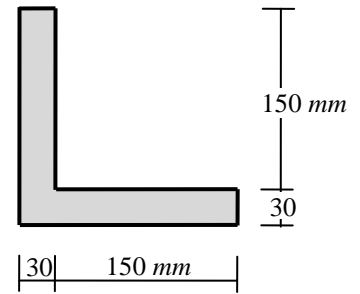


**Question (1): (10 Marks)**

For the shown cross-section, determine the following:

- The location of the centroid.
- The moments of inertia about the centroidal axes.
- The direction of the principal axes.
- The principal moments of inertia.

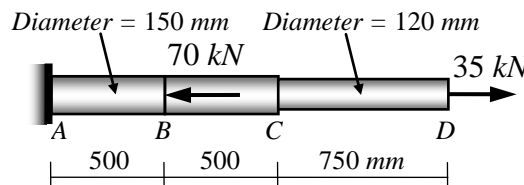


**Question (2): (10 Marks)**

A stepped bar is subjected to axial loads as shown. Calculate the following:

- The normal stress in each part.
- The total elongation.

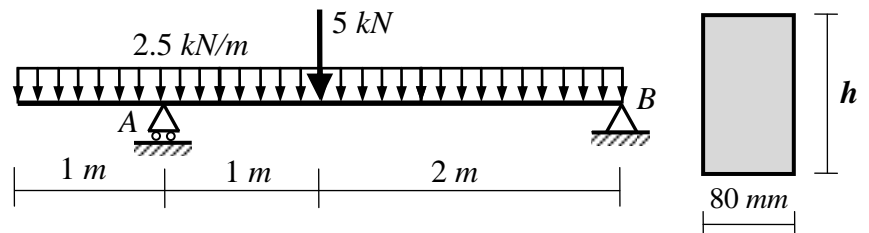
Where  $E = 2.32 \text{ GPa}$



**Question (3): (10 Marks)**

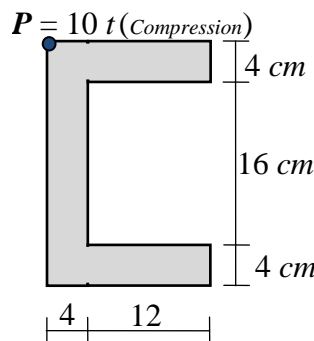
Determine the minimum height  $h$  of the cross section of the beam loaded as shown. The maximum flexural stress,  $f_{b \text{ max}} = 20 \text{ MPa}$ .

Note: *S.F.D* and *B.M.D* are required.



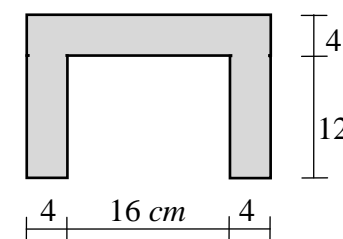
**Question (4): (10 Marks)**

A cross-section is subjected to axial compressive load  $P$  as shown, calculate and draw the normal stress distribution over the cross-section.

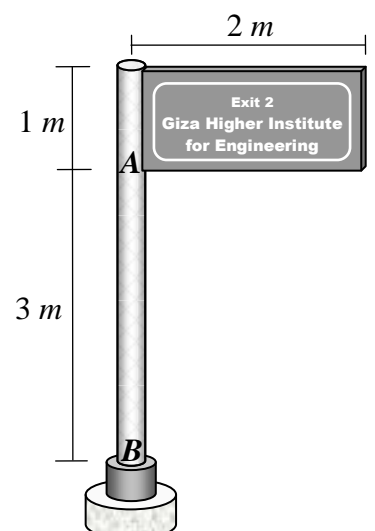
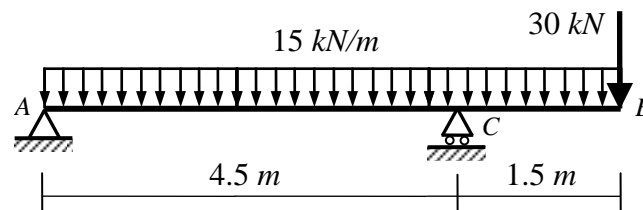


**Question (5): (10 Marks)**

For the shown beam, calculate and draw the shear stress distribution over the cross-section at  $C$ .



Cross-section of the beam



**Question (6): (10 Marks)**

A tube must resist a torque due to the wind load on the sign board. The wind pressure is  $1.5 \text{ kN/m}^2$ . The tube has an outside diameter of  $200 \text{ mm}$  and a thickness of  $5 \text{ mm}$ . Determine:

- The maximum shear stress  $\tau_{\text{max}}$  in the tube at section  $B$  due to the torque.
- The relative angle of twist between  $A$  and  $B$ , where  $G = 30 \text{ GPa}$