**Youngs Modulus**

This can be summarised in the following sentence “Elastic modulus, modulus of elasticity or stiffness, is defined as an object’s resistance to elastic deformation” [1]- [3].

The explanation is given by the following section from page 69 of the given text [1]

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To clarify, we are looking at the straight-line relationship of the stress/stain curve.

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During this section, the material has not been deformed (remove the load and it will return to the original form). Beyond this section, the material is being deformed; this is an important point to explore especially when we consider what happens when we cold-work a material.

When a material is cold worked, the structure of the material is changed through a process called dislocation. The form is changed and the hardness will increase but because the molecular bonds of the metal are unaffected, the Youngs’s modulus will remain the same! (until the elastic limit is changed again).

**Factor of Safety**

The factor of safety is a subjective value that is derived on the basis of what the designer of the system requires as the follow extract explains [3]:

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Re - Yield Point

Rm – Mean Stress

The determination of the Factor of Safety is closely linked with the general risk management for the development and deployment of Materials and components.

In this instance, the Yield Strength has been used.

The Ultimate Tensile Strength (UTS) can be used but this is the absolute stress that the item can tolerate but the item will have been damaged and weakened before this while the material is experiencing plastic deformation. In most applications, that plastic deformation would be considered a failure.

Factors of safety also need to consider and accommodate fatigue failures which relates to cyclic loading and is characterised more by the yield stress and the average stress that the component encounters. This is quite difficult to calculate and normally needs complex finite element analysis (FEA) models to attempt to predict but normally it will be determined empirically.

# References

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| [1] | M. Clifford, An introduction to mecchanical engineering. Part 1, London: Routledge, 2017. |
| [2] | C. Matthews, Engineer's Data Book, Hoboken, NJ: John Wiley & Sons, 2012. |