to pre-stressing only.
   b) ***Calculate*** the equivalent loads due to pre-stressing only.
   c) ***Calculate*** the total deflection due to total loads and prestressing, knowing that Pi =1100 kN
   d) ***Check the stresses*** at all critical sections (full prestressing).

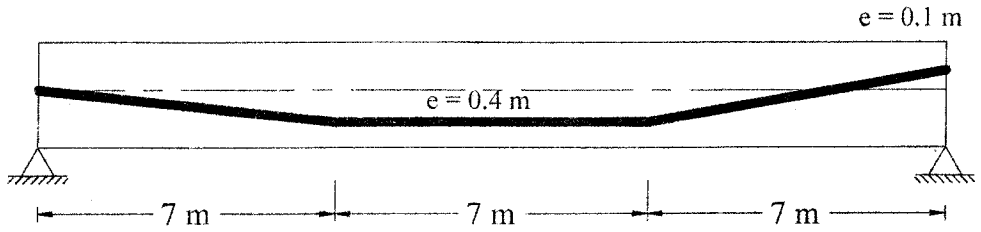


Fig. 3

## Problem (4) (20 %):

1. ***Fig. 4*** shows two types of cylindrical shell covering roof, it is required to define them and compare between the two types.



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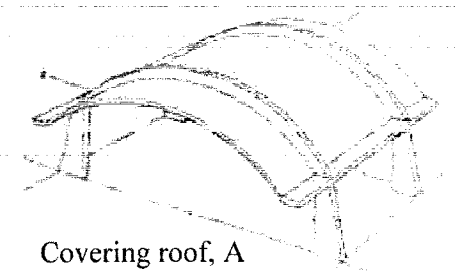
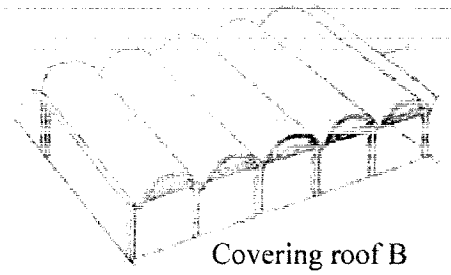


Covering roof, A



Covering roof B

Fig. 4

2- ***Fig. 5*** shows key plan for an exhibition hall with clear height of 5 m, it is required to carry out the following using cylindrical shell covering system: -

a- ***Calculate*** the concrete dimensions for an intermediate panel using beamed type.
b- ***Check*** of bucking for an intermediate panel.
c- ***Calculate*** the main tension reinforcement for an intermediate panel.
d- ***Sketch*** the reinforcement detailing in plan and cross-section.

Note: columns are allowed only along the bold lines.

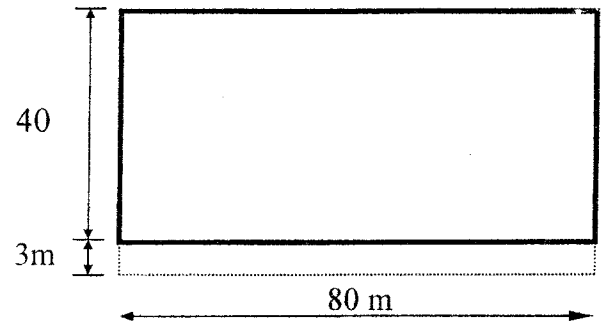



Fig. 5

## Problem (5) (15 %):

For the RC structural system of domes and cones covering circular area shown in ***Fig. 6*** it is required to carry out the following: (assume that the working distributed live load is 1.0 kN/m$^2$)

1. ***Suppose*** all necessary beams and columns then, ***sketch*** to a convenient scale plan and sectional elevation ***showing*** all concrete dimensions of the covering system along with the necessary supporting elements.
2. ***Draw*** the internal force diagrams for the shown domes and the cone (the ring force $N_\theta$ and the meridian force $N_\phi$).
3. ***Design*** the critical sections and ***draw*** the details of reinforcement, to a convention scale, on elevation and plan.

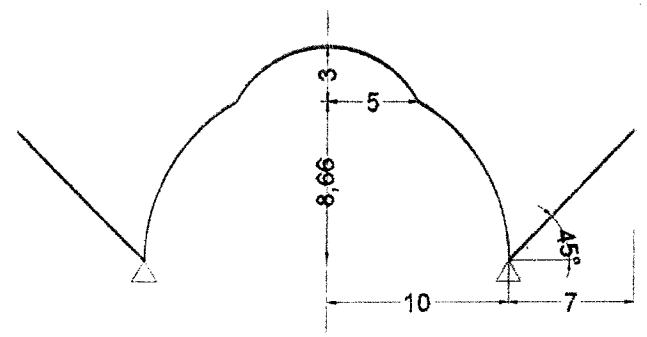



Fig. (6)

## Problem (6) (20 %):

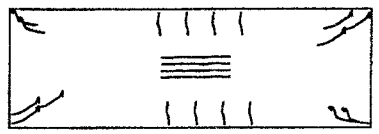


Fig. (7)

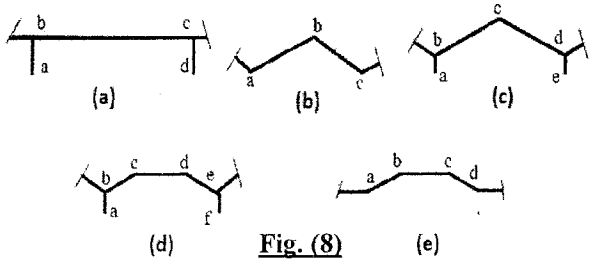



Fig. (8)

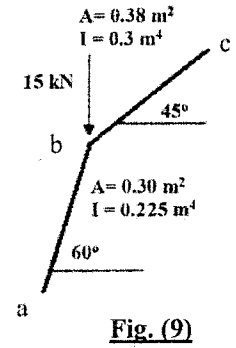



Fig. (9)

TANTA UNIVERSITY
FACULTY OF ENGINEERING
DEPARTMENT OF STRUCTURAL ENGINEERING
FINAL EXAM – FIRST SEMESTER 2021/2022
(STUDENTS OF STRUCTURAL ENGINEERING)

| COURSE TITLE: DESIGN OF REINFORCED CONCRETE STRUCTURES (3)A | | CORSE CODE: CSE 4137 |
|---|---|---|
| DATE: WEDNESDAY 12/1/ 2022 | FINAL TERM EXAM | TIME ALLOWED: 4 HOURS |

1. ***Compare*** between the cylindrical shell and trapezoidal folded plate roofing systems from, supporting elements, rigidity, economy, and deformations.
2. ***Indicate*** the causes for the crack patterns appeared in a V-shape folded plates roof structure shown in the given plan in ***Fig. 7***.
3. Shown in ***Fig. 8*** various cross sections of folded plates roof structures, it is required to:
   a) ***Mark*** ridge lines with internal shear, ***mark*** ridge lines without internal shear and ***mark*** free edges.
   b) Use symmetry conditions whenever possible to ***reduce*** the number of unknown tangential shears.
   c) ***Apply*** the equation of three shears or the stress compatibility condition at the fold lines to get the unknown tangential shears.
4. ***Estimate*** each plate force from the solution of the ridge load shown in ***Fig. 9***. Do plates properties (area and inertia) affect the evaluated components
5. If the industrial hall 18 m x 60 m should be covered with folded plate shown in ***Fig. 10***, given that; the plate thickness is 120 mm, floor cover load is 1.0 kN/m$^2$ and acting on the horizontal projection, live load is 1.0 kN/m$^2$, concrete slope is 2.0 kN/m', it is required to:

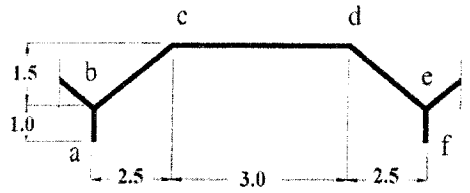



**Fig. (10)**

   a) ***Draw*** neatly to scale 1:100 a structural plan and a sectional elevation of the covering system showing all supporting elements as well as reasonable concrete dimensions.
   b) ***Make*** a complete design for the covering system.
   c) ***Draw*** neat sketches for the reinforcement detailing in plan and cross section illustrating the purpose of each rebar of the main steel.

**End of questions** **(Wishing you best of luck)**

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**Prof. Dr. Mohamed Hussein Mahmoud**
**Assoc. Prof. Nesreen Mohmmed Kassem** **Assoc. Prof. Mahmoud Ahmed Abdel-Aziz**





TANTA UNIVERSITY
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## Data sheet

**Basic wind pressure KN/m²:** $q = 0.5 \times 10^{-3} (\rho . v^2 . c_t . c_s)$, $P_e = C_e . k . q$

| Subjected area | A | B | C |
|---|---|---|---|
| Roughness Hight ($Z_o$) | 0.05 | 0.30 | 1.00 |
| **Hight in (m)** | **k** | | |
| 0-10 m | 1.00 | 1.00 | 1.00 |
| 10-20 m | 1.15 | 1.00 | 1.00 |
| 20-30 m | 1.40 | 1.00 | 1.00 |
| 30-50 m | 1.60 | 1.05 | 1.00 |
| 50-80 m | 1.85 | 1.30 | 1.00 |
| 80-120 m | 2.10 | 1.50 | 1.15 |
| 120-160 m | 2.30 | 1.70 | 1.35 |
| 160-240 m | 2.50 | 1.85 | 1.55 |

| Subsoil class | S | $T_B$ | $T_C$ | $T_D$ |
|---|---|---|---|---|
| A | 1.00 | 0.05 | 0.25 | 1.20 |
| B | 1.35 | 0.05 | 0.25 | 1.20 |
| C | 1.50 | 0.10 | 0.25 | 1.20 |
| D | 1.80 | 0.10 | 0.30 | 1.20 |
| E | 1.60 | 0.05 | 0.25 | 1.20 |

**Fundamental building period:**

$T_l = C_t . H^{3/4}$ where $c_t$ = 0.075 for framing systems, 0.05 for other systems

| Zone | $a_g$ | Location |
|---|---|---|
| 1 | 0.10 g | Luxor, Asyut, Edfu, Sohag, Menia |
| 2 | 0.125 g | Alexandria, Dakahlia, Gharbiya, Matrouh |
| 3 | 0.15 g | Ismailia, Fayoum, Port Said, Cairo |
| 4 | 0.20 g | Safaga, Sinai, Ras Ghareb |
| 5a | 0.25 g | Sharm El-Shaikh, Hurghada |
| 5b | 0.30 g | Taba, Shidwan Island |

| Structural system | R |
|---|---|
| Ductile frames | 7.00 |
| Frames with Limited ductility | 5.00 |
| Shear walls | 5.00 |
| shear walls and ductile frames | 6.00 |
| shear walls and frames with limited ductility | 5.00 |

**Horizontal design spectrum**

$0 \le T \le T_B$ : $Sd(T) = a_g . Yi . S \, (2/3 + T/T_B(2.5/R - 2/3))$

$T_B \le T \le T_C$ : $Sd(T) = a_g . Yi . S \, (2.5/R)$

$T_C \le T \le T_D$ : $Sd(T) = a_g . Yi . S \, (2.5/R).(T_C/T) \ge (0.20)\, a_g . Yi$

$T_D \le T \le 4$ sec : $Sd(T) = a_g . Yi . S \, (2.5/R).(T_C . T_D/T^2) \ge (0.20)\, ag . Yi$

Course Title: Highway Engineering | Course Code:CPW4107 | Year: 4th
Date: 16th January 2022 | Allowed Time: 3 hrs | No of Pages: (3)

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

## Question (1): (30 Marks)

a) ***Choose the correct answer from the following.*** (in *your answer paper, please write down the question number, the correct letter, and the correct chosen answer)*: [20 Marks]

1. Calculate the Middle Ordinate (M) for a horizontal curve with radius (R) = 225 ft and a deflection angle (Δ) angle = 60 degrees
   a) 22.61 ft b) 30.14 ft c) 37.68 ft d) 45.21 ft
2. One of the most important AASHO road test findings.
   a)Specific climate b)Specific subgrade c) Specific materials d) AASHTO 1993 PDG
3. Calculate the Stopping Sight Distance (SSD) for a vehicle travelling 65 mph on a flat highway. Deceleration rate is 11.2 ft/s$^2$ and perception-reaction time is 2.48 sec.
   a) 385.12 ft b) 513.49 ft c) 641.8 ft d) 770.23 ft
4. Main reasons for HMA rutting are_____
   a) Temperature b) Rate of loading c) Asphalt Aging d) A,b
5. Changing tire pressure affects_____
   a) Deeper layers b) Upper layers c) Pavement thickness d) None of the mentioned
6. The term superelevation originated in what industry?
   a) Space travel b) NASCAR c) Railroad d) Airline
7. A _____ has two or more simple curves with different radii that bend the same way and are on the same side of a common tangent.
   a) Simple curve b) Compound curve c) Revers curve d) Deviation curve
8. Curve widening is comprised of mechanical widening and _____ widening.
   a) Psychological b) Aesthetic c) Restorative d) Symmetrical
9. A vertical curve designed to connect a 2% grade with a -3% grade has a total change in grade of _____.
   a) -5% b) 5% c) -1% d) 1%
10. Which of the following make up a highway right-of-way?
    I. The travelled way, II. Median, III. Pedestrian facilities, IV. Drainage channels and side slopes
    a) I, II, & III b) I, II, IV c) II, III, IV d) I, II, III, IV
11. Given the MR value of 22863 psi, calculate the CBR.
    a) 28.4 b) 29.9 c) 30.7 d) 31.5
12. The most important aspect of pavement structural design is providing a uniform, _____, moisture and frost resistant foundation.
    a) Pliable b) Stiff c) Porous Plastic
13. Which of the following is not a general pavement design methodology?
    a) Empirical Design b) Mechanistic Design c) Creative Design d) Mechanistic-Empirical Design
14. The apparent specific gravity of any aggregate material will always be …….. than the bulk specific gravity:
    a) Larger b) Smaller c)Equal d) No relationship
15. Load transfer across the joints in jointed plain concrete pavements may be achieved through:
    a) Dowel bars b) Aggregate interlock c)Tie bars d) a, c
16. Two cars A and B are driving at speeds 120 km/h and 15 km/h on a road section. A strain sensor was impeded in the HMA layer to measure the permanent strain at the mid depth of the layer. The measured permanent strain due to car A compared to Car B is expected be:
    a) Larger b) Smaller c)Equal d) No relationship
17. Two HMA mixes A and B. If the aggregate gradation of mix A is finer than mix B, then the optimum AC content of mix A is expected to be:
    a) Larger b) Smaller c)Equal d) No relationship
18. All the following are flexible pavement distresses except
    a) Bleeding b) Faulting c) Shoving d) Transverse cracks
19. All of the following are major road research projects, except_____
    a) AASHTO 1993 PDG b) AASHO c) SHRP d) MEPDG
20. A concept developed from data collected at the American Association of State Highway Officials (AASHO) Road Test to establish a damage relationship for comparing the effects of axles carrying different loads is _____.
    a) ESAL b) EASL c) SALE d) SAEL

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

1. In thin flexible pavement, the AC is both a wearing surface and structural layer
2. Curbs are a principal element for every road pavement cross-section.
3. One of the island functions is to provide storage area for parking vehicles.
4. Required pavement thickness is mostly determined by load magnitude.
5. Runoff is the length of roadway needed to accomplish a change in outside-lane cross slope from normal cross slope rate to zero
6. Horizontal alignment is the elevation or the profile of the center line of the road.
7. Design criteria and design charts are similar for both sag and crest curves.
8. One of the factors affecting the granular base rutting is the truck speed.
9. Centrifugal force direction is inward towards the center of the curve.
10. Function of Base/Subbase in flexible pavements is to prevent pumping.

## Question (2): (20 Marks)

a) **(3 Marks)** Explain with flow diagram, the structural design criteria of flexible pavements showing the design factors.

b) **(4 Marks)** What is the difference between dowel bars and tie bars in rigid concrete pavements?

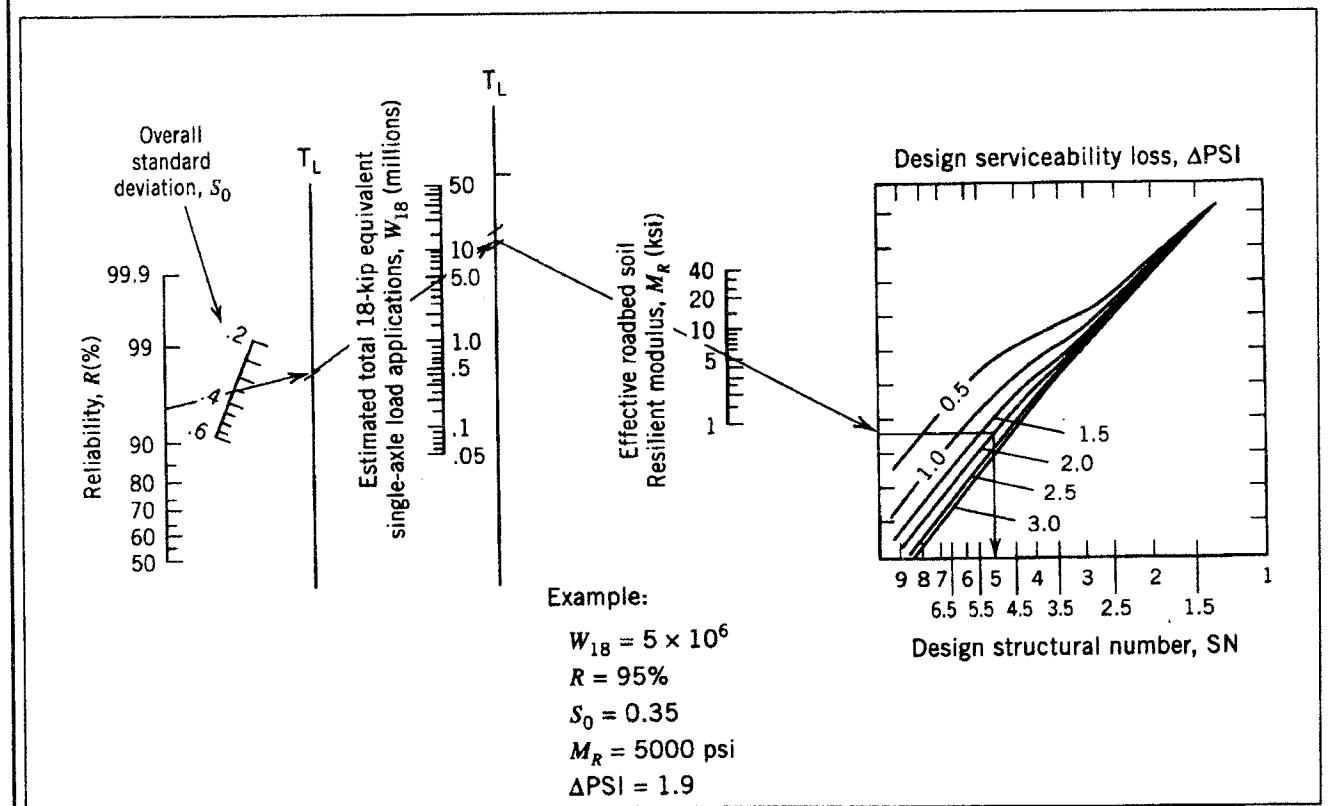
c) **(6 Marks)** Define the following and explain briefly how to obtain their values and what

2. Calculate the resilient modulus of the subgrade soil.
3. What is the CBR value for this subgrade.
4. What is the minimum acceptable CBR value for a base layer according to the Egyptian code of practice?

b) (6 Marks) Determine the missing data in the following table for an ESAL of $10^* 10^6$, R = 90%, $S_0$= 0.45 , initial PSI – 4.5 and terminal PSI = 2.5, and $m_2 = m_3 = 1$

| Layer | CBR | Modulus (psi) | Structural Layer Coeff. | Structural Number | Layer Thickness, in |
|---|---|---|---|---|---|
| AC | | 450000 | 0.44 | | 6.5 |
| Granular base | 60% | ? | ? | ? | 10 |
| Granular Subbase | ? | 25000 | 0.1 | 3.9 | ? |
| Subgrade | 3% | ? | | 5.535 | |

c) ( 5 Marks) An asphalt mix specimen was removed from 6-lane free way pavement surfcae. The extaction test indicated that the percent of asphalt content was 5.0%, expressed as a percentage of weight of mix, the asphalt absorbtion of aggreate was 0.45% and its bulk specific gravity was 2.26. The specific gravity of asphalt cement was 1.03. the bulk and effective specific gravities of the used aggregates were 2.705 and 2.731respectively. It is required to calculate: Air voids perentage, effective asphalt conten, VMA, VFA




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



are they used for:

1. CBR
2. Resilient Modulus
3. Cutback Bitumen
4. Group Index
5. Stability
6. Flow

d) (4 Marks) What are the possible reasons for the following pavement distresses:

1. Transverse cracking
2. Alligator cracking
3. Rutting
4. Bleeding of Asphalt pavement

e) (3 Marks) What are the major differences between the flexible and rigid pavements?

## Question (3): (20 Marks)

a) (10 Marks) Given the following curve information in Figure 1, It is required to

1. Determine the intersection angle at PI.
2. Determine all the curve elements.
3. Find the coordinates and station of curve beginning and end points.
4. Check the proposed alignment for design speed of 60 mph and superelevation 4%.

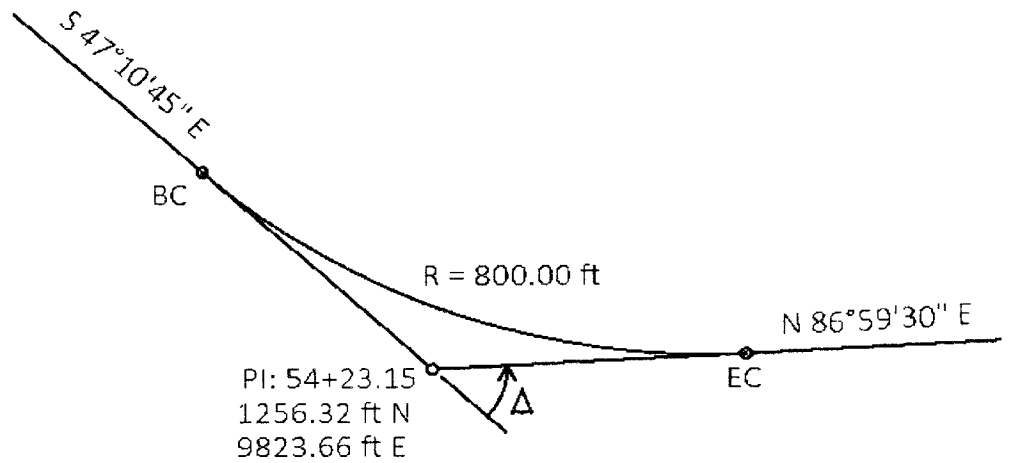



Figure (1)

b) (10 Marks) Given a vertical curve with PVI station and elevation 74+26.50 and 772.30 ft respectively. What are the endpoints' stations and elevations of a 750.00 ft long curve with incoming and outgoing grades of -4.00% and +2.00%?

1. Calculate the complete data to set the curve. Take the peg interval of 50 ft.
2. Find the reduced levels and chainage of the highest/lowest points of the curve

## Question (4): (15 Marks)

a) (4 Marks) The resilient modulus test was performed on a weak subgrade soil with confining pressure of 4 psi, vertical stress of 22 psi by applying a haversine load with load cycle duration of 0.2 second, rest period of 0.8 second. The resulted total strain was 0.006 inch/inch while the permanent strain was 0.002 inch/inch. It is required to:

1. Draw to a reasonable scale the stress time and strain time relationships for one load cycle.

Tanta University — Structural Engineering Department — Faculty of Engineering

Total Marks: 75 Points

| | | |
|---|---|---|
| Course Title: Foundations Engineering (2) | Course Code: CSE4116 | Year: 4th Civil |
| Date: 23/1/2022 (First term) | Allowed time: 3 hrs (Term Exam) | No. of Pages: (4) |

**Answer all the following questions.**

**Problem number (1) (8 points)**

(a) Define the secant pile, discuss the methods of construction and of design **(2.0 points)**

(b) Illustrate the factor affecting the yield discharge of wellpoint and deep wells **(2.0 points)**

(c) Discuss the different types of flow net and define heaving and piping failures **(2.0 points)**

(d) Demonstrate the effect of dewatering process on the adjacent old buildings showing the different techniques to overcome this effect. **(2.0 points)**

**Problem number (2) (15 points)**

(a) The section of an excavation is rectangular (20 x 40) m in plan and 4.0 m in depth. The site profile consists of 8.0 m stiff silty clay overlying 4.0 m medium to coarse sand on intact granite bedrock. The initial ground water table is (-1.0 m). The coefficient of permeability for sand layer = 0.002 m/sec. The available **wellpoints** are 5.0 cm in diameter and 10.0 m in length. The yield discharge of the well is 0.0004 $m^3$/sec. Considering C = 1500. **Design the pressure relief system.** **(5 points)**

(b) The basement of building requires 60 x 60 m excavating 5.0 m deep in a bed of clay 8.0 m, which overlies a 2.0 m bed of sand with an impervious layer below. The initial ground water table is (-0.50 m) and the coefficient of permeability for sand layer = 0.0048 m/sec. Eight Fully penetrating **deep wells** were placed around the site 1.0 m apart from the excavation and 31.0 m spacing center to center. The radius of deep well and influence well system are 20 cm and 800 m respectively. **Determine the capacity of submersible pump in $m^3$/hour.** **(5 points)**

(c) The section of trench excavation is 2.00 wide and 6.00 depth and 150 m long. The soil profile consists of 16.0 m fine to medium sand on very stiff to hard clay. The initial ground water table is (-1.0 m). The coefficient of permeability for sand layer = 0.0006 m/sec. One row of 14.0 m in length **deep wells** -40 cm in diameter- was placed at 1.0 m apart of the trench and. The available submersible pump is 50 $m^3$/hour and the yield discharge of the well = 40.0 $m^3$/hour. If the constant C =2000;

(i) Design the pressure relief system. **(3 points)**

(ii) Check the drawdown at the midway point of the trench **(2 points)**



**Problem number (3) (15 points)**

(a) A reinforced concrete building consists of eight typical floors. The following data are given:

- The plane concrete thickness = 0.25 m
- The thickness of reinforced concrete = 1.00 m
- The unit weight of soil = 1700 kg/$m^3$
- The raft is 10 x 12 m with the long side in X direction
- The foundation level = 2.0 m
- The allowable net stress at foundation level=1.40 kg/$cm^2$
- The load of one floor = 150 t acting in the left bottom quarter with $e_x$ = 0.15 m and $e_y$ = 0.25 m
- The live load of ground floor = 300 kg/$m^2$.
- The acting moment on the raft due to considering the lateral loads in Y direction = 300 tm.
- The acting moment on the raft due to considering the lateral loads in X direction = 200 tm.

Check the stresses under the raft **(5 points)**

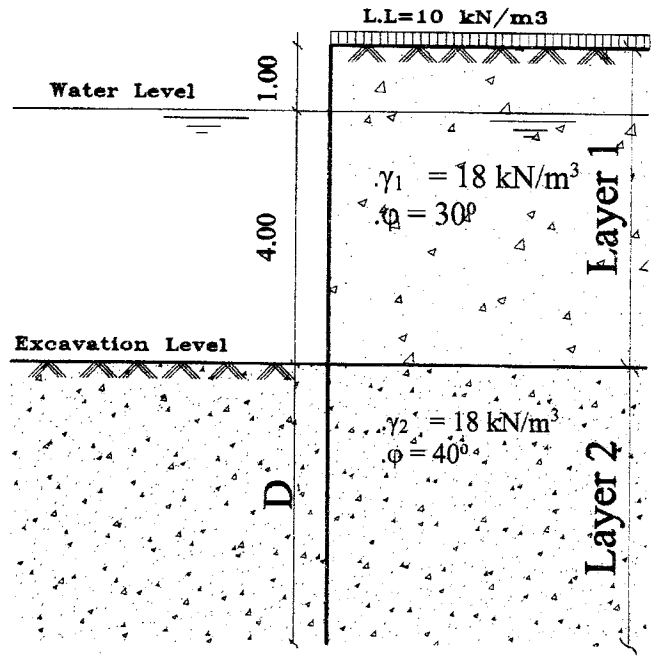
(b) If this building consists of basement and eight typical floors with the foundation level = 4.5 m and the allowable net stress at foundation level =1.50 kg/$cm^2$, determine the maximum number of typical floors can be added so that the soil can support safely for the case of vertical loads only. **(5 points)**

(c) If the eight typical floors building was constructed on raft over piles. The number of 0.4 m in diameter piles required was 64 piles to be constructed in 8 rows with vertical spacing = 1.25 m and 8 columns with horizontal spacing = 1.5m.

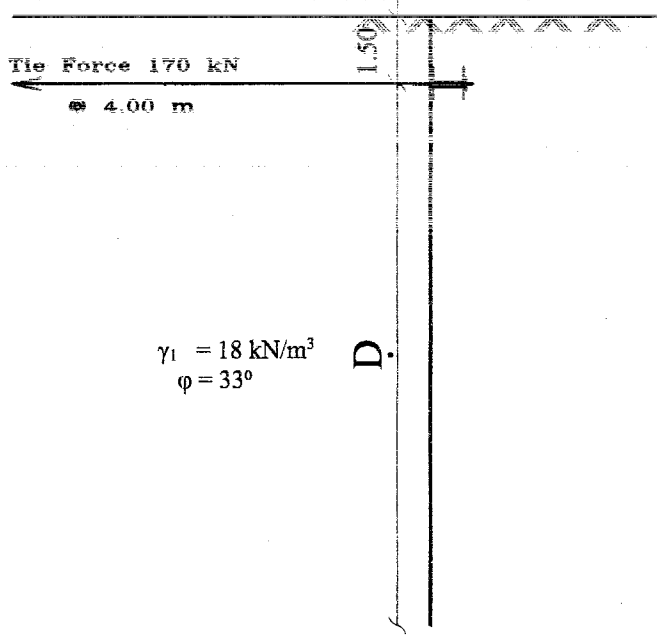
Determine the maximum and minimum loads in the piles for the case of vertical and lateral loads. **(5 points)**

**Problem number (4) (14 points)**

(a) for the attached cantilever sheet pile ***Draw and estimate (only)*** the earth pressure used to design this sheet pile **(5 points)**



(b) for the shown anchorage sheet pile, if the tie force 170 kN@ 4.00 m.
Find out the safe depth, D which is needed for to carry out the tie force **(5 points)**




( c ) give with clear sketches the different failure modes of anchored sheet piles **(4 points)**

**Problem number (5) (10 points)**

1- Explain the main caisson types? **(2 Points)**

2- Briefly describe the main methods that can be used for caissons construction and clarify what are the advantages and disadvantages of each method. **(3 Points)**

3- Clarify how to sink a caisson, what is the most common problems during construction, and how to overcome them (required precautions). **(2 Points)**

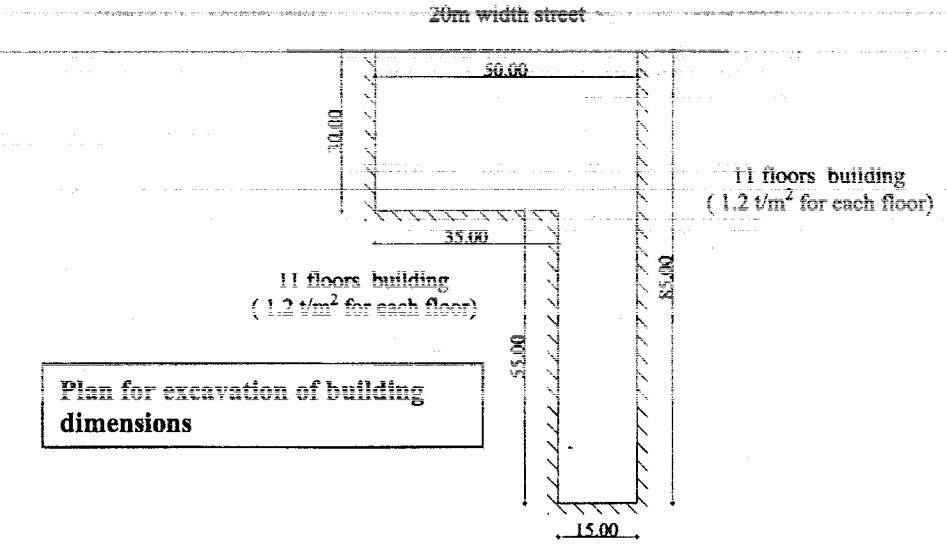
4- With clean drawings what are the main components of the pneumatic caissons and how it works. **(3 Points)**

**Problem number (6) (13 points)**

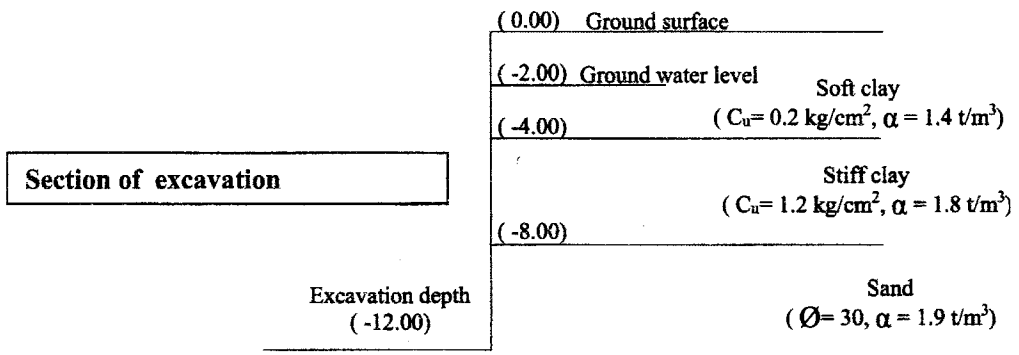
A 12-story building with two basements is to be constructed. The following figure shows the plan and the soil profile. The first and the second basement levels are -5.00 and -10.00, respectively. ***It is not permitted to use the basement slabs to be a part of the bracing supporting system for the excavation***. As a geotechnical engineer, It is required to determine:

- Suggest the most economic and the safest system for the excavation **(4 Points)**
- The apparent earth pressure on the supporting system **(3 Points)**
- Design the whole system. **(6 Points)**






**Plan for excavation of building dimensions**



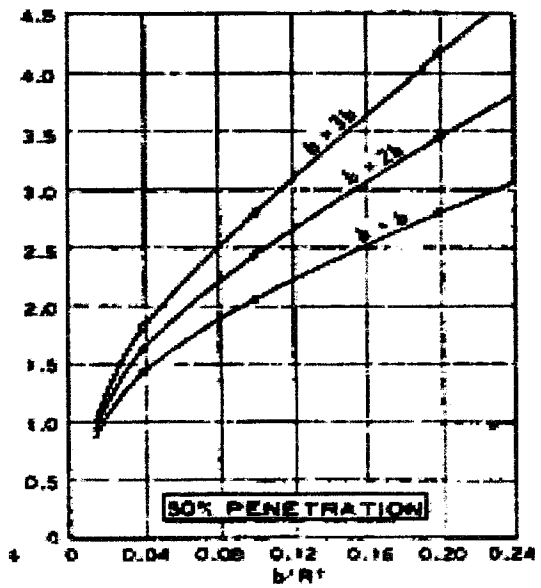

**Section of excavation**

**Equations**:

$Q = K D (H - h_e) S$ and $R = C (H - h_e) \sqrt{K}$

$Q_w = \frac{2\pi K D}{\ln (R/r_w)} (H - h_e)$ and $H - h = \frac{1}{2\pi K D} * \sum Q_i \ln (R/r_i)$

$Q_w = \frac{\pi K}{\ln R/r_w} (H^2 - h_e^2)$ and $H^2 - h^2 = \frac{1}{\pi K} * \sum Q_i \ln (R/r_i)$






أطيب الأمنيات بالتوفيق والنجاح

أ.د. مصطفى عبد اللطيف الصواف  أ. د. / أشرف كمال نظير  د. عبد العزيز ناصر