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SHEAR CORRECTION FACTORS OF PLATE MODEL

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The classical Kirchhoff and Reissner-Mindlin plate models assume that the normal line segments to the mid-plane move as rigid bodies in deformation and that the transverse normal stress vanishes. These assumptions result into a practical model for engineering work but they are also known to be a source for modelling error. In particularly, prediction of the transverse shear stress is poor. The overly stiff behavior for thick sandwich and layered plates need also be corrected by shear correction factors which bring an 'ad hoc' element into the otherwise well-grounded theory.

The number of refined plate models in literature is impressive. Increasing the polynomial order of the displacement assumption in the transverse direction is a popular choice [1,2]. Use of a layer wise displacement assumption in [3] is another common choice. One of the challenges in refinements comes from the need to compromise the modelling error with simplicity of practical calculations [2]. From this perspective, refinements that keep the classical mathematical form of the plate equations are attractive.

The refined plate theory suggested aims to reduce the modelling error without affecting the mathematical form of the Reissner-Mindlin plate model. Following the refinements in [1,2], a warping part is included in the displacement assumption. However, as an improvement over the method in [1,2], the warping part is treated as an unknown of the plate problem. The consistent shear correction factor, implied by the shear stress resultant expressions for the refined model and the classical model

$$\begin{Bmatrix} Q_x \\ Q_y \end{Bmatrix} = \frac{t^6}{36}\left[\int_{z_-}^{z_+} (z-z_-)^2(z-z_+)^2[G]^{-1}dz\right]^{-1}\begin{Bmatrix} \gamma_x \\ \gamma_y \end{Bmatrix} \quad \text{and} \quad \begin{Bmatrix} Q_x \\ Q_y \end{Bmatrix} = \int_{z_-}^{z_+}[G]dz\begin{Bmatrix} \gamma_x \\ \gamma_y \end{Bmatrix}$$

is one of the main outcomes. Comparisons of the classical model, refined model, and exact solutions to isotropic and plywood plates indicate that the refinement suggested may improve the displacement and transverse stress predictions of the Reissner-Mindlin model subtantially.

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