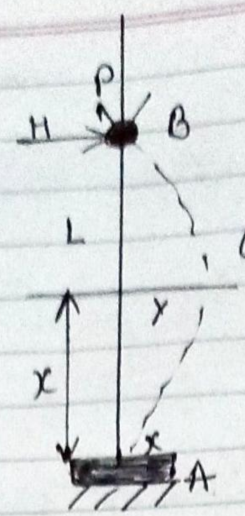
SECTION - 4

Q2



As we know that for long column, when one end of the column is fixed and other end is hinged, we will have following end condition as mentioned here.

At fixed end A of the column, i.e at $x=0$
Deflection y will be zero and slope dy/dx will also
i.e $y=0$ and $dy/dx=0$

At hinged end B of the column i.e at $x=L$
Deflection y will be zero

Let us use the first end condition i.e at $x=0$ deflection $y=0$, in above lateral deflection equation for column and we will have value of constant of integration i.e C_1 and it will be as mentioned here.

$C_1 = (H \cdot L/P)$

Now, we will differentiate the lateral deflection equation with respect to x and we will have slope for column AB it will be displayed by dy/dx.

$$\frac{dy}{dx} = -C_1 \sin\left[x \cdot \sqrt{\frac{P}{EI}}\right] \cdot \sqrt{\frac{P}{EI}} + C_2 \cdot \cos\left[x \sqrt{\frac{P}{EI}}\right] \cdot \sqrt{\frac{P}{EI}} - H/P$$

$$\frac{dy}{dx} = -C_1 \sqrt{\frac{P}{EI}} \cdot \sin\left[x \cdot \sqrt{\frac{P}{EI}}\right] \cos\left[x \cdot \sqrt{\frac{P}{EI}}\right] - H/P$$

As we have already discussed that at $x = 0$, slope will be zero or $dy/dx = 0$ and therefore now we will use this end condition in above slope equation in order to secure the value of C_2.

After using the value of $x = 0$ and $dy/dx = 0$ in above slope equation, we will have value of C_2

$$C_2 = (H/P \sqrt{E.I/P}$$

Now it's time to analyze the lateral deflection equation after considering and implementing the value of both constant i.e C_1 & C_2

$$\frac{dy}{dx} = -C \sqrt{\frac{P}{EI}} \cdot \sin\left[x \sqrt{\frac{P}{EI}}\right] + C_2 \cdot \sqrt{\frac{P}{EI}} \cos\left[x \sqrt{\frac{P}{EI}}\right] - HP$$

$$C_1 = -H.L/P \cos\left[x \sqrt{\frac{P}{EI}}\right] + (H/P \sqrt{E.I/P} \sin\left[L \sqrt{\frac{P}{EI}}\right]$$

$$\tan\left[L \sqrt{\frac{P}{E}}\right] = L \sqrt{\frac{P}{EI}}$$

$$L \sqrt{\frac{P}{EI}} = 4.5 \text{ rad}$$

From here we will have expression for crippling load, when one end of column is fixed and other end hinged and we have displayed it in following figure.

$$\left[P = \frac{2\pi^2 EI}{L^2}\right]$$