Deflection of a cantilever beam lab report

Academia.edu uses cookies to personalize content, tailor ads and improve the user experience. By using our website, you agree to our collection of information through the use of cookies. To learn more, see our Privacy Policy.× Purpose of this laboratory work is to study and understand the deflection of the beam made of different materials Hire us for your Written Laboratory Report2.0 Objective Study and understand different types of beams Study and understand the load allowed from different beams Study and understand the effect of beam material on beam deflection Study and understand the effect of beam bending beam geometry Recommended: Bending moment in a Beam Laboratory Report 3.1 Beams According to Dr. That's a good one. K. Bansal (n.d) a structural element that is used to withstand heavy loads on different structures is called a beam. The beam in any structure carries a huge load that tries to bend the beam and the beam supports the structure, resisting the bending products by the load. The ability of the beam to resist the load depends on the type of beam, beam material and beam shape, S Timoshenko (1940). According to there are many different types of beam and each of these beams can be of any material and can in many different ways. Some different types of beam are described below The simple support beam is one that has support at both ends but does not face any mobile resistance Fixed beam As simple fixed supported beam also has support at both ends, but fixed beam has moving resistance On the hanging beam also has support at both ends as simple support beam, but one of its ends is free and extended further from the double end support on hanging beam is just as over hanging beam, the only difference is that its two ends are extended beyond the end bracket The continuous beam is one that has great length and is supported by more than two brackets The Cantilever beam is one that has its fixed end and the other end is free to vibrate trussed beam is a special type of beam that has greater strength due to additional bars and cables in the beam In this experiment only Two types of beam will be discussed one is a simple support beam and the other is the cantilever beam. Talking about the material of the beam, in this laboratory experiment will be discussed three materials of brass, aluminum and steel. 3.2 Elastic modulus The elastic modulus is the mechanical property of the material which is the ratio of stress and tensile stress. The higher the value of the elastic modulus the more rigid the material is and the lower elastic modulus value means that the material diverts a lot in small stresses, M. F. Ashby (2010). E=σ/ε Where E is elastic module σ = stress ε = tension According to John Case (1999) when a body is under so this stress tries to change its shape and dimensions. Change is body shape is called deflection and change in the it's called tension. The following is the equation that can be used to calculate deflection on beams δ=(FL^3)/KEI F is the K force is constant based on position I is second moment of the area 3.4 Permissible load Load allowed is the maximum amount of load that can be applied on the over the beam that is also called allowed load, Ferdinand P. Beer (n.d). This load shows the force of any beam relative to the load applied to it. It is very important to calculate the permissible load of all beams to obtain a safe structure. According to P. The permitted load of beer (2012) can be calculated with the help of the Flexure formula whose equation is as follows σ=My/I σ=(F*x*y)/I Where F is the permissible load σ is the maximum value of the stresses for the material yield force x is the distance from the fixed point of the beam to the point of application of the load is the Distance from the neutral axis to the point of interest I is the second moment of inertia or area The following is the procedure that was adopted to perform this experiment First of all the apparatus was configured and the beam was placed on it Second the dial meter was placed in its place Third weight pot was placed and weight was placed on it The reading was taken for each and each weight increment The value was properly arranged in the tables The procedure was repeated for different beams and different extensions 5.0 Beam dimensions 5.1 Beam brass length = 30 cm = 0.3 mCross section height = 0.31 cm = 0.0031m Cross section width = 0.95 cm = 0.0095mm Length of beam = 30 cm = 0.3 m Cross section height = 0.31 cm = 0.0031mCross width section = 0.95cm = 0.95 cm = 0.31cm = 0.31cm = 0.0031mCross width section = 0.95 cm = 0.95 cm = 0.0.0095mm 5.3 Steel Length of beam = 30 cm = 0.3 mCross section height = 0.31 cm = 0.0031m Cross section width = 0.95 cm = 0.0095mm 6.0 Simple supported beam calculations6.1 Calculations for permissible load at 1/2 span Flexure Formula σ=My/I σ=(F*x*y)/I σ=11 MPa Distance from the fixed point to application of force= x=0.0.15 m Distance from the neutral axis to the point of interest y=0.00155 Second moment of inertia = I=1/12 bh^3=(0.0098*2.358*-10-11)/(0.15*0.00155)=(2,585*10-10)/(2,325*10^(-4) =1.11 N 6.2 Calculations for permissible load at 1/4 span Flexure Formula σ=My/I σ=(F*x*y)/I σ=11 MPa Distance from the fixed point to application of force= x=0.0075 m Distance from the neutral axis to the point of interest y=0.00155 Second moment of inertia = I=1/12 bh^3=(0.0098*0.0031 12=2,358*-10-11)=(11*2,358*10))/(0.075*0.00155)=(2,585*10-10)/(1.16 25*10-10-10-10-10-10-10-10-10-10-10-10-10--4)=2.2262 N 6.3 Calculation for Elastic Modulus at 1/2 spans δ=(FL^3)/48EI E=(FL^3)/48δI Force = F = 1.96 N Length = L = 0.3 m Deflection = δ = 2.21 mm = 0.00221 m E=(1.96*-0.3-3-3)/(48*0.00221*2.358*-10-11)=(0.05292)/(2.5*1010^(-12)) E= Pa 6.4 Calculation for Elastic Modulus in 1/4 spans δ=Fa/48EI(3a^2-4l^2) E=Fa/48δI(3a^2-4l^2 2) Strength = F = 1.96 N Length = L = 0.3 m Deflection = δ = 2.21 mm = 0.00045 m E=(1.96 * 0,00075)/(48 * 0.00045 * 2,358 * *10-11) (3*0.3-14327462781 Pa 7-.0 Results Experiments were carried out on a single support beam and cantilever beam made of three different brass, aluminum and steel materials. The data of the experiments were written in their respective tables. With the help of the data collected from the design charts were prepared for each case and all these graphs are mentioned below. 7.1 Elastic module of different materials Elastic Beam Table Modulus Supported Simple 1 elastic module for single beam materials 1/2 covers N/m^2 1/4 spans N/m^2 Brass 37202639502 15987959190 Aluminum 25853240976 8345697398 Steel 28401512278 14372135427 Cantilever Beam Table Elastic Module 2 Elastic Module for Cantilever Beams Materials 1/2 covers N/m^2 1/4 spans N/m^2 Brass 1.80525E+12 3948697.329 Aluminum 1.69322E+12 3503701.56 7 Steel 3.8 8114E+12 8759291.181 8.0 Discussion Six different experiments were carried out to study and understand the simple supported beam deflection and the cantilever beam and the results are shown in two tables and six graphs in the results section. Now each chart will be discussed here. The first graphs for simple supported beams made of brass and the values show a liner ratio between load and displacement in 1/2 spans and 1/4 spans. Values of the displacement of bam to brass is higher than steel because, according to Kenneth G. (2010), brass is more dubious than steel has lower elastic modulus value Second aluminum chart showed similar trends as brass charts. It also has a liner response between load and displacement, but its displacement value for the given load is more than that of brass which shows that aluminum is more dubious than brass, as explained by B. K. Agrawal (2007). The third steel chart has a lot of brass and steel chart and has linear response for both periods, but its displacement values at the given load is smaller than two others that show that steel is less dubious than the other two and has the highest elastic modulus value and this property is being proven by George Murray (n.d). Brass chart for cantilever show similar trends of the first chart, but in this chart the displacement value for both periods are very different. 1/4 interval show very little displacement in relation to the 1/2 period under the same load 10 as explained by Daniel D. Pollock (n.d). Aluminum charts for cantilever have the trend from brass chart, but the values are very different. As the 1/4 span brass chart show very little deflection where 1/2 span show deflection under the same load, Charles Gilmore (n.d). Steel graph for cantilever shows very abnormal displacement values. 1/4 length steel shows only only deflection mm at the highest load and 1/2 spans shows deflection of 2.5 mm at the highest load According to James M. Gere (n.d) to the deflection equation, second moment of inertia of the beam that is the property of the beam related to its shape and dimension plays a very important role in beam deflection. Beam with high value of second moment of inertia or second moment of area will show less deflection and beam with low value of the second moment of inertia will show greater deflection. From this it can be concluded that the second moment of inertia is a beam property that resists bending or deflection of the beam. According to the table, the value of the elastic modulus for brass is about 37.5 GPa, while the value of the elastic module in the books is 105 GPa, which is almost three times the value obtained from the charts or experiments. Thus for aluminum the value of the elastic modulus is almost 26 GPa, which is almost 2.5 times lower than the book value of 69 GPa. For steel, the value of the elastic modulus is about 29 GPa, which more than six times less than the book value of 200 GPa. According to Raymond Aurelius Higgins (1994) there is a big difference in elastic module values, which shows that there are some errors in the experiment and these errors needed to be discussed to obtain accurate values for the elastic module. Error in beam experiments can be to form two sources, one in device error and second is human error. The instrument error includes inaccurate dial meter, the device that does not balance on the horizontal surface or the beam is already deformed. A personal error includes observation and calculation with wrong method or lack of experience in experimentation. Error in the device that is also known as instrument error can be easily discovered by repeating a certain experiment repeatedly if all experiments show inaccurate value means that the device has some errors. It can be removed by calibrating it with a good standard device. Personal error can find out by repeating the experiment with some experienced person and can be removed by practices. 9.0 Conclusion The objective of studying and understanding the different types of beams and effect of different factors on beam deflection was successfully completed. Six experiments were carried out in two different types of beam under different conditions of trailer and result where plotted in graphs and were discussed in detail. From these experiments it can be concluded that the deflection in a beam under a constant force depends on its type, shape, material and point of application of the force. It can also be concluded that the experimental elastic module of the same material is different in all cases and really depends on the type of beam, shape and loading location. Place.