



PNG UNIVERSITY OF TECHNOLOGY
DEPARTMENT OF CIVIL ENGINEERING – 3rd YEAR DEGREE
SECOND SEMESTER EXAMINATIONS – 2021

CE 322 DESIGN OF CONCRETE STRUCTURES

DATE: **Thursday, 4th November 2021**

ROOM: **C004/005**

TIME: **08:30 a.m.**

TIME ALLOWED: **3 Hours**

INFORMATION FOR CANDIDATES.

1. You have 10 minutes to read the Paper. You must not begin writing during this time.
2. Answer any four (4) questions out of seven (7).
3. All answers must be written on the answer book provided. No other written material will be accepted.
4. Write your name and number clearly on the front page. Do it now.
5. This is an Open book Exam. Calculators may be used. Notes and Code (AS 3600) are allowed.

Marking Scheme

6. All Questions carry equal marks.

QUESTION ONE *Concrete Material Characteristics/Properties (10marks)*

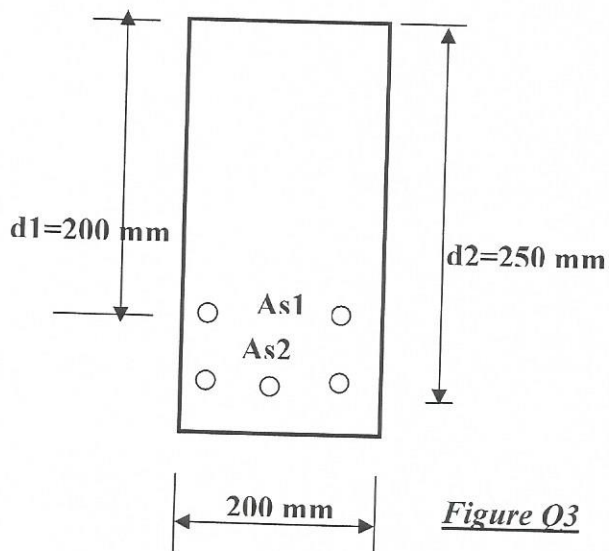
1. Cement – describe the role of cement in the concrete mix.
2. Aggregates – describe the role of each of the following concrete ingredients:
 - a) Course aggregates
 - b) Fine aggregates
 - c) Cement
3. State the significance of the Water/Cement ratio in a concrete mix.
4. Briefly describe the slump test and its purpose.

QUESTION TWO *Properties of Concrete and Codes (10 Marks)*

- 2.1 Describe the following properties of fresh and hardened concrete:
 - i) Workability of concrete
 - ii) Durability of concrete
 - iii) Characteristic strength of concrete.
- 2.2) What is the role of AS 3600 in the design of concrete structures?

QUESTION THREE *Singly Reinforced Concrete beams. (10 Marks)*

- 1) What is the purpose of using load factors (α) in the design of Concrete structures?
- 2) What is the purpose of using Capacity Reduction Factors (ϕ) in the design of Concrete structures?
- 3) Determine the flexural capacity of the singly reinforced concrete beam shown in **Figure Q3**. State clearly any assumptions made.

**Data:**

$$\begin{aligned}As_1 &= 200 \text{ mm}^2 \\As_2 &= 250 \text{ mm}^2 \\f'_c &= 25 \text{ MPa} \\f_y &= 275 \text{ MPa}\end{aligned}$$

Figure Q3

QUESTION FOUR *Doubly Reinforced Concrete.* (10 Marks)

- 1) State two (2) reasons why Compression Steel may be required in the design of a beam. (4 marks).
- 2) A doubly reinforced rectangular section has the following properties:
 $b = 279 \text{ mm}$; $d = 508 \text{ mm}$; cover, $c = 51 \text{ mm}$; $A_{sc} = 600 \text{ mm}^2$; $A_s = 2600 \text{ mm}^2$; $E_s = 200,000 \text{ MPa}$; and, $f_y = 275 \text{ MPa}$; and, $f'_c = 20.7 \text{ MPa}$

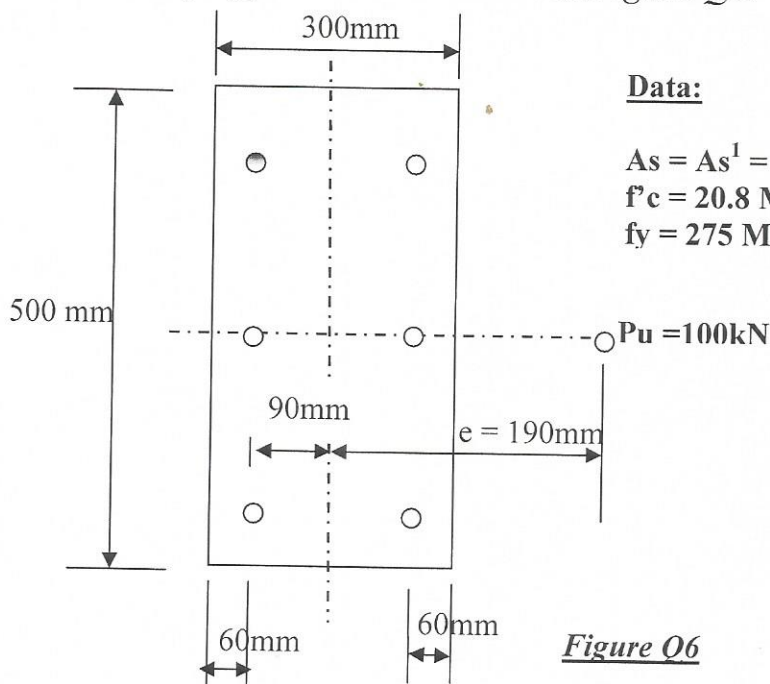
Calculate the ideal flexural strength of the beam. (6 marks).

QUESTION FIVE *Pre-stressed Concrete* (10 marks)

- 1) Define what is meant by prestressed concrete.
- 2) Concrete is generally a compression and brittle material. How does prestressing concrete transform it into an elastic material?
- 3) Define the following terms associated with prestressed concrete:
 - a) Pretensioning
 - b) Posttensioning
- 4) Describe what pre-camber is and what is its role for concrete beams.

QUESTION SIX *Concrete Columns* (10 Marks)

Calculate the flexural capacity of a concrete column loaded by an eccentrically applied load as shown in *Figure Q6*.



QUESTION SEVEN. *Shear Reinforcement for beams* **(10 Marks)**

For the doubly reinforced concrete beam in Question Four above, when it is loaded by a uniformly distributed load (UDL) of intensity 15 kN/m, on simple supports, design the shear reinforcement required by AS 3600 for this situation. Span between supports is 6m

End of Exam.