

On the Source of Singularities in Mechanics

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Stress singularities occur at discontinuities, such as sharp corners, in both fluid and solid mechanics. While such singular stresses are often qualitatively physically appropriate, they are never quantitatively physically appropriate. To begin to improve the modeling so that more physically-sensible stresses are produced, the source of these singularities need to be identified. Here this is demonstrated to be infinite stiffnesses in underlying intermolecular laws that enter implicitly with some traditional boundary conditions. When finite stiffnesses are introduced instead, local asymptotic analysis shows that finite stresses result (confirmed in some instances with global numerical analysis). This is so even with the originating discontinuity still present, thus indicating that it is the infinite stiffnesses involved that are the sources of singularities rather than the associated discontinuities themselves. Removal of singularities via the introduction of finite stiffnesses is illustrated for a range of otherwise singular problems in both fluid and solid mechanics.

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