Memorandum

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Audience: Karen Thompson
Purpose: Technically Defining Torsion
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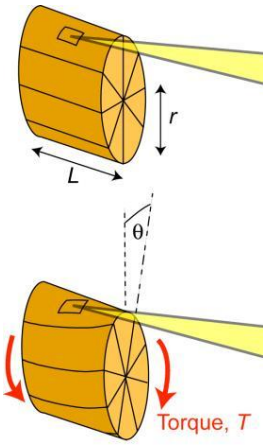
Audience. My audience is a young group of people who has a basic knowledge of physics but has not yet started college level material. This definition would be found in a magazine for young aspiring engineers, physicists, mathematicians, architects, or really curious people.

Torsion & Torque. All objects experience forces. When a force is applied, it is distributed over an area. For example, when a pencil eraser is pushed on a desk, the force on the pencil is being distributed by the area of the eraser. This is called stress; a concentration of force for some area that causes objects like the eraser to deform or warp. If the eraser were pushed into the paper and twisted, a type of stress called torsion would be present. The force causing the torsion is actually called a torque. The reason is because force only acted in a straight line, torque acts circular or goes around a centerline, in the pencil example the centerline of the torque is in the center running the full length of the pencil.

Visual behavior of Torsion. In the below diagram, the first rod is shown without any torque on it. The value r represents the radius and L is the length of the section. In the next example, when torque is applied to the rod, it twists round its centerline. The lines running along the bar shifting clockwise which shows that the deformation due to torsion is in degrees or radians as shown.



Torsion Equation: The Equation used to find the stress caused by torsion is:

$$\tau = \frac{Tr}{J}$$

The term τ is torsion stress. T is the torque acting on the member. The value r is the radius of the member experiencing the torsion. J is the torsion constant which represents the stiffness of the member.

This equation shows multiple clues to how things behave with torsion. If the values for the torque (T), radius (r), and stiffness (J) for a rod were given and then the radius was increased, the torsion stress or τ would decrease. This relationship proves that if a garden hose and a headphone experience the same torque, the headphone would experience greater torsion stress than the garden hose. This goes for the (stiffness) J as well; a stiffer rod shaped object like a metal pole would experience less torsional stress than string cheese if both were given the same torque. Also, simply increasing or decreasing the torque will increase or decrease the torsion stress, respectively.

Real Life Applications:

Stress due to torsion is present in everyday life. Torsion occurs in everyday actions like wringing out a washrag or twisting off an apple stem. When parts of a machine are expected to tolerate torsion stress, engineers design them extra thick and made of stiff materials to prevent breaking or cracking due to twisting.