Peaceman @model

Effective drainage radius for numerical well-reservoir contact model:

(1) $$r_e = 0.28 \frac{\sqrt{\left(\frac{k_{\perp 2}}{k_{\perp 1}}\right)^{1/2} D_{\perp 1}^2 + \left(\frac{k_{\perp 1}}{k_{\perp 2}}\right)^{1/2} D_{\perp 2}^2}}{\left(\frac{k_{\perp 2}}{k_{\perp 1}}\right)^{1/4} + \left(\frac{k_{\perp 1}}{k_{\perp 2}}\right)^{1/4}}$$

where $\mathbf{D} = \{ D_{\perp 1}, D_{\perp 2} \}$ – dimensions of the grid cell around well in transversal plane to the well axis.

Strictly speaking, the above formula is only valid in case well penetrates through the whole length of grid cell $\mathbf{D}$ perpendicular to the cell faces.

There are many modifications and generalization of the Peaceman approximation but in the most practical cases it works very well when sufficiently fine LGR is applied.

In particular case of isotropic permeability $k_{\perp 1} = k_{\perp 2}$ the Peaceman effective radius is given by:

(2) $$r_e = 0.28 \sqrt{D_{\perp 1}^2 + D_{\perp 2}^2}$$

and in case of a square grid cell $D_{\perp 1} = D_{\perp 2} = D_{\perp}$:

(3) $$r_e = 0.4 \, D_{\perp}$$

There is a natural limit to when LGR is capable to support Peaceman approximation.

This can be illustrated on the case of isotropic permeability and square grid.

Formula (3) assumes that external boundary of drainage area is greater than well radius which introduces a natural limitation to applicability of Peaceman approximation for pressure calculations in near-well reservoir zone with $D_{\perp} < 2.5 \, r_w$.

This is, for example, the case in SPT where time lag between pressure response to the flow variation is so small (seconds) that it dictates very small grid size around wellbore and Peaceman approximation can not be properly applied.