NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF THE BUILT ENVIRONMENT

DEPARTMENT OF ARCHITECTURE

STRUCTURAL DESIGN

BAR 2108

Examination Paper

December 2024

This examination paper consists of 5 printed pages

Examiner's Name : **Eng. Mudhindi**
Time Allowed : **3 hours**

Total Marks : **100**

Special requirements : **BS 8110-1:1997**

Graph Paper

INSTRUCTIONS

Candidates should answer any **four (4) questions**.

MARK ALLOCATION

QUESTION	MARKS
1	25
2	25
3	25
4	25
5	25

QUESTION 1

The four –span slab shown in **figure 1** below supports a live load of 3 kN/m 2

, plus finishes and ceiling loads of 2 kN/m2 . Assume 1hr fire resistance and mild exposure.

fcu =30mPa and **fy**=460mPa , **fyv**=250 mPa .The slab Thickness is 175mm ,columns are

400 x400 .

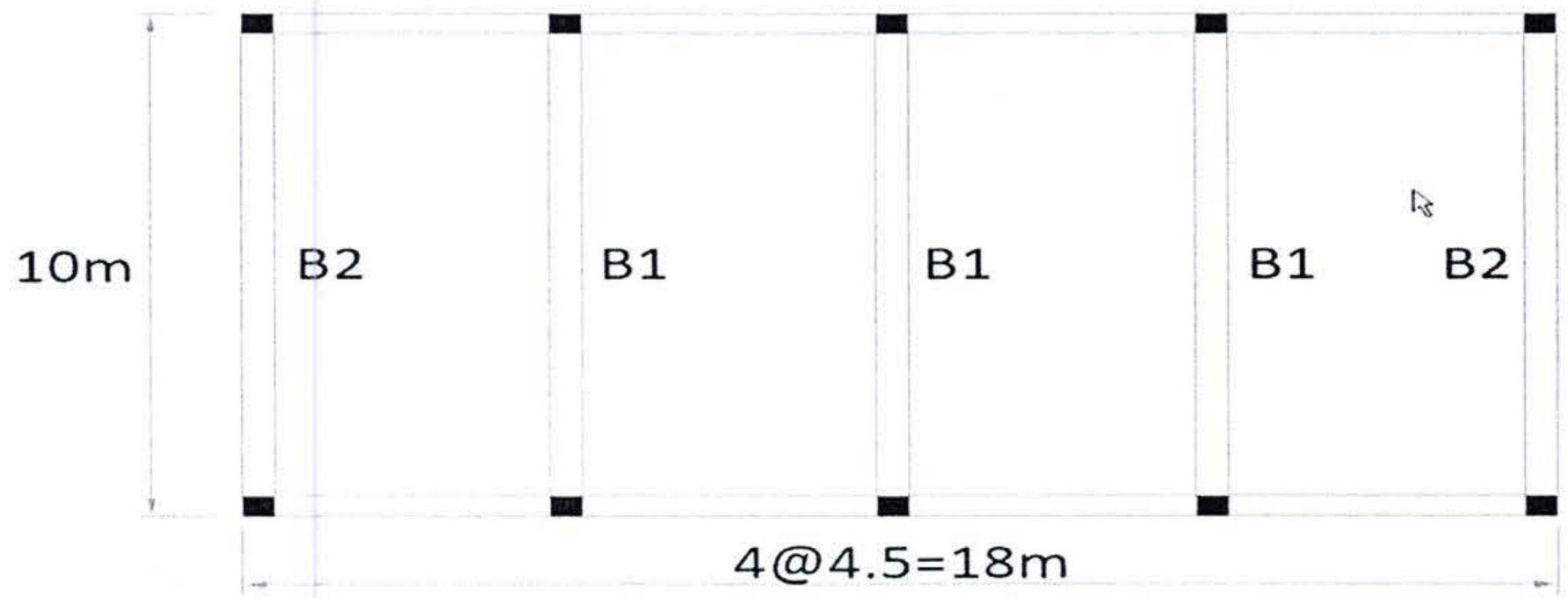

Figure 1

Design the beam B1 (25)

QUESTION 2

(a) For the beam and loading shown in **figure 2**,

I. Calculate the reactions at the supports (5)

II. Draw the shear force and bending-moment diagrams (15)

III. Determine the maximum absolute values of the shear and bending moment (5)

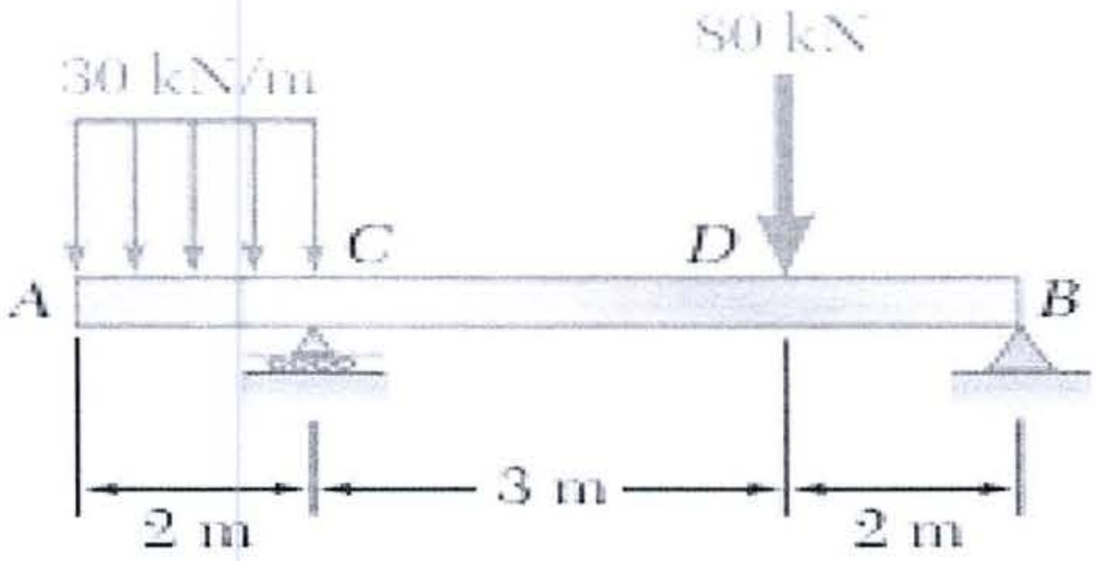

figure 2

QUESTION 3

(a) Providing illustrations, explain the following concepts as used in structural analysis:

i) Point load, (2)

ii) uniformly distributed load (UDL) (2)

iii) uniformly varying load (UVL). (2)

(b) Describe the different types of beam supports (6)

(c) What is the significance of shear force and bending moment diagrams in beam analysis? (5)

(d) Explain the steps involved in designing a beam for a given loading condition. (7)

(e) What factors influence the selection of a beam section? (1)

QUESTION 4

(a) Explain the load path in a typical building structure, (5)

(b)

i. What factors influence the design of foundations? (4)

ii. Explain any **four (4)** different types of foundations and their suitability for various soil conditions. (8)

iii. What are the core principles of sustainable design, and how can these be applied to architectural projects in Zimbabwe? (8)

QUESTION 5

i. a) Explain the following terms as used in static equilibrium of structures:

   i. Statically determinate

   ii. Statically indeterminate

   iii. Unstable

   iv. Improperly constrained

   v. Degree of indeterminacy (5)

b) Explain the procedure for the analysis of reactions in beams (5)

c) Locate the centroid of the steel girder shown in **Figure3.** (15)

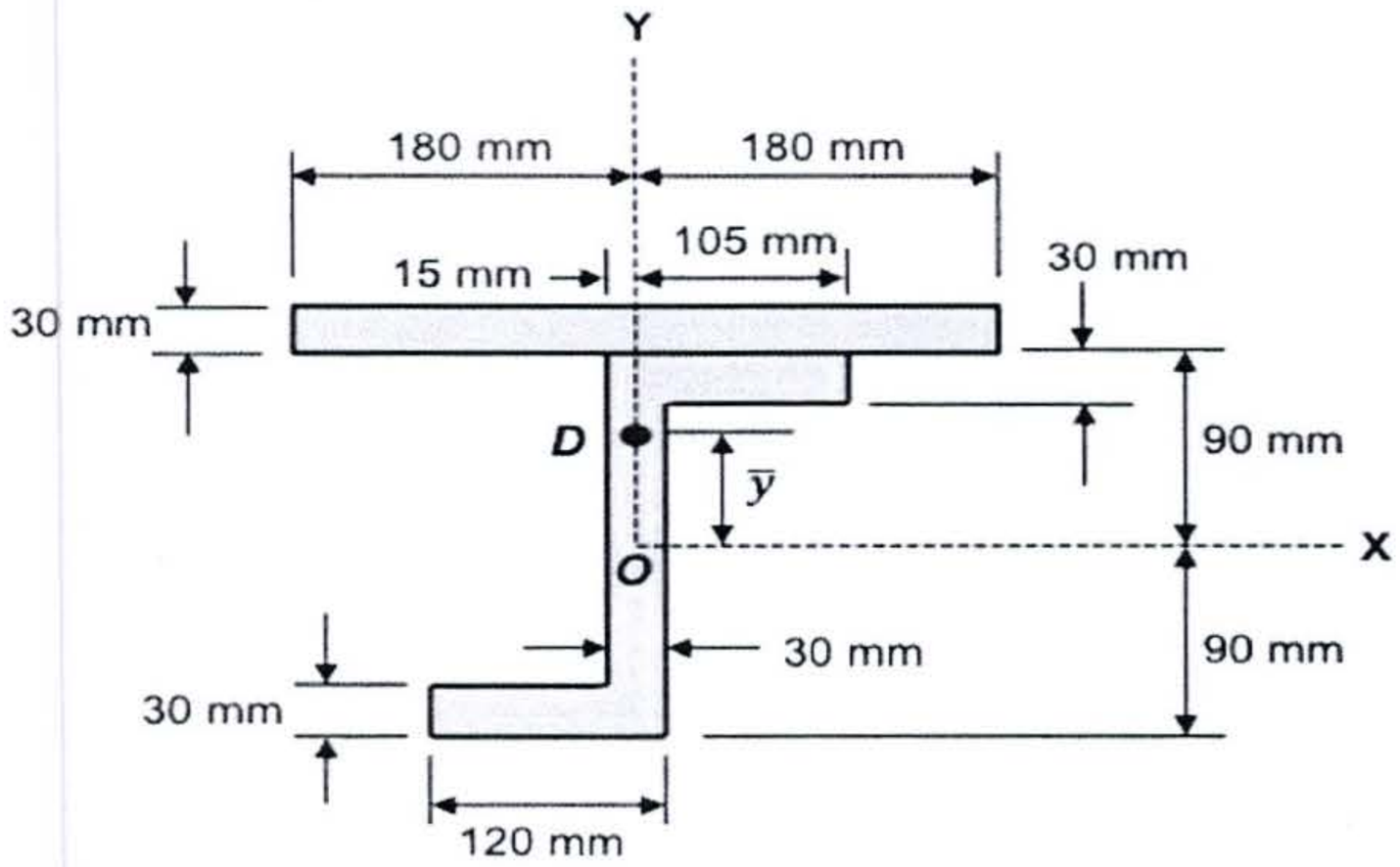
Y
180 mm
180 mm
105 mm
15 mm
30 mm
30 mm
D
$\bar{y}$
90 mm
X
O
30 mm
90 mm
30 mm
120 mm

Fig 3.