KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

COLLEGE OF ENGINEERING

DEPARTMENT OF MECHANICAL ENGINEERING

MECHANICAL ENGINEERING LAB IV

GROUP N

EXPERIMENT: BUCKLING LOAD OF PINNED-END STRUT

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SUMMARY

Compressive members can be seen in many structures. They can form part of a framework for instance in a roof truss, or they can stand-alone; a water tower support is an example of this.

Generally, short wide compressive members that tend to fail by the material crushing are called columns. Long thin compressive members that tend to fail by buckling are called struts.

Unlike a tension member which will generally only fail if the ultimate tensile stress is exceeded, a compressive member can fail in two ways. The first is via rupture due to the direct stress, and the second is by an elastic mode of failure called **Buckling**.

OBJECTIVE

The aim of this experiment is to determine whether or not Euler's formula can predict the buckling load of a pinned-end strut.

We would achieve this by determining experimentally, the buckling load of different struts with different lengths, and then solving for the different buckling loads using Euler's formula.

We would then compare the experimental buckling load with the buckling loads generated from the formula and draw on a conclusion.

PROCEDURE

- The position of the sliding crosshead is adjusted to accept the strut using the thumbnut to lock off the slider.
- It was ensured that there is maximum amount of travel available on the handwheel thread to compress the strut.
- The locking screws were tightened.
- The handwheel was released so that the strut rests in the notch but not transmitting any load; the forcemeter was reset using the front panel control.
- The strut was carefully loaded, the strut was flicked to the right if it begins to buckle to the left and vice versa.
- The handwheel is turned until there is no further increase in load.
- The final load was recorded; the process was repeated for strut numbers 2, 3, 4 and 5 adjusting the crosshead as required to fit the strut.

USING EULER'S FORMULA

$$\boldsymbol{P_e} = \frac{\pi^2 \boldsymbol{EI}}{\boldsymbol{L^2}}$$

$\boldsymbol{P_e}$ **=** Euler buckling load (N)

$\boldsymbol{E}$ **=** Young's modulus

$\boldsymbol{I}$ = Second moment of area (m^4)

$\boldsymbol{L}$ = Length of strut (m)

Also

$\boldsymbol{I} = \frac{bh^3}{12}$, where b = 20mm, h = 2mm

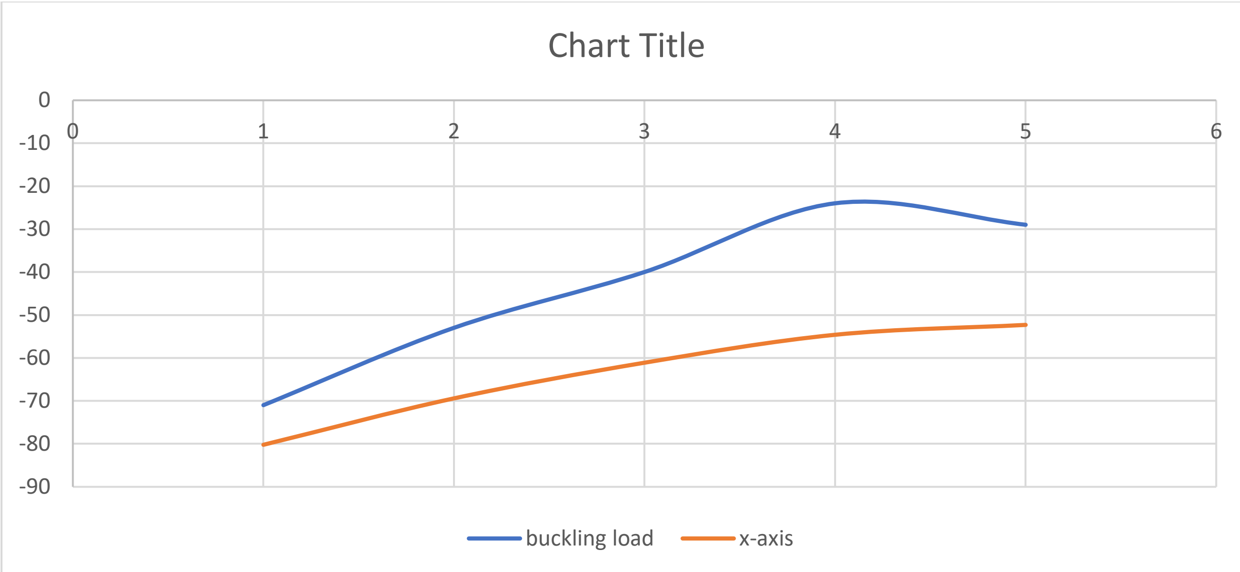
$\Rightarrow \boldsymbol{I} = \frac{0.02\times0.002^3}{12} = 1.3\times10^{-11} m^4$

E = 200 GPa

TABLE OF RESULTS

Strut number	Length (mm)	Experimental Buckling Load (N)	Euler's buckling load (N)
1	320	-71	-80.2
2	370	-53	-69.4
3	420	-40	-61.1
4	470	-24	-54.6
5	520	-29	-52.3

From the results above it can be seen that the buckling load is negative for each length. This is due to the load being compressive. Also, from the table of results, it can be noticed that the longer the strut, the weaker the buckling load.



The graph above shows both the experimental buckling load and the Euler load plotted against the length. The line graph above goes for the buckling load whilst the graph below it goes for the Euler buckling load.

CONCLUSION

From the graph and the table of results, for smaller lengths of 320mm and below, the Euler formula is relatively accurate in determining the buckling load.

With increasing the length of the strut the deviation between the values increases, therefore using the Euler formula for such lengths will give you an in accurate prediction.