# Thursday Reading Assessment: Unit 5, Forces

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## 1 Memory Bank

- Stress versus strain relationship: *stress* = Y x *strain*
- Stress (pressure) is defined like: $stress = F/A$, where $F$ is applied force, and $A$ is cross-sectional area.
- Strain (fractional change in length) is defined like: $\Delta L/L_0$, where $L_0$ is the original length of a system, and $\Delta L$ is the change in length.
- Putting it all together: $F/A = Y(\Delta L/L_0)$

| Material | Young's modulus (tension–compression) $Y$ ($10^9$ N/m$^2$) | Shear modulus $S$ ($10^9$ N/m$^2$) | Bulk modulus $B$ ($10^9$ N/m$^2$) |
|---|---|---|---|
| Aluminum | 70 | 25 | 75 |
| Bone – tension | 16 | 80 | 8 |
| Bone – compression | 9 | | |
| Brass | 90 | 35 | 75 |
| Brick | 15 | | |
| Concrete | 20 | | |
| Glass | 70 | 20 | 30 |
| Silk | 6 | | |
| Spider thread | 3 | | |
| Steel | 210 | 80 | 130 |

Figure 1: (Left) A table of Young's moduli, shear moduli, and bulk moduli. (Right) A diagram of stress and strain on a rod of cross-sectional area $A$ and original length $L_0$.

## 2 Chapter 5 - Stress and Strain

1. Steel suspension cables are used to carry gondolas at ski resorts. Find the Young's Modulus of steel in Figure 1. Consider a suspension cable that (unstretched) has a length of 2 km. Calculate the $\Delta L$ in the steel cable, assuming that the cable has a diameter of 6 cm and the tension is $4.0 \times 10^6$ N.

2. What would the $\Delta L$ be if the original length was 3 km? (*Hint: you can redo the problem with this new number, or just use scaling.*