

- Q.1 A steel column between floors of a multi-storey building is subjected to the following factored eccentric loadings due to beam support reactions as shown in **Figure Q1**. Assume the **stiffnesses of the upper and the lower columns are the same**.

The columns are in simple construction with connections between beams and moment factors are assumed to be 1.0 unless stated otherwise.

Given:

$P = 4500$ kN (compression) including self-weight acting at the centre of the column.

$P_{x1} = 600$ kN (compression) with an eccentricity e_y of 220 mm measured from the y-axis, due to beam reactions.

$P_{y1} = 900$ kN (compression) with an eccentricity e_x of 320 mm measured from the x-axis, due to beam reactions.

$P_{y2} = 850$ kN (compression) with an eccentricity e_x of 280 mm measured from the x-axis, due to beam reactions.

Moment amplification factor due to $P-\Delta-\delta$ effect for all moments = 1.1.

- Determine the total **axial load** and **moment about x-x axis** and **moment about y-y axis** acting on the steel column.
- Check the cross section capacity of the steel column.
- Check the member buckling resistances of the steel column.

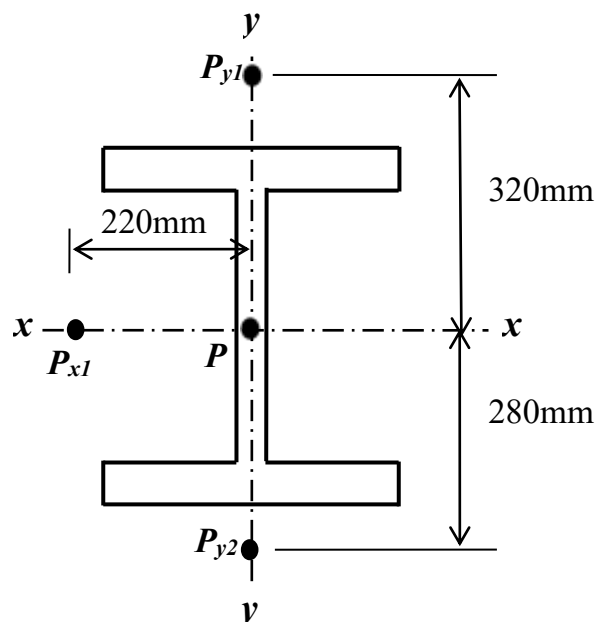


Figure Q3

- Q.2 The factored design loads (including self-weight of the beam) of a 8 m long simply supported steel beam are shown in **Figure Q2**. Lateral restraints are provided at the supports **A** & **C** and the point load **B**. The size of steel beam is **356 x 171 x 67 kg/m UB (Grade S355)**. Assume the section is **Class 1**.

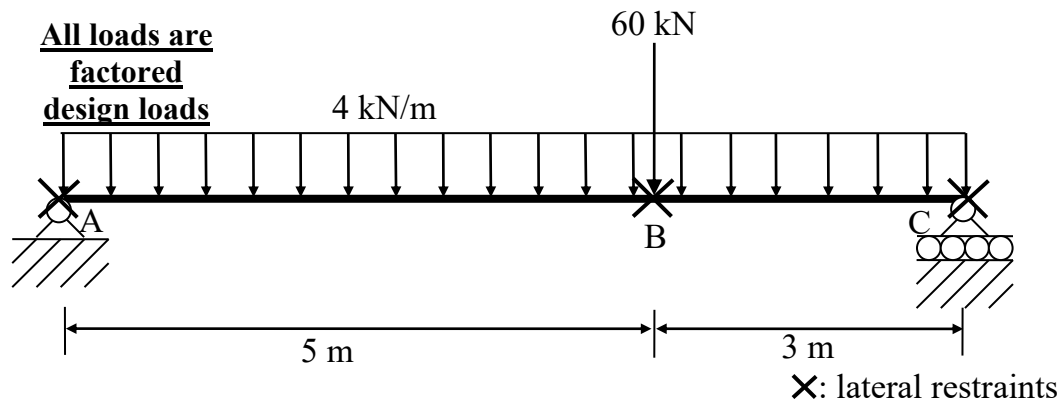


Figure Q2

- Determine the support reactions of the beam.
 - Draw the annotated shear force and bending moment diagram of the beam.
 - Check the buckling moment resistance of the steel beam in segment **AB** by using accurate values of parameters u and v in the calculation of λ_{LT} .
 - Discuss the changes of structural stability in the beam if the lateral restraint at **B** is removed.
- Q.3
- Describe Class 1 (Plastic), Class 2 (Compact), Class 3 (Semi-Compact) and Class 4 (Slender) cross section in structural steel design.
 - Sketch any TWO (2) methods of fire protection for UB sections.
 - With sketches, identify any TWO (2) types of build-up sections in structural steelwork design.
 - With the aid of a sketch, explain the second-order elastic P- Δ and P- δ method of analysis suggested by the Code of Practice for Structural Use of Steel 2011 in Hong Kong.