Problemas sobre columnas

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The formula for the critical load of a column was derived in 1757 by Leonhard Euler, the great Swiss mathematician. Euler's analysis was based on the differential equation of the elastic curve:

$$\frac{d^2v}{dx} + \frac{p}{EI}v \ = 0$$

Find the solution to this equation and apply the following conditions to obtain the values for the constants of integration:

$$v\,|x = 0| \ = 0$$

$$v\,|x = L| \ = 0$$

$$v\,|x = L| \ = 0$$

Finally explain how to get the following result :

$$P = n^2 \ \ \frac{\pi^2 EI}{L^2}$$

1° The first step is to derive

$v = C_1 \ \sin|x \ + C_2| \, x$

$v^! = \frac{dv}{dx} = C_1 \, |\cos - C_2| \, |\sin| \, x$

$v^{!!} = d^{\frac{2v}{dx^2}} = C_1 \, \left|^{2 \ \sin}\right| x - C_2 \, |^2 \cos| \, x$

The second step is to factor

$-C \left|^2 \sin\right| x - C_2 \left|^2 \cos\right| x$

$\left(\frac{p}{EI}\right)(C_1 \sin|x + C_2 \cos| \, x = 0)$

$C_1 \left|^2 \sin\right| x - C_2 \left|^2 \cos + C_1\right| \left(\frac{P}{EI}\right) \sin|x + C_2 \mid \left(\frac{P}{EI}\right) \cos|x| = 0$

$C_1 \sin|x \left(\frac{P}{EI} - x^2\right) + C_2| \, x \left(\frac{P}{EI -} x^2 \ \right) = 0$

$\frac{P}{EI} \, |2| = \sqrt{\frac{P}{EI}}$

$v = C_1 \sin \sqrt{\frac{P}{EI}} x + C_2 \cos \sqrt{\frac{P}{EI}} x$

$v = o \, |x| = 0$

$v = 0 \, |x| \, x = L$

$C_1 \sin \sqrt{\frac{P}{EI}} \ \ (0) + C_2 \cos \sqrt{\frac{P}{EI}} \ \ (0) = 0$

For V=0   X=L

$v \, (x = L) = C_1 \sin \sqrt{\frac{P}{EI}} L = 0 v \, (x = L) = C_1 \sin \sqrt{\frac{P}{EI} \ L \ = 0}$

$\sin\left(\sqrt{\frac{P}{EI} \ \ L}\right) = \ 0 \quad = \sqrt{\frac{P}{EI}} - L = n \, \pi$

it will clear P

$\frac{P}{EI}L^2 = n^2\ \pi^2 = P = n^2\ \frac{\pi^2 EI}{L^2}$

To calculate the critical P

$n = 1\ =\ P\ = \frac{\pi^2 EI}{L^2}$

Conclution:

En este presente documento se llevo a cabo una serie de operaciones,una de ellas fue derivar,otra factorizar y por ultimo despejar **p**.