Chart 4: Young's modulus, E, against strength, σ_f

The chart for elastic design. The contours show the failure strain, σ_f/E. The 'strength' for metals is the 0.2% offset yield strength. For polymers, it is the 1% yield strength. For ceramics and glasses, it is the compressive crushing strength; remember that this is roughly 15 times larger than the tensile (fracture) strength. For composites it is the tensile strength. For elastomers it is the tear-strength. The chart has numerous applications among them: the selection of materials for springs, elastic hinges, pivots and elastic bearings, and for yield-before-buckling design. The guide lines show three of these; they are the loci of points for which:

(a) $\sigma_f/E = C$ (elastic hinges)

(b) $\sigma_f^2/E = C$ (springs, elastic energy storage per unit volume)

(c) $\sigma_f^{3/2}/E = C$ (selection for elastic constants such as knife edges; elastic diaphragms, compression seals)

The value of the constant C increases as the lines are displaced downward and to the right.