Chart 14: Young's modulus, E, against relative cost, $C_R\rho$

The chart guides selection of materials for cheap, stiff, components (material cost only). The relative cost C_R is calculated by taking that for mild steel reinforcing-rods as unity; thus

$$C_R = \frac{\text{Cost per unit weight of material}}{\text{Cost per unit weight of mild steel}}$$

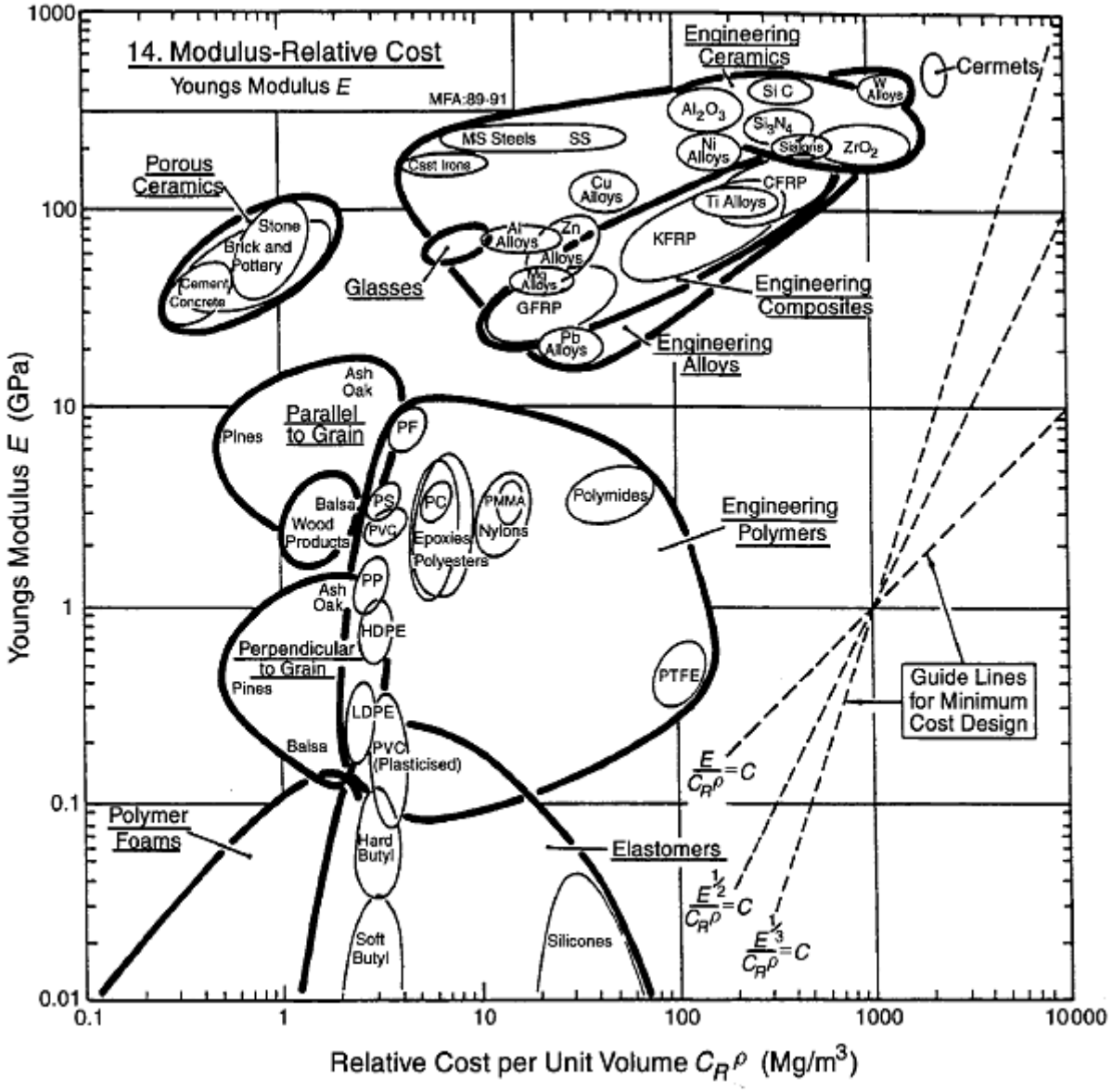
The guide lines show the loci of points for which

(a) $E/C_R\rho = C$ (minimum cost design of stiff ties, etc.)
(b) $E^{1/2}/C_R\rho = C$ (minimum cost design of stiff beams and columns)
(c) $E^{1/3}/C_R\rho = C$ (minimum cost design of stiff plates)

The value of the constant C increases as the lines are displayed upwards and to the left. Materials offering the greatest stiffness per unit cost lie towards the upper left corner. Other moduli are obtained approximately from E by

(a) $\nu = 1/3$; $G = 3/8E$; $K \approx E$ (metals, ceramics, glasses and glassy polymers)
or (b) $\nu \approx 1/2$; $G \approx 1/3E$; $K \approx 10E$ (elastomers, rubbery polymers)

where ν is Poisson's ratio, G the shear modulus and K the bulk modulus.


14. Modulus-Relative Cost
Youngs Modulus E
MFA:89-91
Engineering Ceramics
Cermets
Porous Ceramics
Stone
Brick and Pottery
Cement Concrete
Glasses
MS Steels
SS
Cast Irons
Cu Alloys
Al Alloys
Zn Alloys
Mg Alloys
GFRP
KFRP
CFRP
Ti Alloys
Engineering Composites
Pb Alloys
Engineering Alloys
Ash Oak
Parallel to Grain
Pines
PF
Balsa
Wood Products
PS
PVC
PC
PMMA
Epoxies
Polyesters
Nylons
Polymides
Engineering Polymers
PP
HDPE
Perpendicular to Grain
LDPE
PVC (Plasticised)
PTFE
Guide Lines for Minimum Cost Design
Polymer Foams
Elastomers
Hard Butyl
Soft Butyl
Silicones
Youngs Modulus E (GPa)
Relative Cost per Unit Volume $C_R\rho$ (Mg/m^3)