INTERNATIONAL UNIVERSITY OF EAST AFRICA
'Learning to Succeed'

FACULTY OF ENGINEERING

END OF SEMESTER EXAMINATIONS - APRIL 2025

PROGRAMME: BACHELOR IN CIVIL ENGINEERING

YEAR/SEM: YR. III/SEMESTER II

COURSE CODE: BCE 3201

COURSE NAME: DESIGN OF STEEL STRUCTURES

DATE: 15th/APRIL/2025

TIME: 2:00PM – 5:00PM

INSTRUCTIONS TO CANDIDATES:

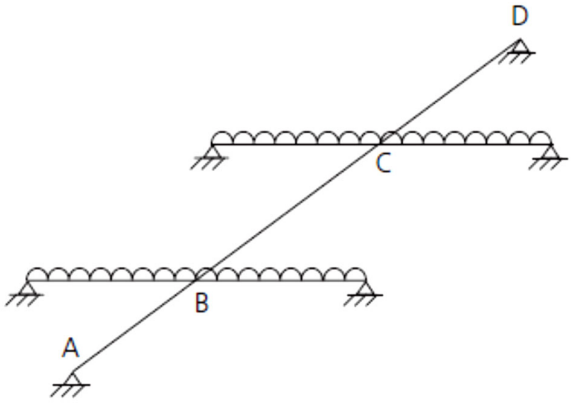
- **THIS EXAMINATION PAPER CONSISTS OF SIX QUESTIONS.**
- **ATTEMPT ANY FOUR QUESTIONS FOR FULL MARKS**
- **DO NOT OPEN THIS EXAMINATION UNTIL YOU ARE TOLD TO DO SO**
- **ALL ROUGH WORK SHOULD BE IN YOUR ANSWER BOOKLET**
- **THE TIME ALLOWED FOR THIS EXAMINATION IS STRICTLY THREE HOURS**
- **ON THE FIRST PAGE OF YOUR ANSWER BOOKLET**

    - **WRITE YOUR REGISTRATION NUMBER PROPERLY**
    - **WRITE THE COURSE NAME AND COURSE CODE**
    - **WRITE EXAMINATION VENUE**
    - **DO NOT WRITE, DROW OR SCRATCH ANYTHING ELSE ON THE FIRST PAGE**
    - **WRITING UNNECESSARY INFORMATION LIKE PHONE NUMBERS IN THE FIRST PAGE SHALL ANNUL YOUR EXAM**
    - **ANSWER BOOKLETS THAT DO NOT CARRY THE REQUIRED INFORMATION, OR THAT HAVE UNNECCESSAY WRITING IN THE FIRST PAGE SHALL NOT BE MARKED**

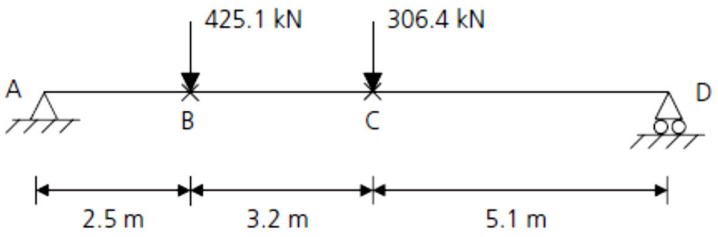
QUESTION ONE (25 Marks)

A simply supported primary beam is required to span 10.8m and to support two secondary beams as shown in Figure below. The secondary beams are connected through fin plates to the web of the primary beam, and full lateral restraint may be assumed at these points.

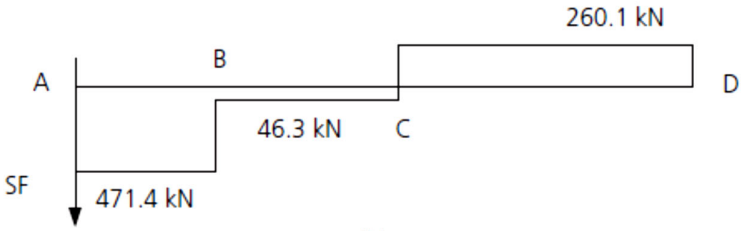
Check the suitability of **762x267x197kg/m UB** member for Lateral torsional buckling on segments AB, BC and CD of the primary beam AD assuming grade S275 steel. **(25 marks)**



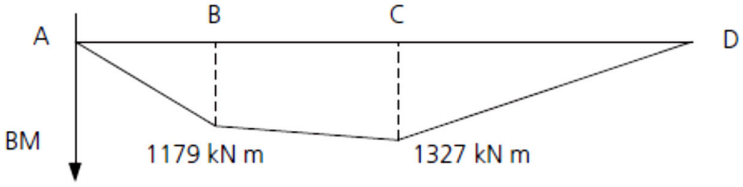
General arrangement



(a)



(b)

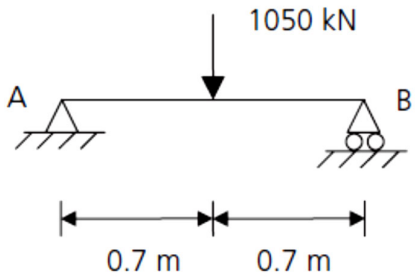


(c)

(a) Loading, (b) shear forces and (c) bending moments

QUESTION TWO (25 Marks)

A short-span (1.4 m), simply supported, laterally restrained beam is to be designed to carry a central point load of 1050 kN, as shown in Figure below. Assess the suitability of a hot-rolled **406x178x85kg/m UB**-section in grade S275 steel for this application. **(25 marks)**



General arrangement and loading

QUESTION THREE (25 Marks)

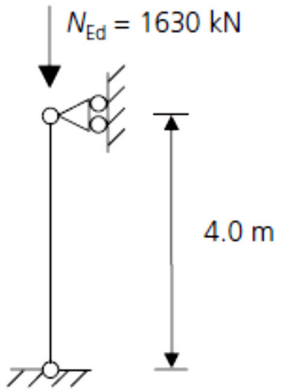
[a] Using illustrations, explain the difference between pinned and fixed steel column bases.

(4 marks)

[b] Using a simple sketch illustrate the connection of a base plate to the concrete pedestal.

(5 marks)

[c] A **457x191x133kg/m UB** member is to be used as an internal column in a multi-storey building. The column has pinned boundary conditions at each end, and the inter-storey height is 4 m, as shown in Figure below. The critical combination of actions results in a design axial force of 2110 kN. Assess the suitability of a **457x191x133kg/m UB** in grade S275 steel for this application. **(16 marks)**



General arrangement and loading

QUESTION FOUR (25 Marks)

A **356×171×67 kg/m UB** section in S355 steel is loaded by uniformly distributed loading G_k = 10 kN/m and Q_k = 5.5 kN/m and spans 8m. Assume that the beam is fully laterally restrained and that the beam sits on 100 mm bearings at each end. Ignore self-weight of beam.

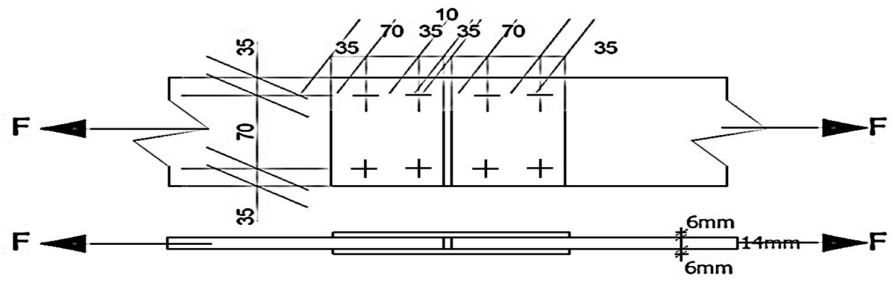
(i)	Determine the design actions	**(3 marks)**
(ii)	Check strength classification	**(1 marks)**
(iii)	Check section classification	**(3 marks)**
(iv)	Resistance of cross section; bending	**(3 marks)**
(v)	Resistance of cross section; shear	**(5 marks)**
(vi)	Resistance of cross section; combined bending and shear	**(2 marks)**
(vii)	Resistance of member to shear buckling	**(2 marks)**
(viii)	Resistance of member to flange-induced buckling	**(3 marks)**
(ix)	Resistance of member to deflection	**(3 marks)**

QUESTION FIVE (25 Marks)

Calculate the design resistance of the connection detail shown below. The cover plates are made of S275 steel and connected with either,

- Non – preloaded bolts of diameter 24mm and class 4.6 or
- Prestressed bolts of diameter 18mm and class 8.8.

Assume that in both cases, the shear plane passes through the unthreaded portions of the bolts.



Determine.

(i) Design shear resistance **(4 marks)**

(ii) Bearing resistance **(8 marks)**

(iii) Tensile resistance of cover plate **(4 marks)**

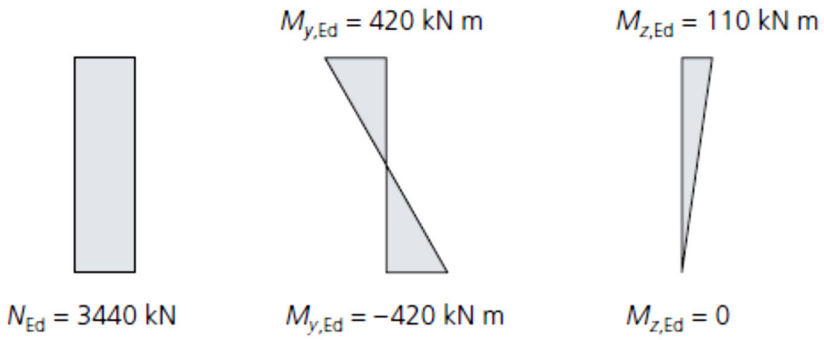
(iv) Slip resistance. (Prestressed bolts) **(4 marks)**

(v) Tensile resistance of cover plates. (Prestressed bolts) **(5 marks)**

QUESTION SIX (25 Marks)

An H-section member of length 4.2m is to be designed as a ground-floor column in a multi-storey building. The frame is moment resisting in-plane and braced out-of-plane. The column is subjected to major axis bending due to horizontal forces and minor axis bending due to eccentric loading from the floor beams. From the structural analysis, the design action effects of Figure arise in the column.

Assess the suitability of a hot-rolled **305x305x283kg/m** H-section in grade S275 steel for this application. **(25 marks)**



Design action effects on an H-section column