

Lab test: torsion test essay sample

Psychology



**ASSIGN
BUSTER**

MEMORIAL UNIVERSITY OF NEWFOUNDLAND
FACULTY OF ENGINEERING AND APPLIED SCIENCE

Engineering: 4312

Mechanics of Solids I

Lab Test #4 – Torsion Test

OBJECTIVES:

To carry out a torsion test to destruction in order to determine for a 1020 carbon steel rod specimen: 1. The modulus of rigidity, 2. The shear stress at the limit of proportionality, 3. The general characteristics of the torque, angle of twist relationship.

REFERENCES:

1. Hibbeler, R. C. “ Mechanics of Materials”, Prentice-Hall, 7th Edition. 2. Instruction Bulletin of Tecquipment Ltd.

MATERIAL:

Mild Steel rod 6 mm diameter over 3” length (overall length including hexagon ends = 5⁵/₈”).

EQUIPMENT:

1. Torsion testing Machine and Torsiometer of Tecquipment Ltd. 2. Steel rule and micrometer.

THEORY:

From the general torsion theory for circular specimen:

$$T G \theta = J I$$

where, T = Applied Torque; J = Polar Second Moment of Area; G = Modulus of Rigidity; θ = Angle of Twist (over length l); l = Gauge Length. (Nm) (mm^2) (N / mm^2) (radians) (mm)

PROCEDURE:

1. Measure the overall length and test diameter of the specimen. 2. Draw a line down the length of the test section of the specimen with a pencil; this serves as a visual aid to the degree of twist being put on the specimen during loading. 3. Mount the specimen firmly in the torsion testing machine as indicated in the operating instructions - see later. (If the Torsiometer is to be used the fixed procedure should be carried as prescribed in the last part the bulletin). For each increment of strain record the following: (a) Angle of twist of the specimen (θ) in degrees. (b) Applied torque (T) (c) Angle of twist over the 50 mm (or 2.0 in) gauge length in radians, as recorded by dial gauge indicator (θ) radians. (d) When the elastic limit has been passed, continue to test destruction with increasing increments of strain, recording for each strain increment, i) ii) Angle of twist in degrees; Applied torque.

MEASUREMENT:

1. Record the following - Initial diameter of specimen. - Final diameter of the specimen. Gauge length of the specimen. - Initial overall length of the specimen. Final overall of specimen. 2. Tabulate the results as follows: Angle of Twist (θ in degrees) Applied Torque T Angle of Twist Over the 50 mm

RESULTS REQUIRED:

a. A graph of applied torque ' T ' against angle of twist θ as a base for the elastic region. Use the slope of the graph to determine the value of modulus

of rigidity. Also from this graph determine the torque, and then calculate the shear stress at the limit of proportionality. b. A graph of applied torque against angle of twist of the specimen as base, for the complete test destruction. c. Discussions of errors involved in determining the modulus of rigidity using the angle of twist from the machine dial, and compare the result obtained with the value found by using the Torsiometer.

Fig. 1 Typical torsion-test specimens; it is mounted between The two heads of a testing machine and twisted.

Shear Stress

Slope = $G = \frac{\text{Shear Modulus}}{\text{Shear Strain (Radians)}}$

Fig. 2 The Shear Modulus is the Slope of the Linear Part of the Relationship between the Shear Stress and Shear Strain

OPERATING INSTRUCTIONS FOR THE TORSION TESTING MACHINE AND TORSIOMETER (In Instruction Form)

1. Allow the spring balance to hang free of the torque arm and zero the balance by adjusting the small knurled screw at the top right hand of the balance.
2. Slide the hook of the balance under knife edge on ~ torque arm with the hook. Hanging free its lowest position.
3. Clamp the specimen into the jaws of the Torsion Machine and fit the torsiometer onto the specimen – a full account of this is found in the bulletin under main heading “ Use and Operation of Torsiometer”. It is essential when using the Torsion Machine to

make sure that the whole length of the hexagon ends of the specimen are contained fully within the chuck jaws. Also when the straining head, specimen and Torsiometer are pushed along the bed so that the end of the specimen enters the headstock chuck, enter the specimen into the chuck until the light compression spring behind the headstock chuck just begins to compress. 4. When the specimen has been firmly fixed in poison clamp the straining head to the bed. 5. Turn the handle on the straining head until the torque arm is in the horizontal as shown by the spirit level. 6. Turn the spring balance hand wheel to raise the balance until the hook on the balance is just contacting the knife edge on the torque arm. This will be seen by movement of the spirit level bubble.

Care should be exercised to carry out this operation so that the torque arm and spring balance are “zeroed”. Both the balance hand wheel and straining head hand wheel may have to be adjusted together to obtain this condition. 7. Zero the fine and course angular displacement dials on the input and output shafts of the straining head. A knurled nut is provided behind each dial to lock the dial in position. 8. Zero the revolution counter – by turning the wingnut clockwise. 9. Adjust the arm on the Torsiometer so that it just contacts the dial gauge plunger. A knurled nut is provided for this purpose and full description is found under the main heading “Use and Operation of the Torsiometer” in the bulletin. 10. Zero the dial gauge indicator by rotating the dial. 11. The apparatus is now ready for use and the rest specimen can be loaded, in desired increments, by turning the handle on the straining head until the specimen has been rotated the requisite number of degrees as shown on the fine angular displacement dial on the machine. BEFORE

TAKING TORQUE AND DIA GAUGE READINGS BRING THE TORQUE ARM BACK INTO HORIZONTAL BY TURNING BALANCE HANDWHEEL. 12. When testing the more elastic materials the Torsiometer dial needs to be reset periodically to zero due to the limitation on the plunger travel. See "Use and Operation of the Torsiometer" in the bulletin

Note: Make all calculations (hand written or typed on a computer) legible and professional looking with sufficient margins, titles and good amount of "white space." The report must be produced the same way as you would a work term report. You may include photographs as well.