TANTA UNIVERSITY FACULTY OF ENGINEERING DEPARTMENT OF STRUCTURAL ENGINEERING مدنى وإنشاءات لائحة جديدة EXAMINATION (THIRD YEAR) STUDENTS OF CIVIL AND STRUCTURAL ENGINEERING	

COURSE TITLE: DESIGN OF REINFORCED CONCRETE STRUCTURES (2) b			COURSE CODE: CSE3210/3223
DATE: JUNE – 2023	TERM: SECOND	TOTAL ASSESSMENT MARKS: 75	TIME ALLOWED: 4 HOURS

Systematic arrangement of calculations and clear neat drawings are essential. Assume any data not given. Consider for all problems, f_{cu}= 30MPa and f_y= 400MPa. The exam consists of three problems in two pages. Answer many questions as you can.

Problem # 1 (27 Marks)

A. i. An arched girder carries a horizontal roof at the level of the tie. A cut has occurred in the reinforcing steel of one of the hangers, either due to corrosion or due to the incorrect the reinforcement details of the hanger with the structural elements connected to it. It is required to:

a) Draw the correct reinforcement details for the hanger with the structural elements connected to it? **(2Marks)**

b) What will happen to the structural elements because of cutting the reinforcement of the mentioned hanger? **(2Marks)**

ii. What are the selection criteria of an efficient structural system? **(1Mark)**

iii. Compare between the following items: Arches with and without tie - Arches with and without hangers - Tension and compression structures. **(3Marks)**

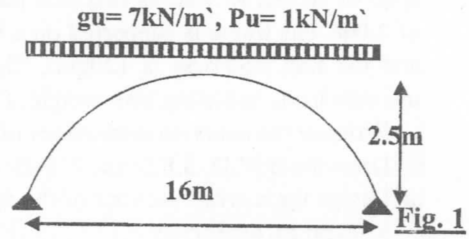


Fig. 1

B. Figure 1 shows one meter strip of the arched slab of span 16m carries an ultimate dead and live loads **(gu and Pu)** shown in the figure. The following data are considered: Column spacing **S= 6m**, ultimate own weight of the vertical and horizontal beams= **5 and 8kN/m`**, respectively, ultimate load of the stiffener, $w_{u,stif}$= **6kN/m`**. **It is required to** ***determine*** the loads and straining actions on all components of the structure. ***Make a complete design*** (design + drawing details) of the **arched slab** and the **tie. (12Marks)**

C. Figure 2 shows a Vierendeel girder of span 25m. It is required to ***draw*** the B.M.D, S.F.D and N.F.D diagrams of the **V.G** under the given loads and design the marked member **(A). (7Marks)**

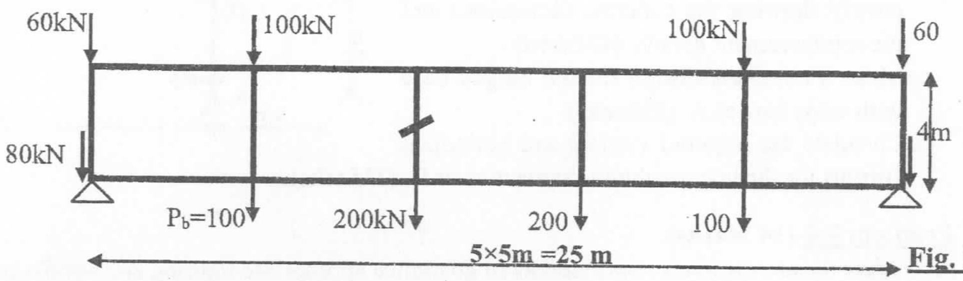
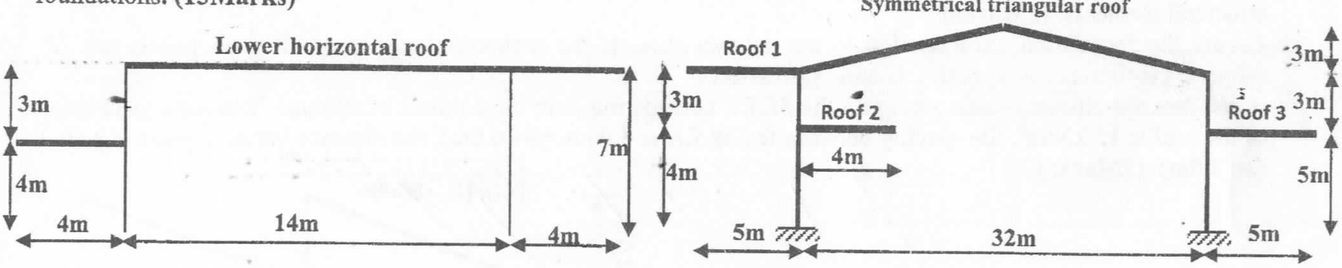


Fig. 2

Problem # 2 (25 Marks)

Figure 3 shows general layout of architectural sectional elevations of covering industrial halls using two different roofs, as shown in **cases 1 and 2.** The supported columns of spacing, **S= 7m** are only allowed on the outer perimeter of the halls. It is required to carry out the following:

i- **For the roofs of cases 1 and 2**: ***Suggest*** more economic main supporting elements (MSE) to carry all slabs of each roof and ***draw*** to a suitable scale structural sectional elevation, showing concrete dimensions of all necessary needed elements. ***Using diagrammatic sketches, illustrate*** without calculations, the loads transfer from the roof slabs to the foundations. **(13Marks)**



Case 1 Fig. 3 Case 2

ii- **For the roof of the case 1**: ***Make a complete design*** (design and reinforcement details) for the suggested MSE and its components. Consider the average total ultimate loads from the roof and its elements on the MSE is **20kN/m²** not included own weight of the MSE. **(4Marks)**

iii- **For the roof of the case 2**: ***without calculations, draw*** of shape of the B.M.D and the main reinforcement of the triangular roof slabs. ***Determine*** the straining actions of the suggested **MSE** of the triangular roof if average total ultimate loads from the roof and its elements on the MSE is **20kN/m²** not included own weight of the MSE. **(8Marks)**

PLEASE TURN OVER

Problem # 3 (24 Marks)

(a) Sketch the possible shear cracks in opening and closing joints in RC frames. **(1Marks)**

(b) State the ECP recommendations for lab, mechanical and welded splices of the steel reinforcing bar. **(2Marks)**

(c) For each of the RC structures shown in **Figure 4**, it is required to ***draw*** shape of the B.M.D under the given uniform load. ***Sketch*** shape of the longitudinal reinforcement. ***Classify*** type of the joint (A). ***Sketch*** shape of the transversal reinforcement at joint (A). **(3Marks)**

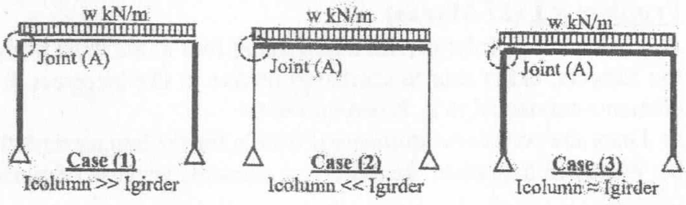


Fig. 4

(d) Figure 5 shows the statical system, ultimate loads, and dimensions of intermediate RC frame ABCDEFGH. The frame is used to cover a hall with a span of 16.0m, as well as two side parks with a span of 4.0m. The frame is supported on a hinged support at (A) and a link member at (DG). The frame is spaced at 5.0m and the slab thickness is 120mm. The frame has a constant cross section width of 400mm. The given loads are ultimate loads including own weight. Determine the following:

i. Estimate the concrete dimensions of the frame elements. **(2Marks)**

ii. Draw the B.M.D, S.F.D and N.F.D. **(3Marks)**

iii. Design the marked sections of the frame (1, 2, 3, 4 and 5). **(4Marks)**

iv. Draw to a convenient scale the intermediate frame in elevation and in cross sections clearly showing the concrete dimensions and the reinforcement details. **(4Marks)**

v. Make a complete design for the hinged base with cross bars at A. **(3Marks)**

vi. Calculate the required vertical and horizontal stirrups for the beam-column-connection at B. **(2Marks)**

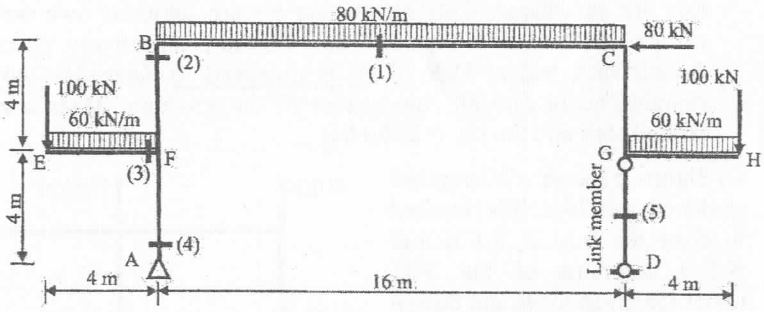


Fig. 5

Problem # 4 (14 Marks)

A. i- ***State*** the architectural requirements to guarantee appropriate lighting and ventilation in north-light roof structures? **(2Marks)**

ii- ***Define*** the following (using illustrative sketches): expansion, structural and settlement joints in reinforced concrete structures. **(2Marks)**

B. Figure 6 shows a sectional elevation of an industrial hall having **14m width and 40m length**. a north-light roof is required to cover this hall. The executed glass windows were vertical. It is required to:

i- ***Suggest*** a suitable main supporting element (M.S.E) to carry the shown north-light roof elements. **(2Marks)**

ii- ***Draw*** to a convenient scale; a sectional elevation and a part of plan showing all concrete dimensions of the structural elements. **(2Marks)**

iii-***Locate*** the foundation axes relative to the column axes. If the inclination angles of all glass panels are *20º*, ***relocate*** the foundation axes in this case. **(3Marks)**

iv- ***Calculate*** the ultimate loads acting on the ***M.S.E*** considering that; the equivalent ultimate load per square meter of the roof is 15 kN/m², the spacing between the ***M.S.E*** is 6.00 m (**S= 6.0m**), the distance between posts is 2.00 m (**a= 2.0m**). **(3Marks)**

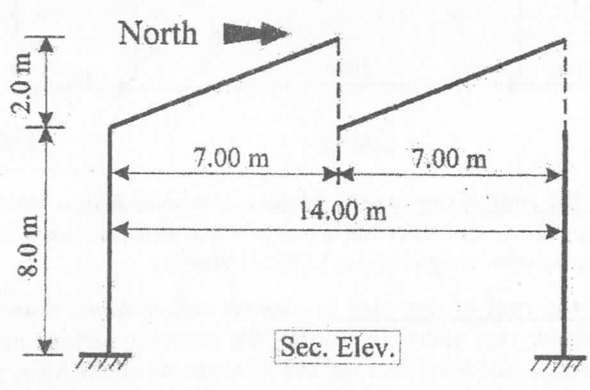


Fig. 6

All the best wishes

Prof. Dr. Tarek Fawzy El-Shafiey

Dr. Ali Hasan Abdel Mawgoud

Dr. Mohamed Ezat Ellithy

Tanta University | Public Works Engineering Department | Faculty of Engineering

Total Marks: 70 Marks

Course Title: Railways Engineering	**Course Code:** CPW3204	**Year:** 3rd Civil Eng. Program
Examination Date: 7/6/2023	**Allowed Time:** 3 hrs	**No of Pages:** (٢)

ملاحظات هامة: يقع الامتحان في ورقة واحدة.... اجب عن جميع الأسئلة مع العناية بترتيب الإجابة ومراعاة عدد ورقات كراسة الإجابة.

السؤال الأول (٣٠ درجة)

١. أذكر مميزات نظام النقل بالسكك الحديدية

٢. استنتج المعادلة المستخدمة لحساب ارتفاع الظهر عن البطن في المنحنيات الأفقية

٣. وضح بالرسم **العلاقة البيانية** بين كل من:

أ) مقاومه السير والهواء ومقاومه البدء مع السرعة ب) قوه الجر والتماسك مع السرعة.

٤. أحسب **أقصى سرعة** وكذلك **السرعة الحرجة** لقطار يتحرك علي خط سكة حديد مفرد يقع عليه منحني دائري نصف قطره ٨٠٠ متر وارتفاع الظهر عن البطن المنفذ هو ١٦٠ مم.

٥. المطلوب حساب **أقصى سرعة** تسير بها قاطرة تجر عشر عربات ركاب وزنها ٥٠٠ طن علماً بان القاطرة قدرتها ٢٠٠٠ حصان وكل عجلاتها جاره وتسير علي انحدار حاكم ٧ %o في سكة حديد مصر.

٦. لمح سائق قطار ركاب عائق علي خط السكه الحديد فقام بفرملة القطار وتوقف علي بعد ١٠ متر من العائق. المطلوب ايجاد **المسافة بين القطار والعائق** حال اكتشاف السائق للعائق علي هذا الخط. اذا علم ان سرعة القطار كانت ٩٠ كم/ساعة وهو مكون من قاطرة وزنها ١٢٠ طن قدرتها ٢٠٠٠ حصان وجميع محاورها مزودة بالفرامل تجر خلفها ١٠ عربات وزن العربة وهي محملة ٥٠ طن ووزنها وهي فارغة ٤٠ طن ويسير القطار علي خط منحدر إلى أسفل بمقدار ٢ %o وعلي منحني نصف قطره ٦٣٠ متر.

السؤال الثاني (٢٥ درجة)

١. وضح بالرسم ما يلي:

نموذج محطات ركاب من النوع (**محطة نهائية متوسطة — محطة نهائية ذات مبان موازية — محطة تفرع**)

٢. أذكر **فوائد** المنحنيات الإنتقالية **وطرق توقيعها** في المنحنيات الأفقية.

٣. وضح بالرسم **الطرق المختلفة لتنفيذ ارتفاع الظهر عن البطن** لخطوط السكك الحديدية علي المنحنيات الأفقية.

٤. **عرف** الفلنكات **والغرض** من استخدامها ثم أحسب الإجهادات في الفلنكات التي أبعادها (٢٦٠سم- ٢٥سم — ١٥سم) إذا علم أن أقصي حمل محور = ٢٠ طن وسرعة القطار ٧٠كم/ساعة — مع فرض أن **توزيع الإجهادات منتظم.**

٥. أحسب **الإنحدار الأقصى** في جزء دائري نصف قطره ٥٠٠ متر لخط سكة حديدي في سكة حديد مصر تسير علية قطارات بضائع بسرعة قصوى ٤٠كم/ساعة ووزن العربات محملة ١٦٥٠ طن (ذات بواجي) إذا كانت القاطرات المستخدمه وزنها ١٢٠ طن والوزن الواقع علي عجلاتها الجارة ٩٠ طن وقدرتها ٢٥٠٠ حصان. تحقق ما إذا كانت القاطرة تستطيع جر القطار إذا ما توقف علي الانحدار الحاكم؟

٦. خط سكة حديد مترو علي شكل منحني **مركب متتالي** أنصاف أقطاره ١٤٠٠ متر و ٩٠٠ متر. المطلوب إيجاد طول المنحني الإنتقالي بين المنحنيين المتتاليين. إذا علم أن سرعة قطارات المترو ٨٠ كم/ساعة.

السؤال الثالث (١٥ درجة)

١. أذكر **الغرض** من استخدام كل من :

أساس السكة – قطاع الترليط

٢. **عرف:**

جناح التقاطع – المعوجة – فدو كعب الإبرة

٣. المطلوب إيجاد قيمة الأجهادات علي عمق ٥٠سم داخل قطاع الترليط نتيجة لقاطرة وزنها ١٣٢ طن - ٦ محاور تسير بسرعة ١٠٥ كم/ساعة إذا كانت الفلنكات المستخدمة مقاس (٢٦٠سم - ٢٥ سم - ١٥سم) والتقسيط ٦٠ سم بلستخدام **طريقة تالبوت.**

٤. استنتج **طول المفتاح** ١٠:١ إذا كان طول الإبرة ٥ متر وفدو كعب الإبرة ١٢٨ مم والجزء المستقيم قبل التقاطع ٢ متر وكذلك أحسب **أقصي سرعة للسير علي هذا المفتاح.**

GOOD LUCK

Assoc. Prof. Dr./ Islam Abu El-Naga and the Examination committee.

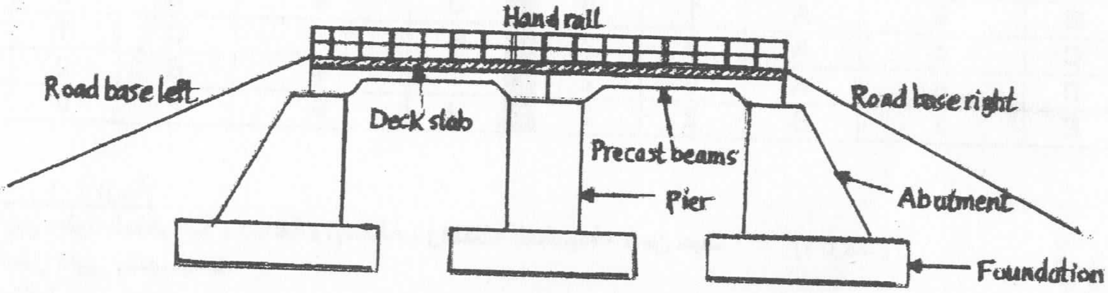
Question (1) [15 marks]:

Perform CPM analysis for the following activities in order to determine project duration, critical activities, critical path(s), and total float and free float for each activity:

Activity	Duration(days)	Pred.s	Lag	Activity	Duration(days)	Pred.s	Lag
A	4	--		F	4	B,D	
B	10	A		G	3	F	-1
C	2	A		H	2	B,D	
D	6	C	2	I	1	E,G,H	
E	15	B,D		J	3	H	

Question (2) [20 marks]:

1- The figure below shows the main components of a double-span bridge. It is required to:
- Identify the main activities involved in constructing this bridge.
- Determine the logical relationships between the identified activities.



2- In an operation of producing and placing concrete for a solid slab, the optimum crew size is shown in the following table. The table also provides the cost of using various resources. The optimum crew size can produce 6 m3 (concrete)/ hour. If it is required to place 42 m^3 concrete, determine the following:
- Duration to place the required concrete amount?
- Total cost to place the required concrete amount?
- The cost of placing 1 m3 of concrete?

Resource	Number	Cost	Resource	Number	Cost
Drivers:	1	30/hr	Sand:	0.4 m^3	150/m^3
Labour (On site crew):	7	30/hr	Cement:	350 Kg	2000/ton
Mixer:	1	200/hr	Admixtures:	0.8 kg	100/kg
Gravel:	0.8 m^3	350/m^3	Water:	170 litres	10/m^3
Compactor:	1	50/hr			

Question (3) [15 marks]:

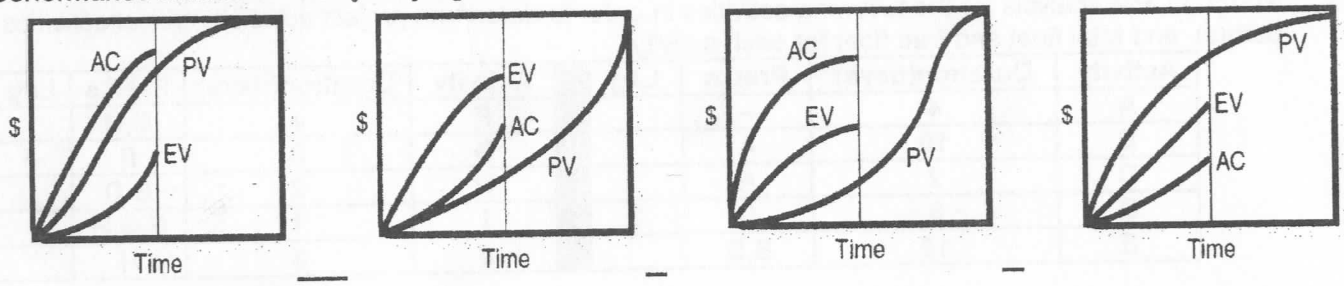
The activities involved in the construction of 10 meter of a retaining wall are given together with their estimated durations in the table below. The project consists of 100 meters. The number of crews needed for each activity is provided in the table. Assume one day buffer time between activities. It is required to:

1. Draw the LOB diagram.
2. Determine the project duration.
3. Determine the entering and leaving dates for the crews utilized in activity D.

Activity	Duration	Pred.	Number of crews
A	1	-	1
B	3	A	2
C	1	A	1
D	4	B,C	2
E	1	D	1
F	2	E	2

Question (4) [10 marks]:

Redraw each shape in your answer sheet. Comment on the performance of each project, using proper "performance indicators" and your judgment.



Question (5) [15 marks]:

Re-schedule this project to satisfy resource constraints. Draw the final two histograms for R1 and R2.

Act.	Dur.(days)	Pred.	R1≤3	R2≤4	Act.	Dur.(days)	Pred.	R1≤3	R2≤4
A	2	---	1	0	F	4	A	0	0
B	6	A	1	0	G	6	C	2	3
C	4	A	3	2	H	7	D	1	1
D	6	A	0	2	I	4	E	2	2
E	2	B	2	2	J	6	F	0	1

السؤال السادس (١٠ درجة)

١- قارن في جدول بين عقود المقطوعية ، التكلفة والإضافة ، والتكلفه المستهدفه ، من حيث : (٦ درجات)

- المرونة لإدخال تغيير بالتصميمات
- إشتراك المالك في إدارة المشروع
- التغطية المالية للمخاطر

٢- هذا النوع من العقود يستوعب كل تغييرات المالك وعدم اتضاح الرؤية الخاصة بالمشروع من البداية. وله من المرونة الكثير في التعامل مع المستجدات اثناء التنفيذ. ما هو هذا النوع؟ ما هي مميزاته وعيوبه؟ (٤ درجات)

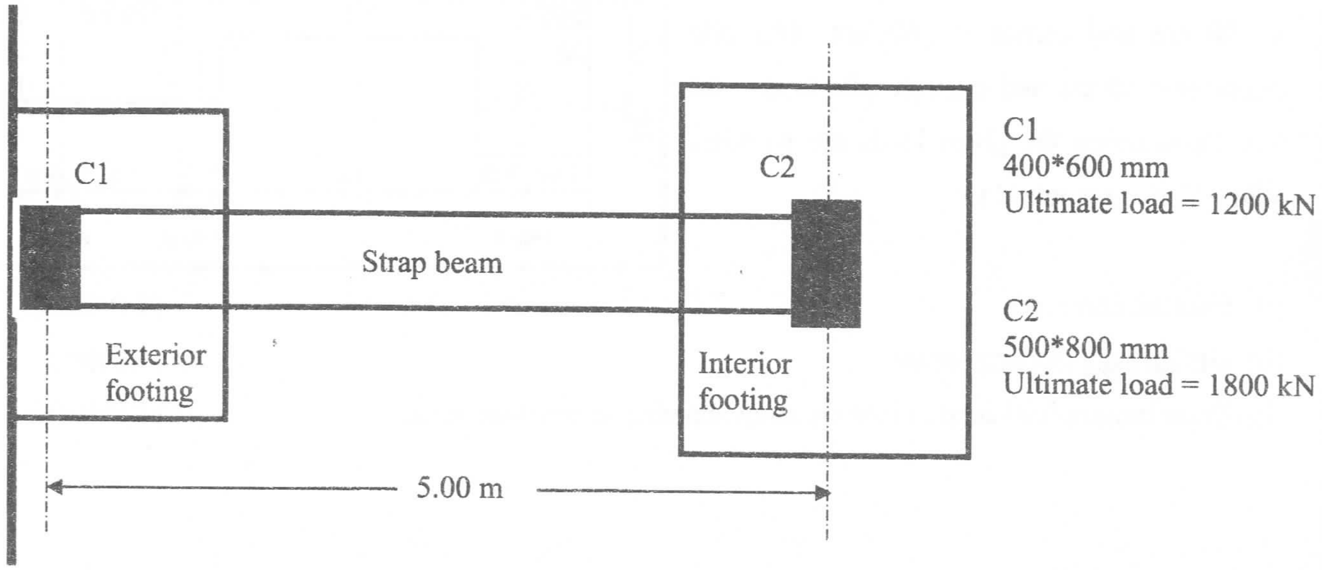
Question No. 1 (19 Points)

a) Differentiate between total, net and allowable stress in shallow foundations (2 Points)

b) Explain with clear sketches the reinforcement details of the flat raft (2 Points)

c) Illustrate with sketches the different locations of smmells that connecting the shallow isolated footings (2 Points)

For the strap beam that connecting the shown two footings to carry columns, C1 and C2. If the allowable net bearing capacity $q_{all,net} = 2.00$ kg/cm^2 and the thickness of the plain concrete is 20 cm.



a) Determine the dimensions of Exterior footing. (3 Points)

b) draw the bending mommment and shear force acting on the strap beam (3 Points)

c) Estiamte the required section and reinnforcement for the strap beam (3 Points)

d) Draw longitiodinal and cross setion for the desingned strap beam (considering that the height of the strap beam greater than the thickness of the two footings) (4 Points)

Question No. (4) (8 point)

a) Using clear sketches define the negative skin friction showing its effect on pile capacity. **(2 Point)**

b) Explain the term "deviation of piles" showing how to calculate the loads in piles **(2 Point)**

c) Write detailed notes about reinforcement of bored and precast driven piles **(2 Point)**

d) Discuss how to determine the tension load capacity of a pile group installed in sand **(2 Point)**

Tanta University **Structural Engineering Department** Faculty of Engineering

Total Marks: 85 Points

Course Title: Foundations Engineering (1);	CSE3214	Year: 3th
Date: 18/ 06/ 2023 (Second term)	Allowed time: 3.0 hrs (Term Exam)	No. of Pages: (4)

Answer all the following questions.

Question No. 1 (11 Points)

a) Give in clear sketches the different locations for critical section of moment used to design the wall footing in different wall materials. (3 Points)

b) Design a rectangular reinforced concrete footing to support a column (30· x 80·) mm if the working column loads 1400 kN. The allowable net bearing capacity $q_{all,net} = 1.30$ kg/cm^2 and the thickness of the plain concrete is 40 cm. (8 Points)

Question No. 2 (12 Points)

The Figure shows the plan of four adjacent columns. The allowable net soil pressure is 1.8kg/cm^2.The thickness of plain concrete and R.C strip footings are **20 cm and 80 cm** respectively. The left columnis(300x600) mm and carries allowable column load of 100 ton,while the other three columnsare(300 x800) mm and carry allowable column loads of 120, 130 and 120 ton respectively. You are required to:

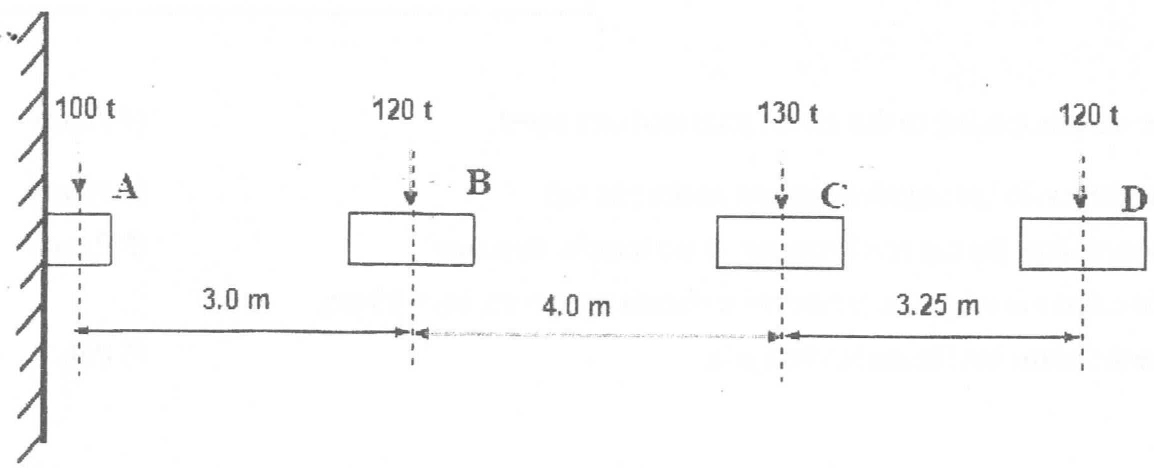
a) Determine the dimension of strip footing to make the stress distribution under the footing is uniform and draw the contact pressure. (2 Points)

b) Check the shear stress for column (A). (2 Points)

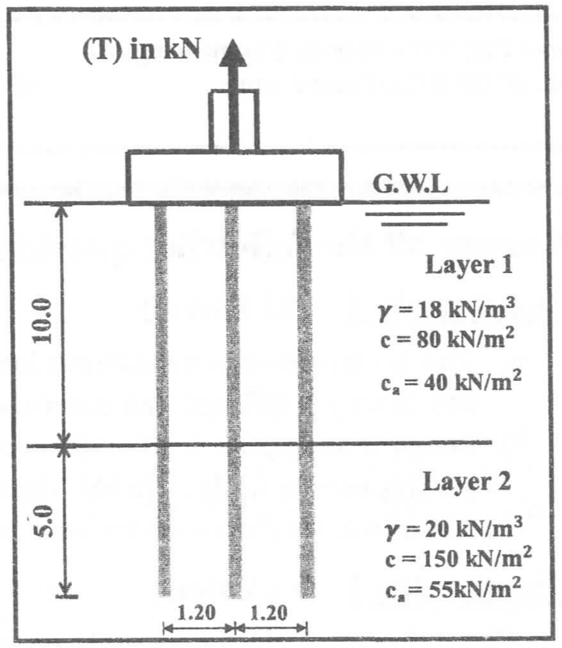
c) Determinethe maximum negative moment in span (AB). (3 Points)

d) Check the punching stress for column (B). (2 Points)

e) Determine the reinforcement in the transfer direction under column (C). (3 Points)



Question No. (5) (25 point)



(a) The shown driven <u>nine pile cap</u> carries a column load of (T) kN at ground level. The soil profile consists medium stiff clay having thickness 10.0 m overlying a layer of stiff clay. The ground water level was located at foundation level.

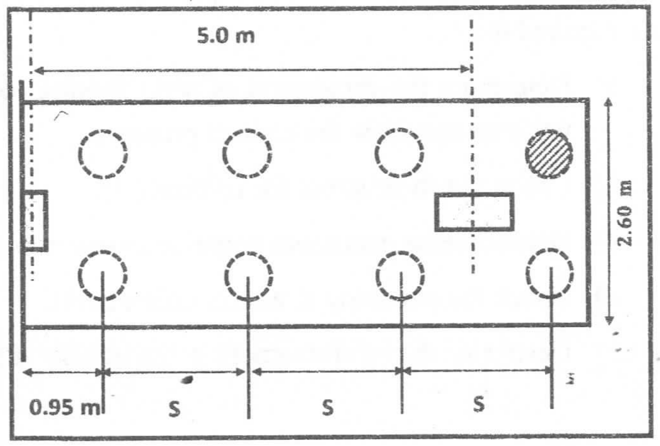
The pile diameter and spacing are 40 cm, and 120 cm.

The weight of pile cap and overlying soil =250 kN.

Considering the factor of safety = 3,

(i) Find the safe tension load of the column **(4 Point)**

(ii) Find the safe compression load of column **(4 Point)**



(b) The figure shows the plan of two adjacent columns. The left column is (30 x 60) cm and carries 120 t and the right column is (40 x 80) cm and carries 280 ton. The pile diameter = 50 cm and the safe pile load = 60 ton. The thickness combined pile cap is 90 cm and the given loads are working loads:

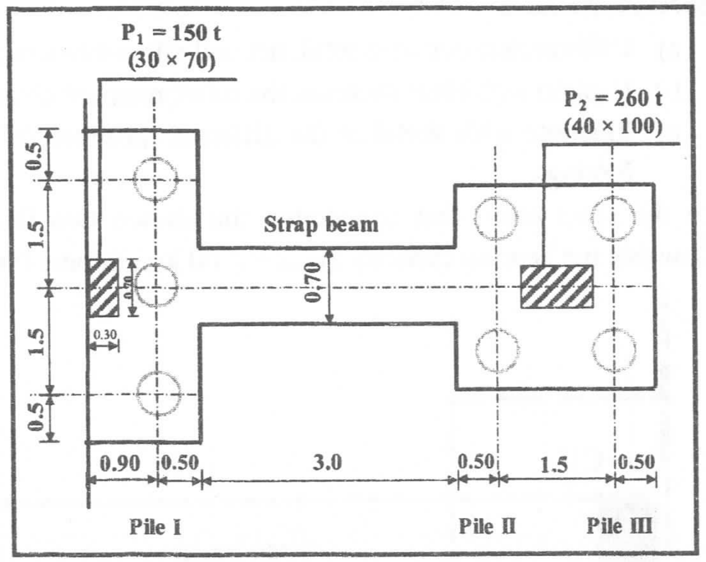
a) Determine the pile spacing so that all the piles loads are equal. **(4 Point)**

b) Determine the maximum negative moment on the pile cap **(4 Point)**

c) Determine and draw the cap reinforcement in the transfer direction **(3 Point)**

d) If the right column is subjected to clockwise direction moment, $M_y = 80$ tm, Determine the actual load in the hatched pile. **(6 Point)**

Question No. (6) (10 point)



The figure shows a strap beam connecting two columns with suggested pile number and arrangement. The left column is 30 x 70 cm and carries 150 ton while the right column is 40 x 100 cm and carries = 260 ton. The pile diameter = 50 cm and the safe pile load = 80 ton. Considering the given loads are working loads, You are required to:

(i) Find the pile loads **(4 Point)**

(ii) Design <u>only</u> the strap beam **(4 Point)**

(iii) Draw longitudinal section into the strap showing its reinforcement **(2 Point)**

.... *Best Wishes*

Prof. Dr. Mostafa El-Sawaf | *Prof. Dr. Ashraf Nazir* | *Dr. Ahmed Sallam*

Tanta University

Structural Engineering Department

Faculty of Engineering

Course Title	Design of Steel Structures (b)	Academic Year 2022/2023 Second- Semester Exam	Course Code	CSE3211 (Civil)
Year/ Level	Third			
Date	14-6-2023	No. of Pages (8)	Allowed time	3 hrs

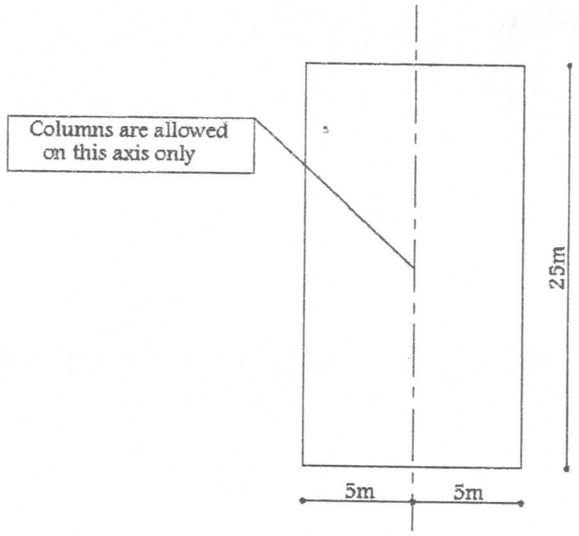
Remarks:

- **The exam consists of six questions in four pages,**
- **Any missing data may be reasonably assumed,**
- **The code of practice and the tables of the steel sections are not allowed to use**

Question Number (1) (10%)

Double side steel cantilever to be established and used as car shed. The dimensions of the covered are to be as shown 10m×25m. The required minimum clear height to be 4.0 m and the used covering material is single layer of steel corrugated sheets.

It is required to draw with suitable scale different views of the system showing the arrangement of systems and the used bracing systems considering that the columns are only allowed on the shown axis.

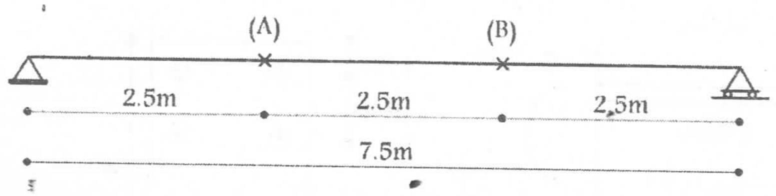


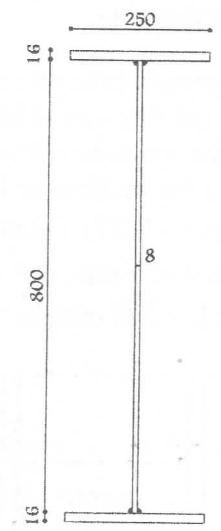
Question Number (2) (20%)

For the shown steel welded section given next, using steel ST37 (F_y = 2.4 t/cm² – F_u = 3.7 t/cm²), **it is required to:**

1. Calculate the values of (M_p , M_r , L_p , L_r) of the beam. (5%)
2. Using the same section, calculate the design flexural strength ($\phi_b M_n$) of the shown simply supported beam which is laterally supported at supports and point (A). (10%)
3. Discuss the effect of using another lateral support at point (B). (5%)

Properties of section			
b_f (mm) =	250	t_f (mm) =	16
h_w (mm) =	800	t_w (mm) =	8
S_{weld} (mm) =	6	A (cm²) =	144
I_x (cm⁴) =	167321	I_y (cm⁴) =	4170
S_x (cm³) =	4022	S_y (cm³) =	333
r_x (cm) =	34.09	r_y (cm) =	5.38



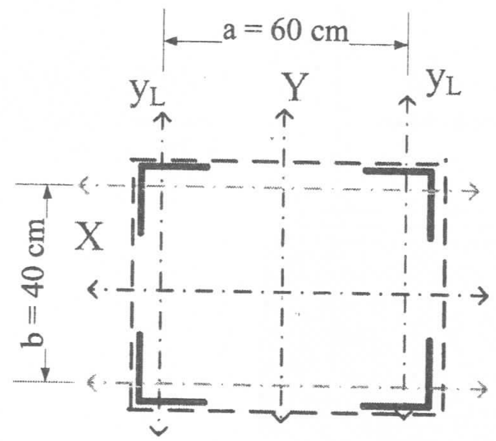


Question Number (3) (20%)

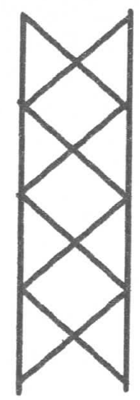
For the combined column given, if no bending moment acting along the column, with normal force N = 22 t and the maximum shear Q = 4 t, as a **double lacing column** using 4 L 120 spaced 60 cm in the direction of the frame and 40 cm perpendicular to the frame as shown in the following figure. (For single angle 120*12: area = 27.50 cm², e = 3.40 cm, I_x = 368 cm⁴, r_x = 3.65 cm, r_v =2.35 cm)

required:

1. Calculate the combined section properties.
2. Arrange single lacing (α = 50°) and calculate the equivalent slenderness ratio λm
3. Find Normal Strength (ϕ Pn) of the given column, given Lb_{inplan} = $Lb_{out\ of\ plan}$ =10 m, St. 37 (F_y = 2.4 t/cm² – F_u = 3.7 t/cm²)
4. Suggest only (without design) the dimensions of welded lacing plate in the direction of frame.



Column cross section



veiw of double lacing plates

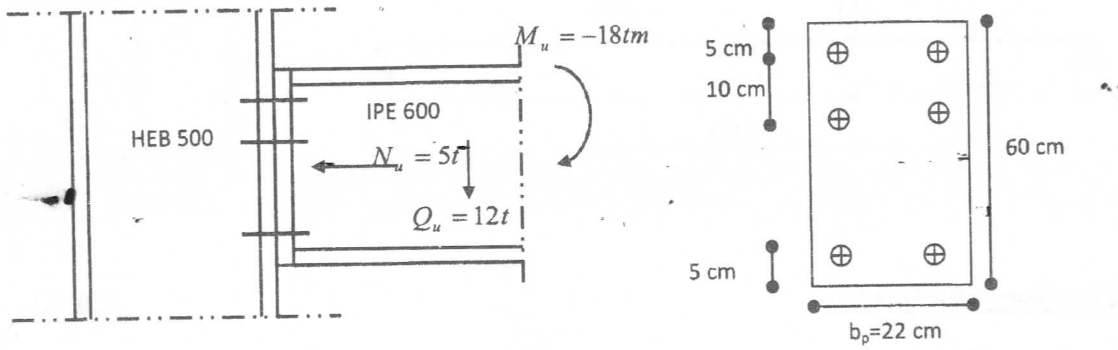
Question Number (4) **(20%)**

For the flush beam-to-column connection shown in the next figure of St 44, **it is required to:**

1. Design the filled weld between the steel beam and the end plate.
2. Drive the equation of the thickness of plate and determined it.
3. Assume the number of bolts in the given connection then, design the bolted connection as category C- M27 of Grade 10.9, $A_s = 4.59 cm^2$.

(IPE 600: h = 600 mm, b_f = 220 mm, t_w =12 mm, t_f = 19 mm)

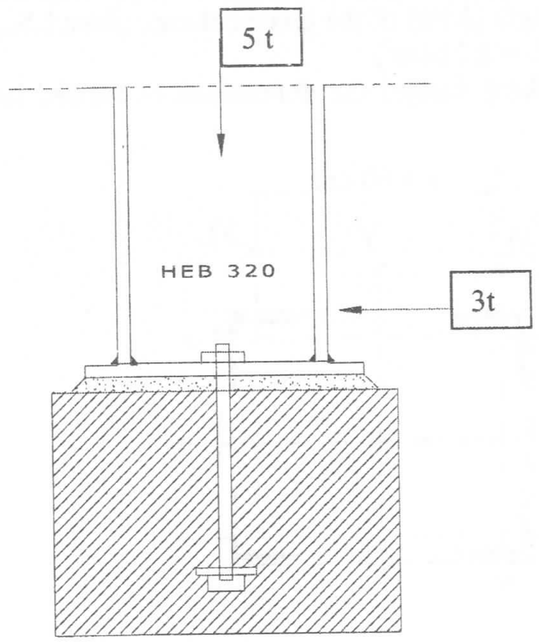
(HEB 500: h = 500 mm, b_f = 300 mm, t_w =14.5 mm, t_f = 28 mm)



Question Number (5) **(10%)**

Design the hinged base shown in the next figure and draw to scale 1:10 elevation and plan to show the detail of the base. (St44, Fcu = 250 kg/cm2, M27 of Grade 10.9, $A_s = 4.59 cm^2$)

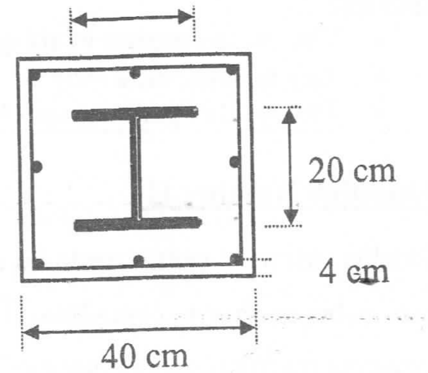
(HEB 320: h = 320 mm, b_f = 300 mm, t_w =11.5 mm, t_f = 20.5 mm)



Question Number (6) **(20%)**

1. It is required to design a composite column of concrete encased I-section type. The column is a hinged-hinged column with a height of 4ms. The design force of the column equals 220t. The steel tube is formed of St 37 and the concrete cubic strength is $300 kg/cm^2$. Assume that the column section is HEB 200. Use 8Φ12mm as a longitudinal reinforcement. **(15%)**

(HEB 200: h = 200 mm, b_f = 200 mm, t_w =9.0 mm, t_f = 15 mm)



2. *Discuss briefly the following:* **(5%)**

a) Different types of the Composite columns.

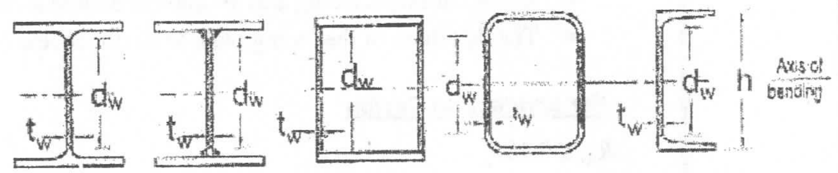
b) Methods of construction for composite beams.

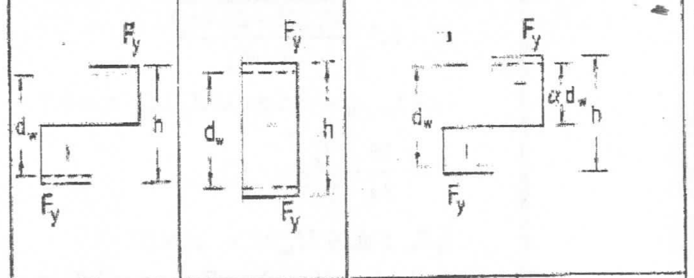
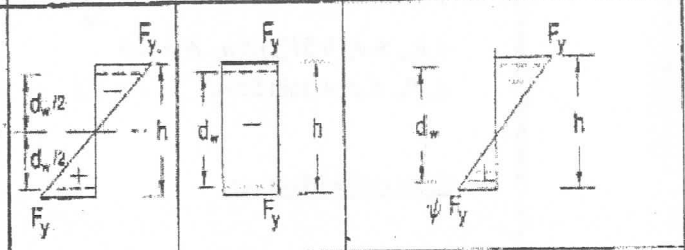
c) Types of shear connectors.

Design Aids

Table 2.12a Maximum Width to Thickness Ratios for Stiffened Compression Elements

(a) Webs: (Internal elements perpendicular to axis of bending)

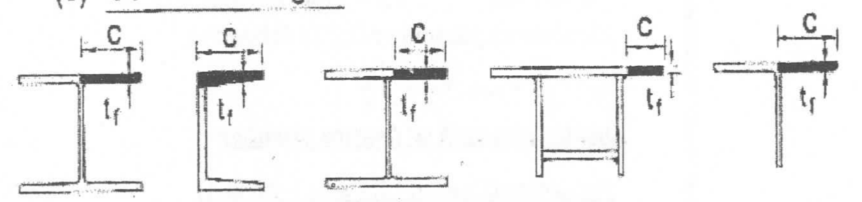


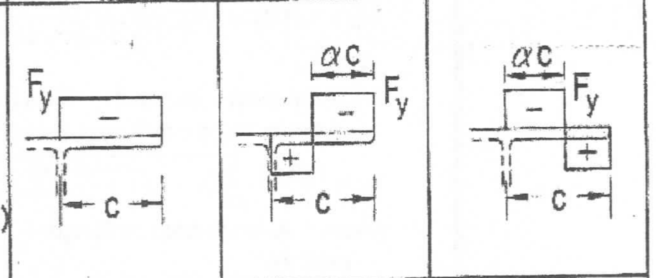
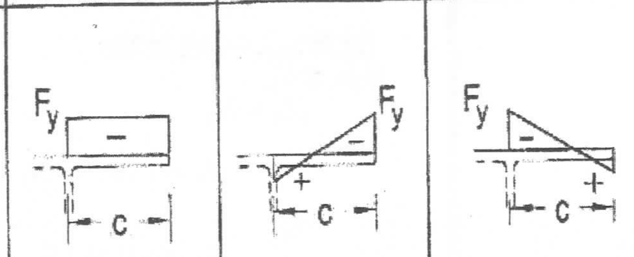
Class / Type	Web Subject to Bending	Web Subject to Compression	Web Subject to Bending and Compression	
1. Compact Stress distribution in element.				
Not for single channel (λ_p)	$\alpha = 0.5$	$\alpha = 1.0$	$\alpha > 0.5$	$\alpha \leqslant 0.5$
	$\frac{d_w}{t_w} \leqslant \frac{127}{\sqrt{F_y}}$	$\frac{d_w}{t_w} \leqslant \frac{58}{\sqrt{F_y}}$	$\frac{d_w}{t_w} \leqslant \frac{699/\sqrt{F_y}}{13\alpha - 1}$	$\frac{d_w}{t_w} \leqslant \frac{63.6/\alpha}{\sqrt{F_y}}$
2.Non-Compact Stress distribution in element. (λ_r)				
	$\psi = -1$	$\psi = 1$	$\psi > -1$	$\psi \leqslant -1$
	$\frac{d_w}{t_w} \leqslant \frac{222}{\sqrt{F_y}}$	$\frac{d_w}{t_w} \leqslant \frac{64}{\sqrt{F_y}}$	$\frac{d_w}{t_w} \leqslant \frac{222/\sqrt{F_y}}{2+\psi}$	$\frac{d_w}{t_w} \leqslant \frac{111(1-\psi)\sqrt{-\psi}}{\sqrt{F_y}}$

F_y in t/cm^2

Table 2.12c Maximum Width to Thickness Ratios for Unstiffened Compression Elements

(c) Outstand Flanges



Class / Type		Flange Subject to Compression Due to M_x	Flange Subject to Compression and Bending: Tip in Comprssion	Flange Subject to Compression and Bending: Tip in Tension
1. Compact Stress distribution in element (not for single channel or T section) (λ_p)				
	Rolled	$\frac{C}{t_f} \leqslant 16.9/\sqrt{F_y}$	$\frac{\alpha C}{t_f} \leqslant 16.9/\sqrt{F_y}$	$\frac{\alpha C}{t_f} \leqslant 16.9/\sqrt{\alpha F_y}$
	Welded	$\frac{C}{t_f} \leqslant 15.3/\sqrt{F_y}$	$\frac{\alpha C}{t_f} \leqslant 15.3/\sqrt{F_y}$	$\frac{\alpha C}{t_f} \leqslant 15.3/\sqrt{\alpha F_y}$
2. Non-Compact Stress distribution in element (λ_r)				
	Rolled	$\frac{C}{t_f} \leqslant 33/\sqrt{F_y}$	$\frac{C}{t_f} \leqslant 50\sqrt{K_\sigma/F_y}$	
	Welded	$\frac{C}{t_f} \leqslant 28/\sqrt{F_y}$	$\frac{C}{t_f} \leqslant 43\sqrt{K_\sigma/F_y}$	

F_y in t/cm^2

For K_σ see Tables 2.14 & 2.15

Design strength of compression member

$P_u = \phi_c * P_n = \phi_c * A_g * F_{cr}$ where $\phi_c = 0.8$

For $\lambda_c \le 1.1$ $F_{cr} = f_y\left(1 - 0.384\,\lambda_c^{\,2}\right)$

For $\lambda_c > 1.1$ $F_{cr} = 0.648\, f_y/(\lambda_c)^2$

Slenderness parameter (λ_c) is defined as

$$\lambda_c = \sqrt{\frac{f_y}{f_e}} = \lambda_{max} * \frac{1}{\pi} * \sqrt{\frac{f_y}{E}}$$

Design strength of flexure member

For compact section ($L_b \le L_p$) (zone 1).

If $L_b \le L_p$ so $M_n = M_p$ $M_u = 0.85\, M_n$

$L_p = \frac{80\, r_{min}}{\sqrt{f_{yf}}}$ for I shaped r_{min} is radius of gyration, f_{yf} is yield stress for flange

For compact section ($L_p < L_b \le L_r$) (zone 2)

$$M_n = C_b\left[M_p - (M_p - M_r)\left\{\frac{Lb - Lp}{Lr - Lp}\right\}\right] \le M_p$$

Where :

M_p is the plastic moment M_r is the limiting buckling moment = F_L .S

C_b is the bending coefficient such that

$$L_r = \frac{1380\, A_f}{d.F_L}\sqrt{\frac{1}{2}\left(1 + \sqrt{1 + (2\,X\,F_L)^2}\right)}$$ for I shaped & channels

Where : A_f is the area of flange d is total depth $F_L = 0.75\, f_y$ (for rolled section) = $0.6\, f_y$ (for welded section)

$X = \left(\frac{0.104\, r_t\, d}{A_f}\right)^2$ r_t is radius of gyration about minor axis for flange and 1/6 of the web.

For compact section ($L_b > L_r$) (zone 3)

$M_n = C_b\, M_{cr}$ Where: C_b is the bending coefficient

M_{cr} is the critical elastic moment, determine as follow: $M_{cr} = S\sqrt{\left(\frac{1380\, A_f}{d\, L_b}\right)^2 + \left(\frac{20700}{(L_b/r_t)^2}\right)^2} \le M_p$

For Non-Compact section

a) $L_b \le L'_p$

$$M_n = M_p$$

$$M_n = \left(M_p - (M_p - M_r)\left(\frac{\lambda - \lambda_p}{\lambda_r - \lambda_p}\right)\right) Cb \le M_p$$

$$L'_p = \left(L_p + (L_r - L_p)\left(\frac{M_p - M_n}{M_p - M_r}\right)\right)$$

b) $L'_p < L_b \le L_r$

M_n shall be computed as the smaller of

$$M_n = \left[M_p - (M_p - M_r)\left(\frac{L_b - L_p}{L_r - L_p}\right)\right] C_b \le M_p$$

and

$$M_n = \left(M_p - (M_p - M_r)\left(\frac{\lambda - \lambda_p}{\lambda_r - \lambda_p}\right)\right) Cb \le M_p$$

c) $L_b > L_r$

$$M_n = C_b\, M_{cr} \le M_p$$

$$M_{cr} = S_x\sqrt{\left(\frac{1380\, A_f}{d\, L_b}\right)^2 + \left(\frac{20700}{(L_b/r_T)^2}\right)^2} \le M_p$$

For Built up column

- The slenderness ration λi of the individual component $\lambda i < 60$ or 2/3 λmax

$$\lambda_m = \sqrt{\left(\frac{KL}{r}\right)^2 + \left(\frac{L_z}{r_i}\right)^2}$$

- where λm is the equivalent slenderness ratio for lacing member
- $\lambda < 140$ in single lacing and $\lambda < 200$ for double lacing.
- The thickness of the lacing plate shall not be less (a/50).

For connection Design

$$R_{uw} \le 0.4SF_u$$

$$(R_{uw})_{eff} = \sqrt{(R_{uw,f})^2 + 3(R_{uw,q})^2} \le 0.77(0.4SF_u)$$

$$t_p = 0.5\sqrt{\frac{M_u(2b + 2s + t_b)}{d_b w F_y}}$$

$$(\gamma_i T_i)_{ext,b,M} + P \le \phi_t(0.8F_{ub})A_s,\ \phi_t = 0.7$$

$$P = \left[\frac{5b}{8a} - \frac{t_p^3}{100}\right].(\gamma_i T_i)_{ext,b,M}$$

$$\phi_v R_{nv} \le \phi_v(0.5F_{ub})A_s n,\ \phi_v = 0.6$$

$$\phi_{br} R_{br} \le \phi_{br} d(\min \Sigma t(\alpha F_u)),\ \alpha = 2.0,\ \phi_{br} = 0.7$$

For bases

$$P_u \le \varphi c(0.67 * F_{cu} * Area_1)\sqrt{\frac{Area_2}{Area_1}}$$

$$\phi_v R_{nv} \le \phi_v(0.5F_{ub})A_s n,\ \phi_v = 0.6$$

$$\phi_{br} R_{br} \le \phi_{br} d(\min \Sigma t(\alpha F_u)),\ \alpha = 2.0,\ \phi_{br} = 0.7$$

Composite Member:

$$\phi_c P_n = \phi_c A_s F_{cr}$$

$F_{cr} = F_{ym}(1 - 0.384\lambda_m^{\,2})$ $\lambda_m \le 1.1$

$F_{cr} = 0.648 F_{ym}/\lambda_m^{\,2}$ $\lambda_m \ge 1.1$

$F_{ym} = F_y + c_1 F_{yr}\left(\frac{A_r}{A_s}\right) + c_2 f_{cu}\left(\frac{A_c}{A_s}\right)$ $E_m = E_s + c_3 E_c\left(\frac{A_c}{A_s}\right)$

$c_1 = 0.7$ $c_2 = 0.48$ $c_3 = 0.40$ for encased composite columns

$$\lambda_m = \frac{L_b\sqrt{\frac{F_{ym}}{E_m}}}{\pi r_m}$$

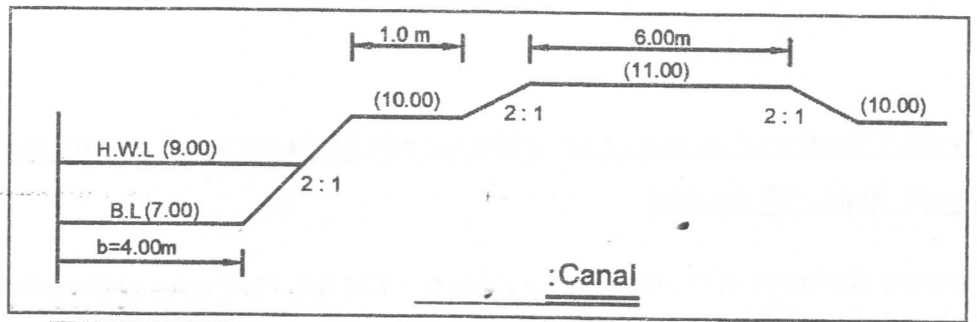
1. **Check** the hydraulic design if the maximum discharge is **6 Mm^3/day – high water level is (6.50)**. (5 marks)
2. **Give** the complete structural design of the bridge **slab and sidewalks.** (10 marks)
3. **Check** the soil bearing capacity under the pier for the case of **maximum axial force.** (5 marks)
4. **Calculate** the straining action of the pier **and Calculate** the foundation depth of the pier, **K_1=1 and D_{50}=8mm.** (5 marks)
6. **Check** the stability of **R.C. abutment (stem thickness =40cm, base thickness and length are 80cm and 4m, foundation depth is 1.5m).** (10 marks)
7. **Draw,** into scale of **1:20, the reinforcement** details of the **bridge slab** and the **sidewalk.** (5 marks)

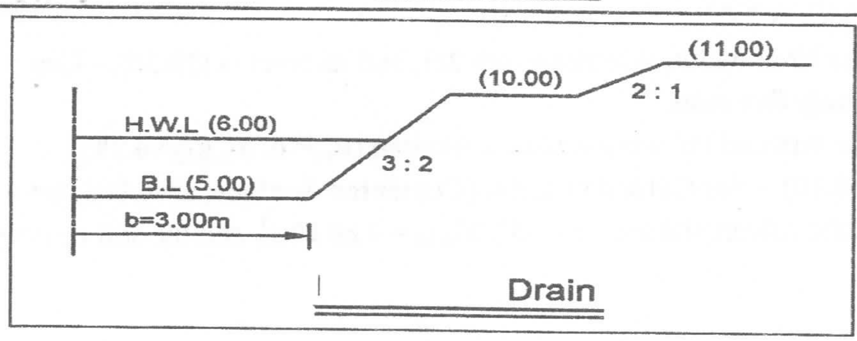
Question No. 2 (55 Marks)

A. Give and discuss, using neat sketches, **(15 marks)**

1. The acting forces for **steel hope** and **penetration length of bolts** at the aquaducts design.
2. The **culvert design considerations.**
3. **Five types** of the **culvert flow condition.**

B. For the following figures of cross sections, using **scale (1:100)**, Draw a **Half longitudinal section** of (2 vents) **RC Box syphon (S=H=1.10m),its thickness=0.30m** showing **all levels, dimensions and the seepage line. (10 marks)**





Tanta University Faculty of Engineering Construction Engineering Program		
Course Title: design of irrigation works 1	Course Code: CIH3206	Final Exam
Date: June,2023	No. of Pages: 3	Allowed time: 4 hours

INSTRUCTIONS:

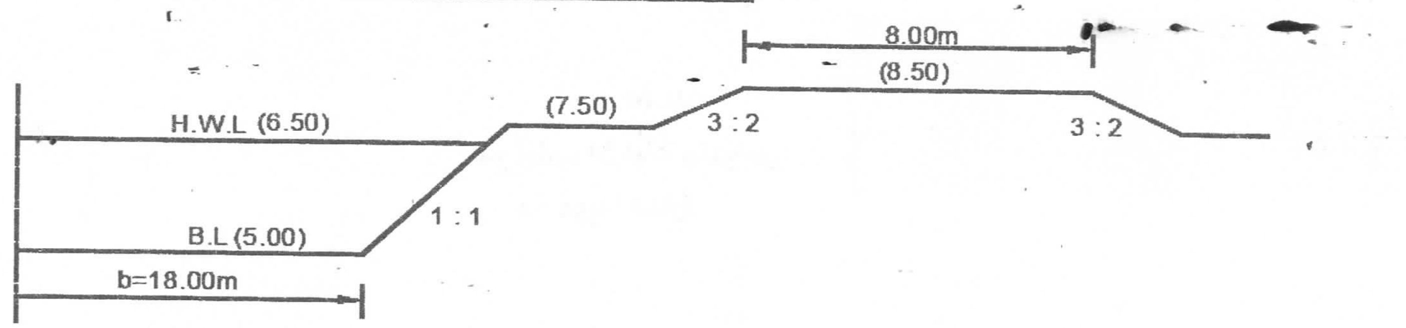
- غير مسموح باصطحاب أى جداول أو منحنيات -.
- The exam consists of **2 questions,** answer all questions.
- This is a closed book exam; no external material is permitted.
- The total value of the exam is **100 marks** (5 marks over); the value of each question is indicated.
- Systematic arrangement of calculations and **clear neat drawings are essential**.
- Make suitable assumptions where necessary.

Question 1: (50 marks)

A. Distinguish between the following items: (10marks) clear neat drawings are required.

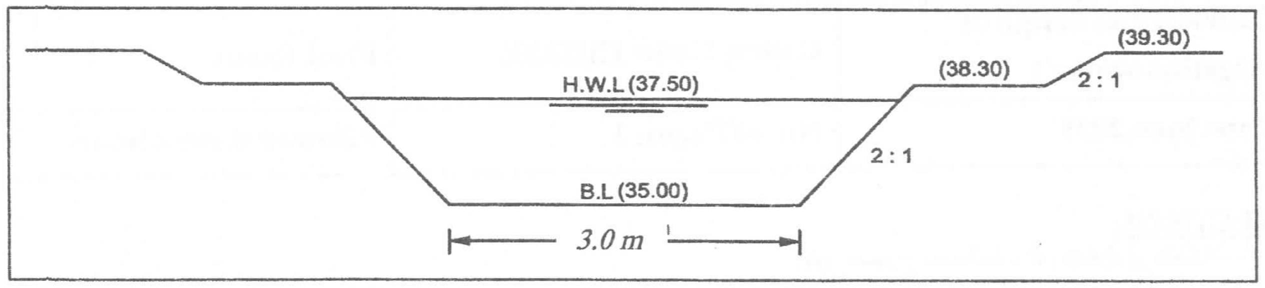
1. **Super passage** and **syphon super passage.**
2. **Counterfort** Walls and **Buttress** Wall.
3. **Armouring and altering countermeasurments.**
4. **Toe and heel** design.
5. **Sand and clay soil at the retaining wall foundation**

B. A **RC slab bridge** is to be constructed across the shown **Lined** main canal shown in Figure. The bridge consists of **two vents**, each is **7 m span**. The crossing road is a **10 m** width, its level is **(8.50)** and its side slopes are 3:2. **(According to code of load 2012): (40 marks)**



The bridge deck width is **12 m** and has 2 sidewalks of **1.5m** each.
- PC pier of **1 m** width is used.
- The US and DS used wing walls are **RC box walls.**

The soil properties at the bridge site are: **φ** = 30°, **Ɣbulk** = 1.7 t/m^3, **Ɣsat** = 1.9 t/m^3, GWL= (6.00) and the soil bearing capacity is **2** kg/cm^2.
- For **RC** elements, **steel (36/52)** and **concrete (Fcu = 250 kg/cm2)** are used.



1. **Check** the culvert hydraulic design. (**Kr** =0.1 , **a**=0.003 & **b** = 0.03) **(5 marks)**
2. **Give** the complete structural design of the culvert only , considering **only** the **worst case of loading (15 marks)**

$$\frac{d_s}{a} = 0.32K_1(\frac{a'}{a})^{0.62}(\frac{y_{ds}}{a})^{0.46}F_{ra}^{\ 0.2}(a/D_{50})^{0.08}+1$$

For Box Culvert

$$K_f = f \times (\frac{L}{4R}) \ , \ f = a \times (1+\frac{b}{R})$$

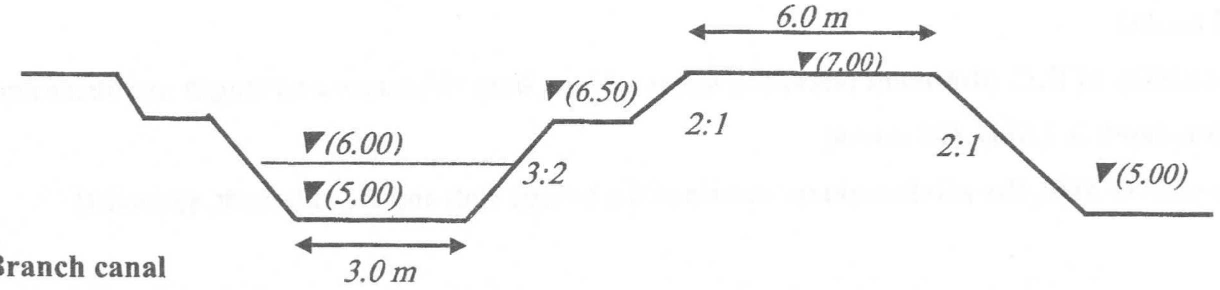
End of questions, Best Wishes,

إنتهت الأسئلة

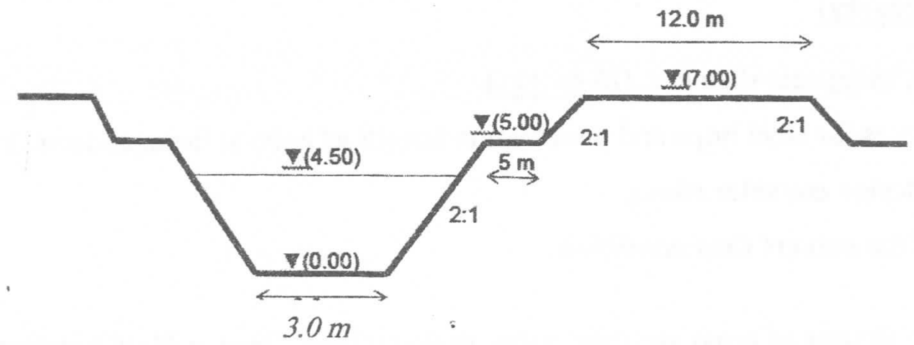
مع أطيب الأمنيات بالتوفيق

د / هويدا عمارة

C. <u>A steel pipe aquaduct (3 pipes with diameter of 0.9m each) will be constructed to pass the discharge of the branch canal across the main canal. (10 marks)</u> The maximum passing discharge of the branch canal is **3 m³/sec.**



Branch canal



Main canal

1. If the **aquaduct length is 30 m** to get the most economic section **find the space between the two supports.**
2. If the **total aquaduct length is 80 m,** the US and DS used box wings walls check **the hydraulic losses.**

D. <u>A RC Box Culvert (1 vent) and its thickness (t=30cm) will be constructed to pass the discharge of the canal under a main Road. (20 marks)</u>

- The maximum passing discharge of the canal is **10 m³/sec.** - The **internal span** of the culvert vent equals to **its internal height** which is **2.40**m.
- The main road width is **10 m** width, side slopes are **2:1**, and its level is **(39.30)**. - Use an equivalent live load of **2 t/m²** as the **only live load.**
- The US wing walls are **box** and DS wing walls are **broken** (**k_{en}= 0. 5 , k_{ex}= 0.70**).
- At rack location (**k_r=0.10)** - For Culvert material (**Cemented Surface; a= 0.003, b= 0.03**)
- The soil properties at the culvert site are: **φ = 30°, γ_{bulk} = 1.80 t/m³**, and the soil bearing capacity is **1.60** kg/cm²