The $k-\varepsilon-v^2$ Model with Elliptic Relaxation:

Prior to the elliptic relaxation Reynolds stress model, Durbin (1991) introduced elliptic relaxation for a $k-\varepsilon-v^2$ model. In this model, the system of equations for the Reynolds stress tensor is replaced by a transport equation for a velocity scalar v^2 representing $\langle (v')^2 \rangle$ and an elliptic equation is introduced for a function f. This function is analogous to a redistribution term. The objective of this model is to retain a characterization of near-wall stress anisotropy, but to embed it in a more computationally tractable framework.

The equations of the model are:

$$\frac{\bar{D} v^2}{\bar{D} t} = \frac{\partial}{\partial x_k}\left((\nu + \nu_T) \frac{\partial v^2}{\partial x_k} \right) + k f - \varepsilon \frac{v^2}{k}$$

$$(L^2 \nabla^2 - I) f = \frac{c_1}{T}\left(\frac{v^2}{k} - 2/3 \right) - c_2 \frac{P}{k}$$

where $c_1 = 0.4$ and $C_2 = 0.3$. The above equations are coupled with transport equations for k and ε, and the turbulent viscosity model is used with:

$$\nu_T = C_\mu v^2 T$$

The $k-\varepsilon-v^2$ model with elliptic relaxation has been applied to a number of complex flows exhibiting, for example, separation and impingement.