

UNIVERSITY OF RUHUNA

Faculty of Engineering

Mid-Semester 7 Examination in Engineering: June 2015

Module Number: CE7323

Module Name: Computer Analysis of Structures

[Two Hours]

[Answer all questions. Each question carries 10 marks]

All Standard Notations denote their regular meanings

Q1. a) A continuous beam **ACB** is carrying a uniformly distributed load of 1 kN/m in addition to a concentrated load of 10 kN as shown in Figure Q1(a). Using force method, determine the support reaction at **C**.

[5 marks]

b) Analyse the truss structure shown in Figure Q1(b) using matrix flexibility method and find the displacement at point **B**, and member forces in all members. Assume for all members $AE = 200 \times 10^4$ kN.

[5 marks]

Q2. a) Determine the displacements and support reactions for the bar combination shown in Figure Q2(a). Bar **AB** is made of Aluminium with young's modulus $E_a = 70 \times 10^9$ N/m² and cross section $A_a = 900$ mm². Bar **BC** made of steel with young's modulus $E_s = 200 \times 10^9$ N/m² and cross section $A_s = 1200$ mm². Horizontal load of $P = 200$ kN applied at point **B**.

[5 Marks]

b) Pin-jointed 2D truss is pinned support at Node **A** and Node **C** as shown in Figure Q2(b). The Young's modulus $E = 200$ GPa for both bar element and cross-section area $A = 8 \times 10^{-4}$ m² for element **BC**, $8\sqrt{2} \times 10^{-4}$ m² for element **AB**. Truss system is subjected to a force 100 kN at Node **B**.

Determine the global structural stiffness matrix.

[3 Marks]

Determine the Nodal displacements at Node **B**.

[2 Marks]

(Use the stiffness matrix for a 2D-bar element as shown below.)

$$[k^e] = \frac{EA}{L} \begin{bmatrix} c^2 & cs & -c^2 & -cs \\ cs & s^2 & -cs & -s^2 \\ -c^2 & -cs & c^2 & cs \\ -cs & -s^2 & cs & s^2 \end{bmatrix}$$

where $c = \text{Cos}\theta$, $s = \text{Sin}\theta$ and θ is the anticlockwise angle at node measured from the global X-axis to the local x-axis of the bar element.

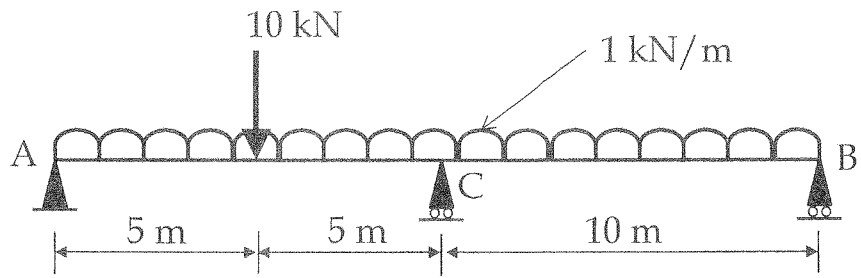


Figure Q1(a)

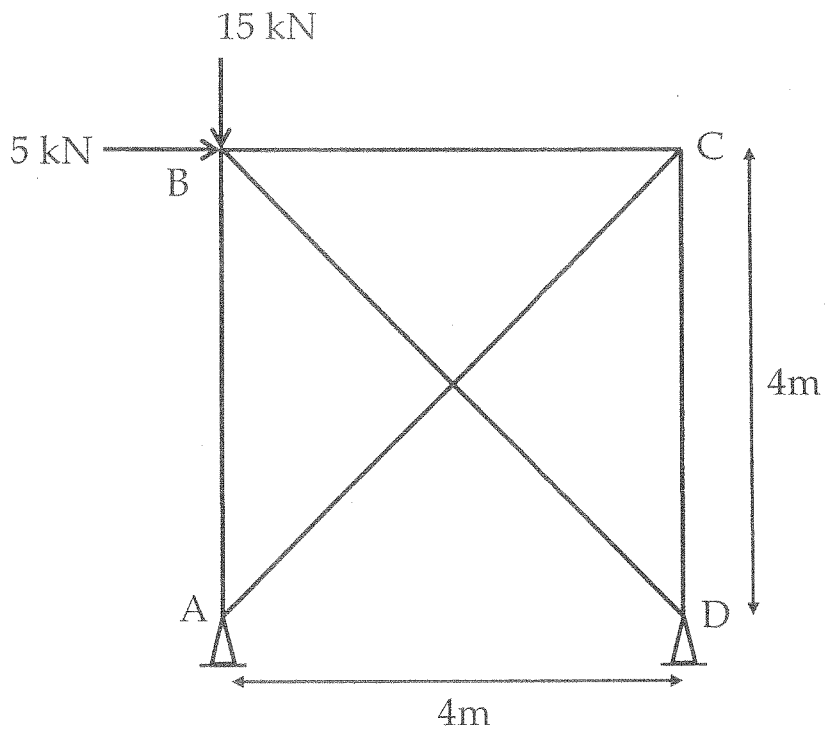


Figure Q1(b)

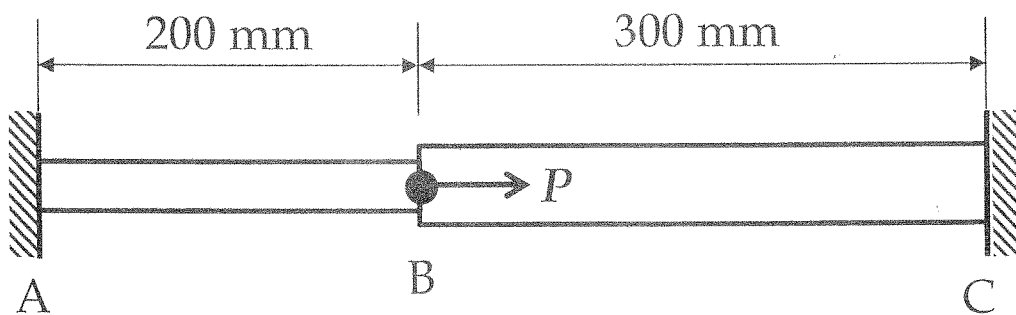


Figure Q2(a)

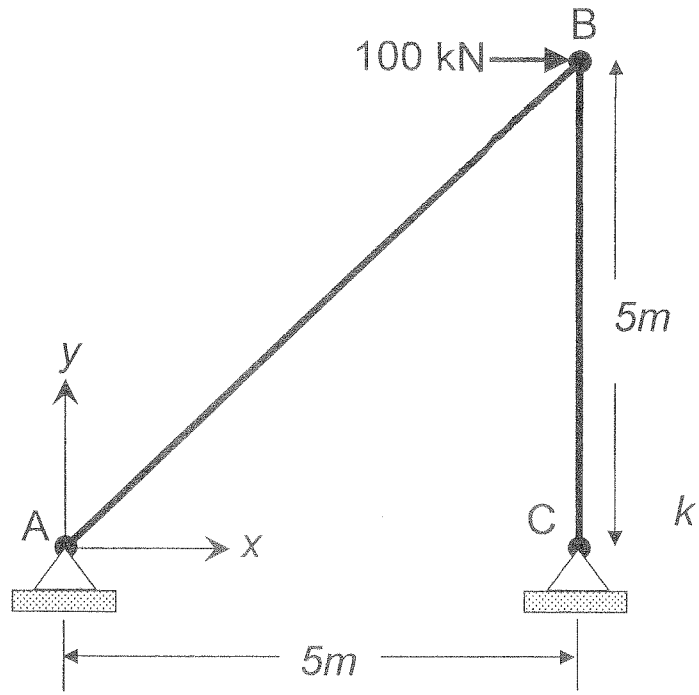


Figure Q2(b)