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The Young's Modulus of Cu, Al, Fe, Stainless Steel and Wood by using Y by bending of a bar Technique

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Abstract

Y by bending of a bar technique is a simple and easy technique to determine Young's modulus of Material such as Cu,Al,Fe, Stainless Steel,Wood etc. This technique require Traveling microscope, metal bar, two knife edges,weights etc. This technique can easily and accurately record the change in the dimensions of a bar under the load and measure depression at certain load by Traveling microscope. It has wide application in science and engineering. It is found that values of Young' modulus obtained by using Y by bending of bar in close agreement with standard values of Y of material. The young modulus of iron was found highest 14.2128×10^{11} dyne/cm^2 by Y by bending method.

Key word: Traveling microscope,Y by bending,Material Bar.

Introduction

The Main Purpose of this Research is to determine Young's modulus of any material by Y by bending of bar technique. This technique has wide advantages over other technique. And its will be advantages in civil Engineering to build up bridge[2]. If A Solid is formed when large number of atoms come together and arrange themselves in a three dimensional lattice .These atoms are held together by inter atomic forces that can be represented by spring. When these springs are stiff we perceive the object as rigid .for example objects like table,chair etc. on the other hand objects like rubber band ,garden hoses do not seem to be rigid. This is because in case of these objects the lattice is not rigid and objects have long flexible molecular chains where each chain is loosely bound to its neighbor[8]. These objects seem elastic .If we stretch the steel wire with some weight it gets elongated but when weight is withdrawn it regains its original position[1,8]. If we go on continuing the

process with increase in weights the wire will get stretched till it breaks. Though this deformation is very small it is extremely important in engineering applications. The material whose Young's modulus is to be measured is to be taken in the form of a rectangular bar with small width and thickness and a large length. The three parameters i.e. length,breadth and thickness are chosen so that with moderate weights reasonable bending can be observed[1,8]. A traveling microscope would be necessary to observe the depression at certain weight. Young's modulus can be determined by various techniques but Y by bending of a bar have some advantages over others techniques such as easy, accurate, etc. From this method strain,stress can also be studied.

Material and technique to be Used:

The main reason for using this technique is it is very simple technique than other technique to determine Y. and require material for this technique are easily available. The values of Young's modulus of material is given in book but Young' modulus obtained by using Y by bending of bar in close agreement with standard values of Y of material. So we choose this technique. The material selected for this purpose are copper, aluminium, iron ,stainless steel and wood. The formula used to determine Young's modulus is

$$Y = mgl^3/4b\delta d^3$$

Where,

g=gravitational force in cm/sec^2

l=distance between two knife edges

m=mass

b= breadth of a bar

d=thickness of a bar

δ=depression for a particular mass in

The Apparatus used for this method is Traveling microscope, Vernier caliper, Micrometer screw gauge, Material bar, Meter scale. The given beam was placed on the two knife edge supports as shown in the fig 1. and the distance between two edges was about 40 cm. a weight hanger was kept suspended at the center of the beam and a pin was fixed vertically on the frame of the hanger. A microscope was used to view the tip of needle microscope was adjusted such that the pin just touches the horizontal cross wire. The reading of the microscope in the vertical scale was noted .in the same way reading for loading weights and unloading weights were recorded then by using above formula Young's modulus of different material bars were calculated[8].

Result and Discussion

It was observed that The Young's modulus of wood was Increased with Increasing thickness with 709 mm Hg atmospheric pressure in fig 2. It is linear relationship between Young's modulus and thickness of wood bar. The dimensions and the Y of the materials are given below .with the help of Y by bending method the calculated values of Y of aluminium, copper ,iron, stainless steel, wood are given in table 1.It is found that values of Y calculated are in close agreement with standard values

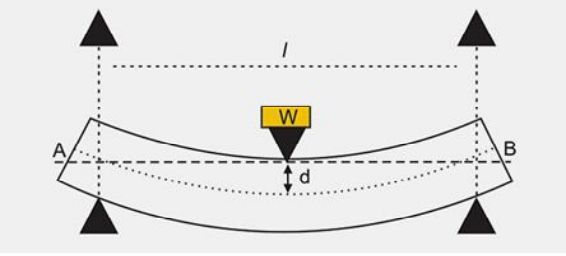

Fig 1: Y By Bending Method

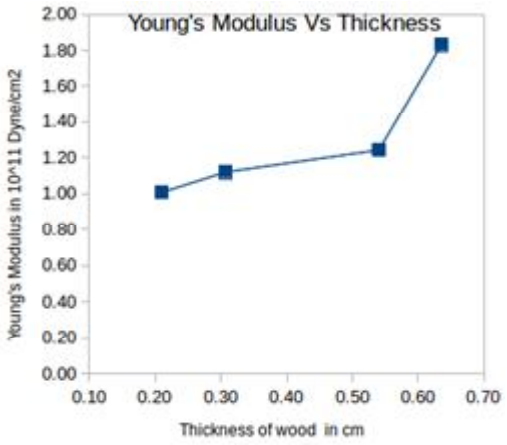

Fig 2: Thickness Vs Young's Modulus

Table 1: Determined values of Y

Materials	Length in 'cm'	Breadth in 'cm'	Thickness in 'cm'	Experimental values of youngs modulus in 'dyne/cm^2'	Standard values of youngs modulus in 'dyne/cm^2'
Aluminium	42	2.53	0.2055	6.099x10^{11}	7.50x10^{11}
Copper	44	3.10	0.1940	5.2891x10^{11}	12.40x10^{11}
Iron	42	3.21	0.1115	14.2128x10^{11}	19.90x10^{11}
Stainless steel	42	2.95	0.1270	13.2988x10^{11}	19.50x10^{11}
Wood	42	3.13	0.2100	1.0085x10^{11}	1.1x10^{11}
Wood 1	42	2.94	0.3070	1.1210x10^{11}	-
Wood 2	42	3.15	0.5400	1.2429x10^{11}	-
Wood 3	42	3.13	0.6355	1.8319x10^{11}	-

Conclusion

The Young's Modulus of aluminium, Iron, stainless steel, copper, wood were obtained successfully by Y by bending method. The young modulus of iron was found to be highest by Y by bending method. The Young's modulus of wood is going to increased with thickness of wood bar was successfully studied by y by bending technique. The future scope is very wide by using Y by bending of bar technique.

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