CAMEROON GENERAL CERTIFICATE OF EDUCATION BOARD

Technical and Vocational Education Examination

JUNE XXXX **INTERMEDIATE LEVEL**

Specialty/Spec. Code	**ARCHITECTURAL DRAFTMANSHIP** CE-AD(F4 BE)
Subject Title	**ARCHITECTURAL APPLIED MECHANICS 2**
Subject Code No.	**7215**
Paper No.	**TWO**

INSTRUCTIONS TO CANDIDATES

DURATION: THREE HOURS

Answer FOUR questions. Choose TWO questions in Section A and ONE in Sections B and C.

All questions carry equal marks.

The total marks for this paper is 100.

Precise answers should be given and where necessary support them with neat sketches.

Answers should be corrected to two decimal places. Take $\pi = 3.14$.

You are allowed to use a mathematical set and a non-programmable calculator.

You are reminded of the necessity for good English and orderly presentation in your answers.

SECTION A: MATERIAL

QUESTION 1

1) Here below is one of the beams of an overhead transportation system use in warehouse. The displacement of objects is done through a bloc of trolleys as indicated in figure 6 below.

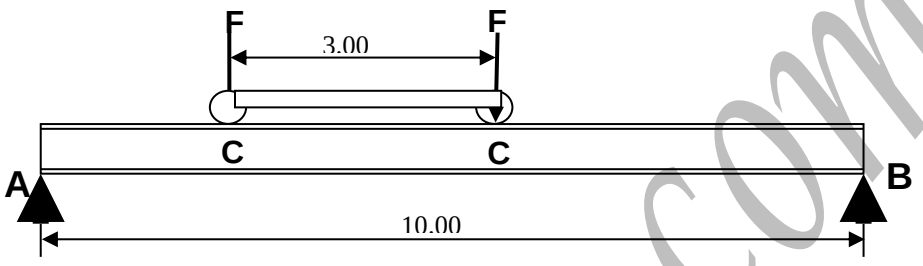


Figure 6

Considering that: F1 = 20kN and F2 = 30kN

a) Calculate the resultant force and indicate its position about C_1 **(4 marks)**

b) Determine using Barre's Theorem the maximum bending moment under each wheel or load and indicate the critical position of the trolley (neglect the self-weight of the profile). **(10 marks)**

c) Position the wheel C1 on the beam such as to obtain the maximum shear force in the beam and calculate its value. **(6 marks)**

QUESTION 2

The diagram in **figure 2** below is a beam loaded as shown. We intend to study the solicitations, in order to make an appropriate choice of IPE beam.

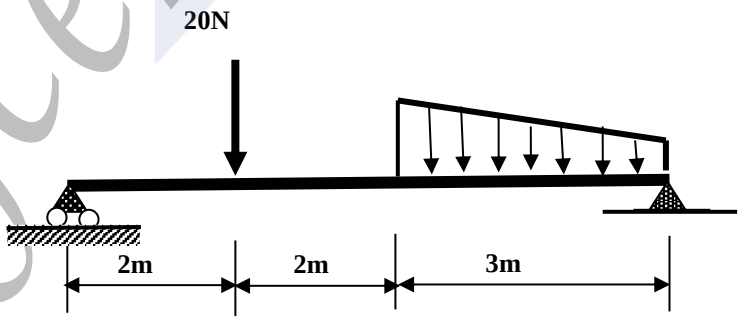
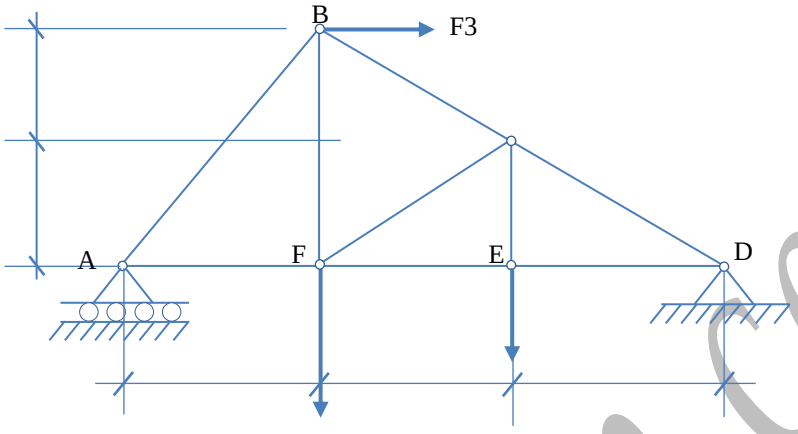


Figure 2

1. Determine the load variation equation between x=4m and x=7m. **(2 marks)**
2. Determine the reaction at the supports. **(8 marks)**
3. Draw the diagram of T(x) and M(x) **(10 marks)**

QUESTION 3:

A frame is loaded as shown on the figure below. Given that F1=1500daN, F2 = 1300daN and F3=1600daN



a) Prove that the frame is structurally determinate. **(2 marks)**

b) Isolate the frame and calculate the reactions at A and D **(6 marks)**

c) Isolate knot D and determine F_{DE} and F_{DC} and state their mature. **(6 marks)**

d) Isolate knot D and determine F_{EF} and F_{EC} **(6 marks)**

QUESTION 4:

Figure 4(a) below is the formwork plan of a RC shelter of a fuelling station. We wish to design longitudinal reinforcements for Beam B1. As shown on the plan, B1 is supporting a 6.00m long by 5.20m wide RC floor surface. Considering its mechanical diagram in figure 4b and given that the service load on the floor slab is 200daN/m^2, density of RC is 2500daN/m^3, fc_{28} = 20MPa, and Rods are Fe E400 type 1

(4) (a). Calculate the service load transmitted by the slab per unit length of the beam B1 **(3 marks)**

(b) Calculate the dead load per unit length of the beam B1 neglecting the slope on the slab **(3 marks)**

(c) Deduce the combined load at the ultimate limit state Pu per unit length of the beam B1. **(3 marks)**

(d) Knowing that the maximum bending moment at the supports and at mid span is given by Pul^2/12 and Pul^2/24 respectively and considering that Pu=3990daN/ml, deduce the moment over B1 at X=0, X=L/2, and at X=L, **(5 marks)**

(e) Considering that the section of longitudinal rods at the mid span and at the supports is respectively 3.344cm^2 and 7.08cm^2, choose the appropriate diameter and number of rods from table below and draw a longitudinal section of B1 to show how the longitudinal rods should be positioned. **(6 marks)**

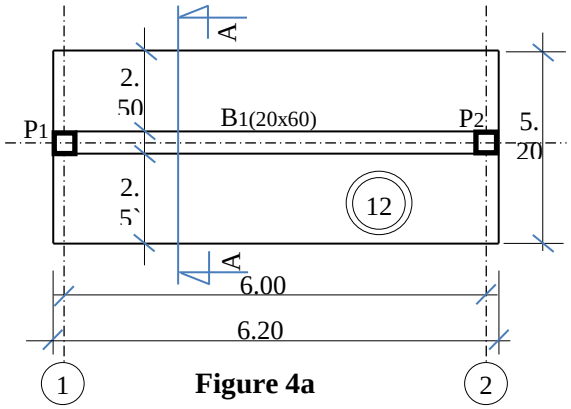


Figure 4a

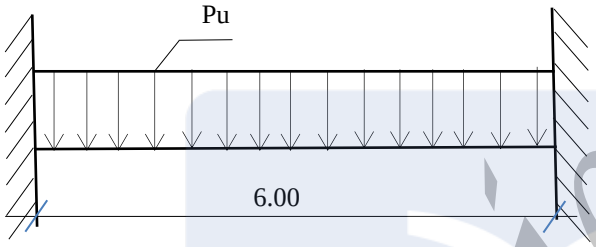


Figure 4b: Mechanical diagram of

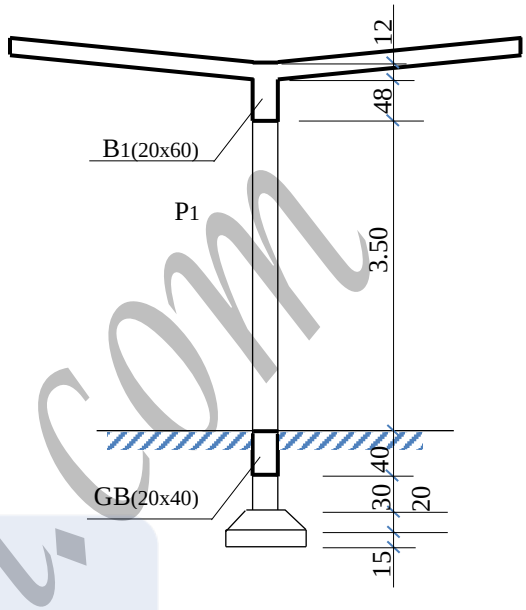


Figure 4b: Section A-

QUESTION 5:

Below is a wooden beam of cross section (bxh) such that h=3b, resting on two simple support and design to carry a point load at mid span as seen on the simulated mechanical sketch. We intend to determine a safe cross sectional area. Given the following data;

L=6m, F=6kN, E=-2x10^5 N/mm^2 , Y_{lim} =L500,Y(1/2)=PL^3 /4EI, Mmax=FL/4, σ=100 N/mm^2

(a) Calculate RA **(1 marks)**

(b) Calculate Mmax **(1 mark)**

(c) Determine b and h using the rigidity condition **(8 marks)**

(d) Determine b and h using the bending condition **(8 marks)**

(e) What can you conclude **(2 marks)**

QUESTION 6

2. A 5.00 meters long structural member is fixed at the extreme right end, on a roller support at the left end and loaded as shown here below in figure 2.

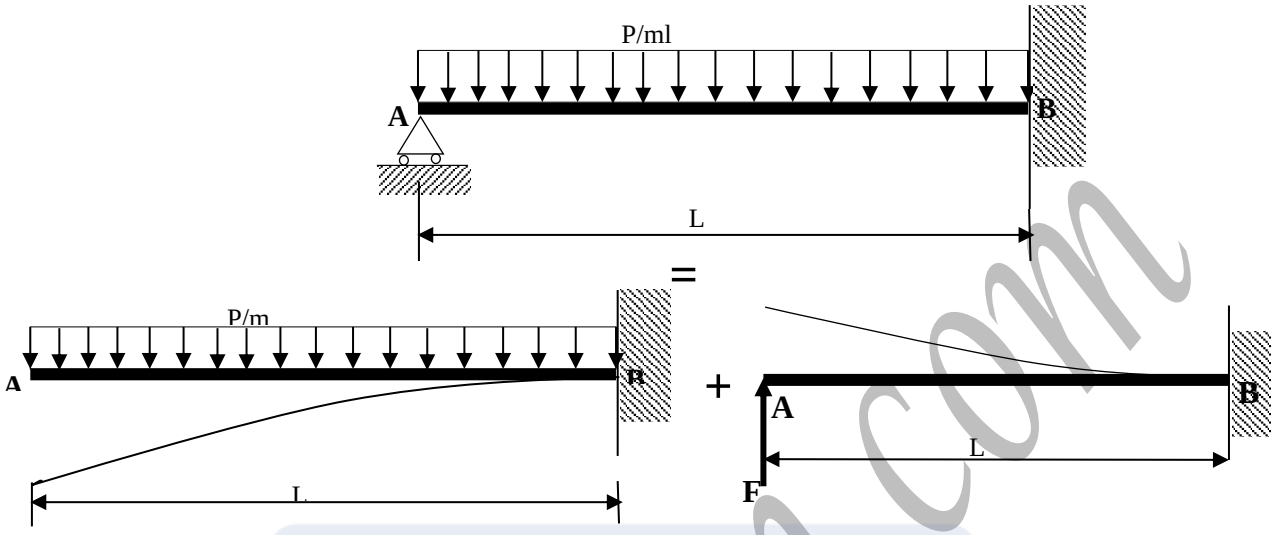


Figure 2

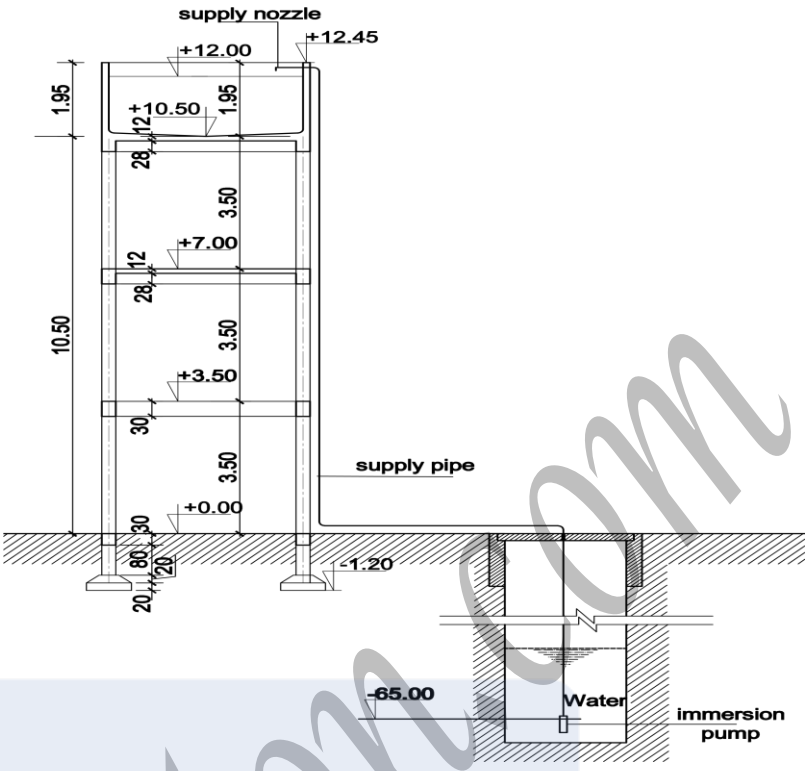
Max. Deflection = $-\frac{PL^4}{8EI}$ Max. Deflection = $\frac{FL^3}{3EI}$

a) Calculate the contact actions at the supports $\mathbf{R_A}$, $\mathbf{R_B}$ **and** $\boldsymbol{\mu}_B$ in function of **P** and **L**. **(6 marks)**

b) Given that the ultimate moment at the support Mu=200KNm, Mser=140KNM,Fe=50
Calculate the reinforcement at the support and represent the horizontal section. **(14 marks)**

QUESTION 7

The figure bellow is a RC reservoir, designed to store and supply water to an inn in your neighbourhood. Water is drawn from a well as shown on the figure with the aid of an immersion pump powered by electric energy, through the supply pipe to the reservoir. The proprietor of the inn has consulted you for technical advice. The reservoir is equipped with a floater whose rule is to put of the pump once water reaches an elevation of 12 meters in the reservoir and put it on when the reservoir is running dry.



a) What must be the pressure head of this pump for it to be able to supply this reservoir? **(3 marks)**

b) Calculate the volume of water in the tank when it is full with the free water surface being at 12.00 meters **(3 marks)**

c) Assuming that the volume of water necessary to fill the tank is 10.644m^3, what would be the flow if the pump takes 60 minutes to fill the tank? **(2 marks)**

d) Calculate the velocity through the supply pipe if the diameter is 32mm **(4 marks)**

e) Calculate the velocity through the nozzle if a diameter of a nozzle is 15mm. **(4 marks)**

Appendix 1

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