Good essay about elastic properties of solids ways in which the elastic propertie...

Health & Medicine, Stress

In our world today, there has been a huge interest in the study and understanding of the elastic properties of materials and how they are measured. It is an established fact that every solid object has a tendency to become deformed under the influence of an external force. However, the resistance offered by these solid objects against these external forces varies. This variation depends on the constituent materials of each of these solids. The resistance offered by a crystal object is greater than that of the ones made of amorphous materials. The applied external force, if large enough, can alter the size and shape of these solid objects. These alterations in the shape or size of an object are known as deformation. Therefore, elasticity can be described as the ability of solid material, which has been deformed, to get back to its initial size and shape after the applied external forces that caused the deformation has been removed.

The quantity which is proportional to the applied external forces that causes the deformation is referred to as stress. Stress is usually described as the ratio of the external force acting on the object to the unit area of the object. The other quantity involved in this is the strain. Strain occur as a result of a stress, and is described to be the measure of the extent of the deformation. The stresses, when sufficiently small, have direct proportionality to the strain. The third quantity is referred to as the elastic modulus. The elastic modulus is the constant of proportionality, which is dependent on the material that undergoes the deformation and the nature of the deformation. The elastic modulus is usually described as the ratio stress to strain.

That is, elastic modulus = stress/strain

The other types of modulus are the Young’s modulus, the shear modulus,

and the bulk modulus. The Young modulus describes the measures of the resistance that a solid offer to a change in its length. The shear modulus describes the measures of the resistance to the motion of the planes that exists within one solid parallel to the other. While, the bulk modulus describes the measure of the resistance of the solid objects to that of the changes that occur in their volume.

If we are to consider a long uniform rod which has an initial length of L(initial) and suspended vertically in such a way that an external force is applied to its rear, with the force being parallel to the rod. The application of this force makes the equilibrium distance, existing among atoms in the solid, to change and this bring about an internal restoring force, known as reaction; it also makes the rod elongate by a value of ΔL. Generally, when there is an increase in the rod's length there would be a non-uniform decrease in the thickness of the rod. It is possible for the change in the rods' cross sectional area to be neglected if the value of ΔL is negligibly smaller than that of L. When this occurs, then the Young Modulus may be said to be

E = FAΔLL(initial) = σε

It can then be seen that ε= ΔLL(initial) and σ= FA.

F represents the value of the applied external force to the cross sectional area of the rod A while ε= ΔLL(initial) represents the tensile strain. The SI unit of stress is N/m2 = Pascal, and that of the Y is also N / m2.

A typical plot of the relationship between strain and stress in an elastic is as illustrated in the graph below

The Young modulus can be deducted from the graph above by finding its slope. It can be deduced from the plot in this graph that the sold restores it

initial length and shape within the elastic once the applied external force has been removed. The plastic region (i. e. the region within which the solid is no longer elastic) and the elastic region is separated by that which is either called the yield point or elastic limit. The breaking point is the point where the solid breaks, after which it enters into the plastic region. Deformations are not reversible at the plastic region, meaning that once the object gets to that region it becomes permanently deformed and cannot return to its initial shape after the removal of the applied external force.

This technique is usually employed for the measurement of the elastic properties of solid materials whenever the wave velocity is dependent on the elastic properties of the medium of propagation. This method shows a better accuracy and repeatability than the indentation and tensile test. From the results gotten from the works of Franco et al, this method showed an excellent repeatability and a less than 3% numerical error. One of the major advantages of this technique is that almost all the necessary equipment are readily available in most engineering laboratories while transducers and the pulse/ receiver designed specifically for ultrasonic applications are very cheap.

Works Cited

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