We present new kinematic bending measures and quadratic energies for isotropic elastic plates and shells, with certain desirable features not present in commonly employed models in mechanics and soft matter. These are justified both by simple physical arguments related to the through-thickness variation in strain, and through a detailed reduction from a three-dimensional energy quadratic in stretch. The measure of plate bending is a dilation-invariant surface tensor that couples stretch and curvature in a natural extension of primitive generalized bending strains for straight rods. The extension to naturally-curved rods and shells, for which the pure stretching of a curved rest configuration is not a dilation, contrasts with previous ad hoc postulated forms. Our results provide a clean basis for simple models of low-dimensional elastic systems, and should enable more accurate probing of the structure of singularities in soft sheets and membranes.