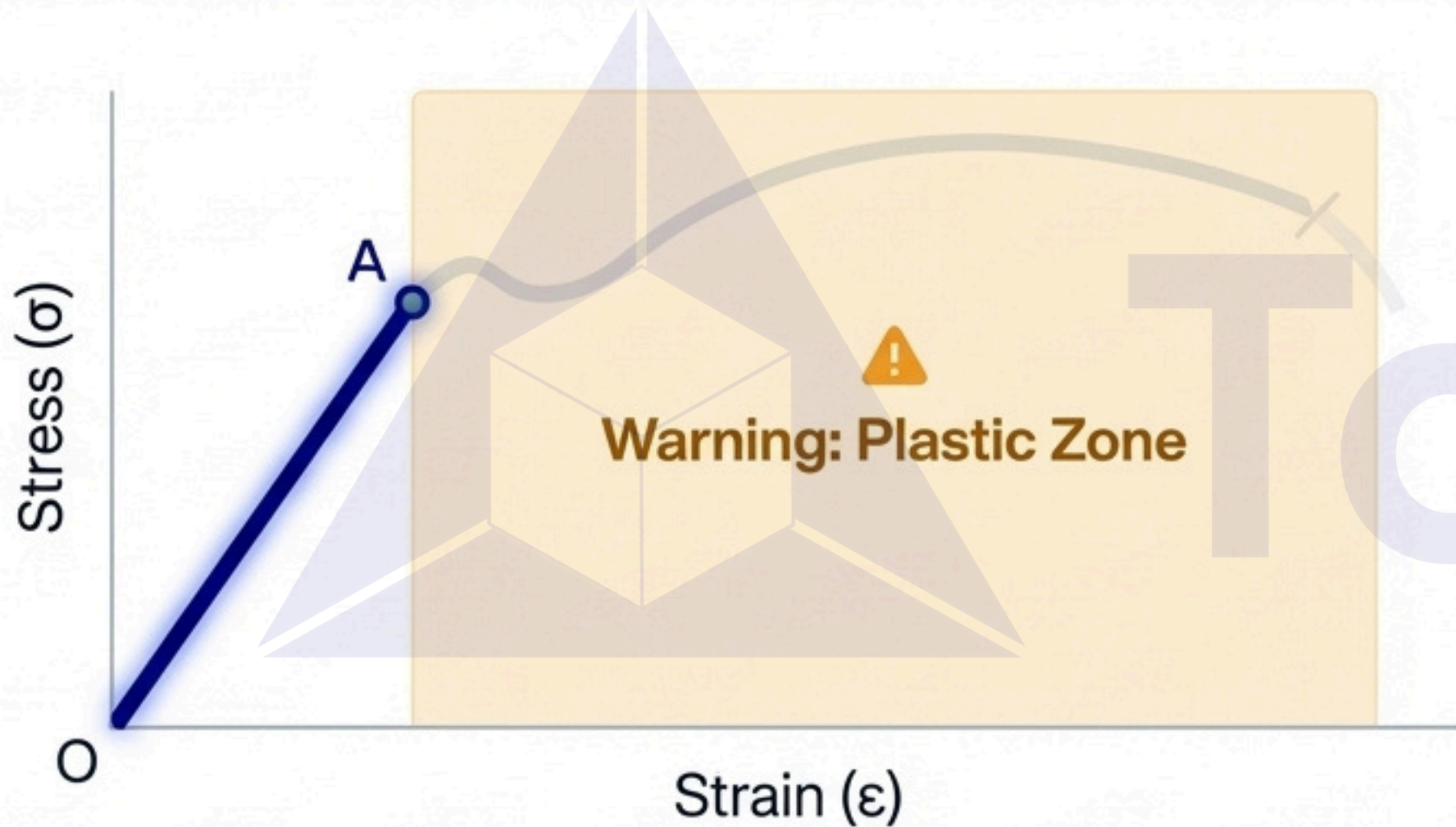


CLASS 11 PHYSICS | CHAPTER 8

Elastic Moduli

The ratio of stress to strain and the mathematical foundation of structural engineering.

Engineering the Safe Zone: The Proportional Region



1

The Physics

Within the elastic limit, stress and strain are strictly proportional.

2

The Application

Structural and manufacturing engineers design exclusively within this safe zone so buildings and machines do not permanently deform under load.

Exam Takeaway: Hooke's Law is mathematically valid ONLY in this linear Region OA.

The Governing Rule: Defining the Modulus

$$\text{Modulus of Elasticity } (k) = \frac{\text{Stress}}{\text{Strain}}$$

Represents the slope of the linear Region OA.

SI Unit: N m^{-2} or Pa

Because strain is a dimensionless ratio, the modulus inherits the exact same unit as stress.



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$$E=mc^2$$



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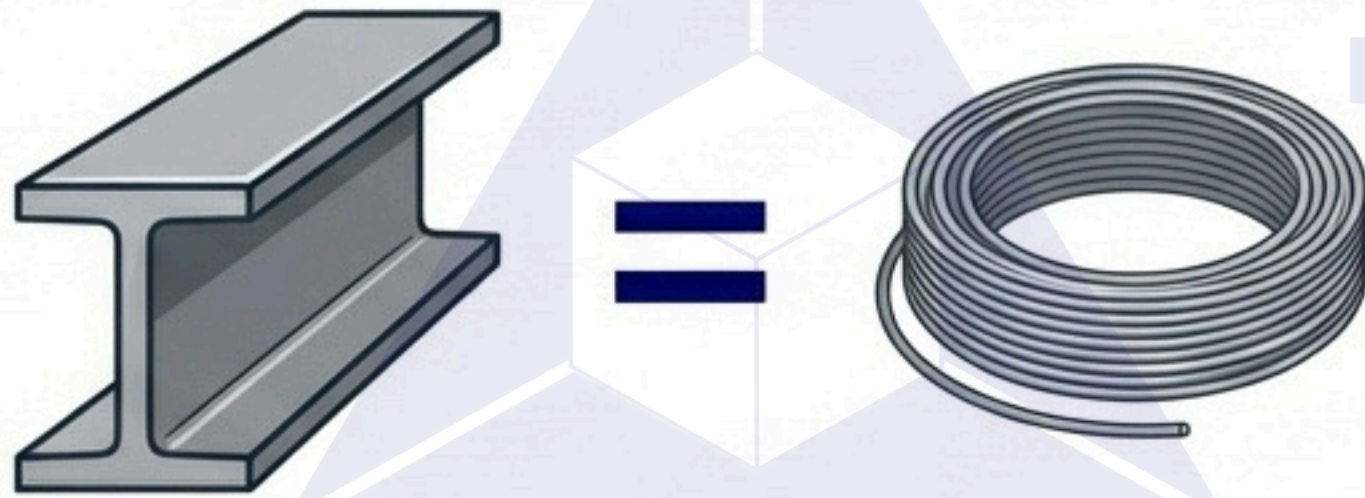
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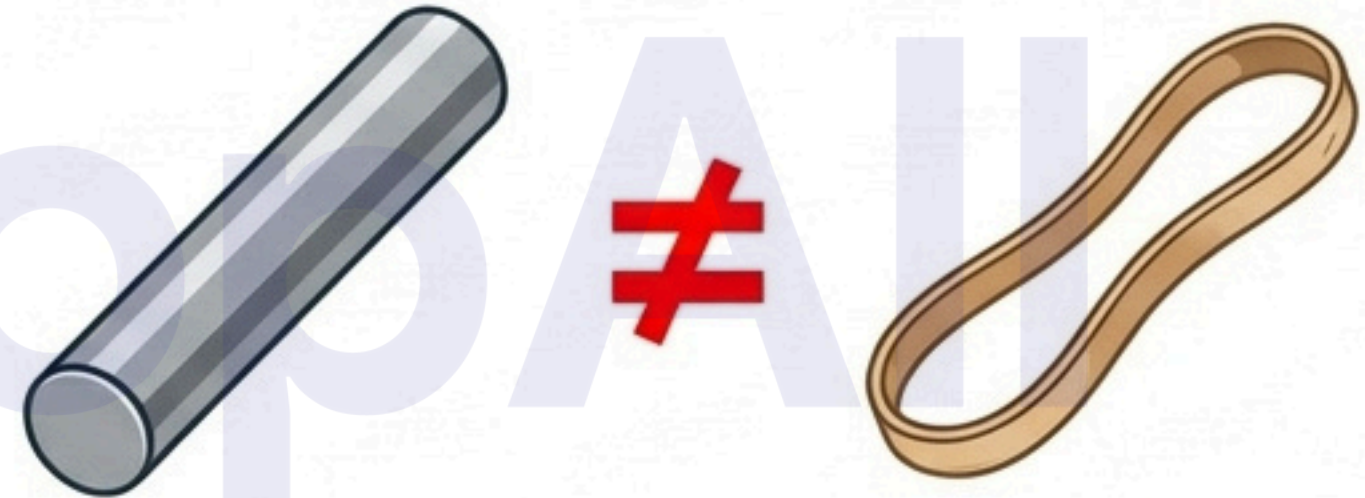


The Material Fingerprint

The modulus of elasticity is an intrinsic characteristic. It depends ONLY on the nature of the material itself, completely ignoring its dimensions, shape, or the amount of applied force.



Same Material = Same Modulus.

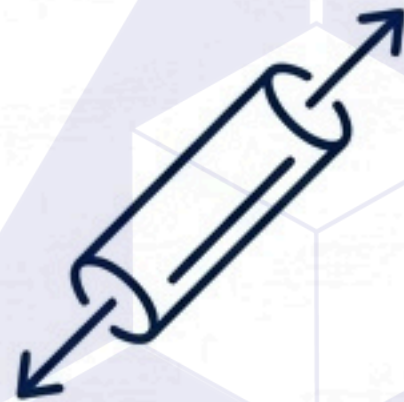


Different Material = Different Modulus.

Key Idea: A higher modulus means a stiffer material—it requires significantly more force to create the same amount of deformation.

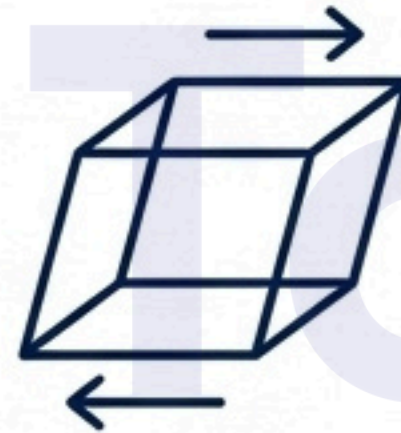
Three Dimensions of Deformation

Young's Modulus (Y)



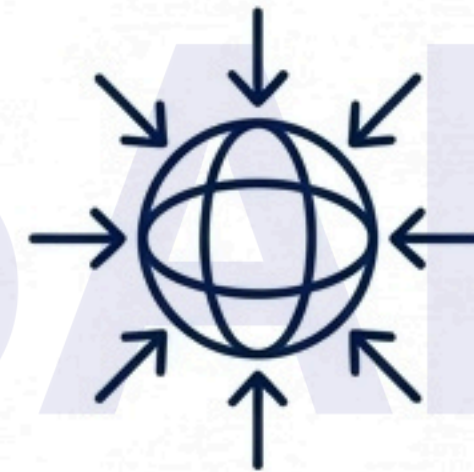
Length / Tensile

Shear Modulus (G)



Shape / Tangential

Bulk Modulus (B)



Volume / Hydraulic

Exam Takeaway: The physical state and the direction of the applied force dictate exactly which modulus you must use to solve the problem.

Chapter 8.5 Revision Checklist

- ✓ Proportional Region (OA) is the Proportional Region (OA) is the mathematical 'safe zone' for engineering.
- ✓ Modulus = Ratio of Stress to Strain.
- ✓ It is an intrinsic property (depends on material type, not dimensions).
- ✓ Three main forms: Young's (Length), Shear (Shape), Bulk (Volume).

Exam Memory Cue

$$M = S / \epsilon$$

Modulus is Stress over Strain.



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