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Powell inversion mechanical model of foundation parameters with generalized Bayesian theory

Jian ZHANG, Chu-wei ZHOU, Chao JIA, Jing LIN

Key words:Powell inversion; Mechanical model; Foundation parameter; Bayesian objective function; Stochastic property

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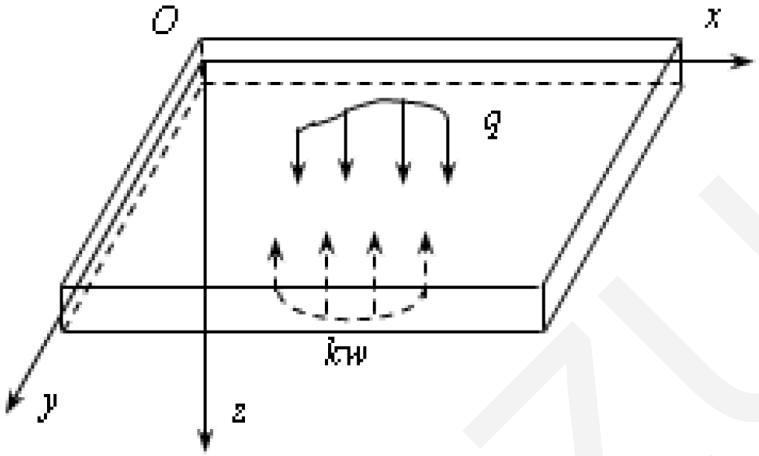
Moderately-thick plate on the foundation



$$\frac{\partial Q_x}{\partial x}+\frac{\partial Q_y}{\partial y}+q-kw=0,$$

$$\frac{\partial M_x}{\partial x}+\frac{\partial M_{xy}}{\partial y}-Q_x=0,$$

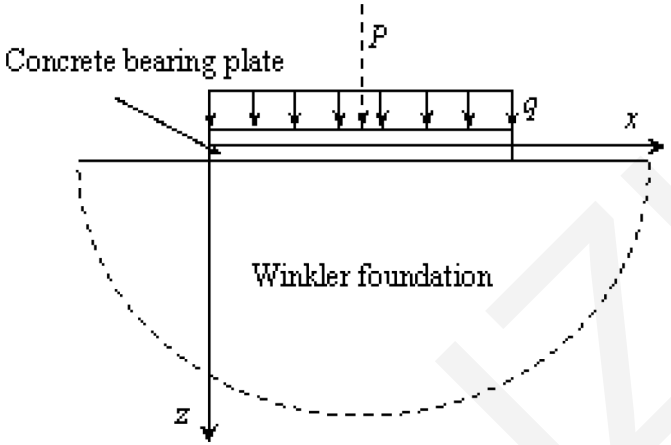
$$\frac{\partial M_{xy}}{\partial x}+\frac{\partial M_y}{\partial y}-Q_y=0,$$

The main suppositions :

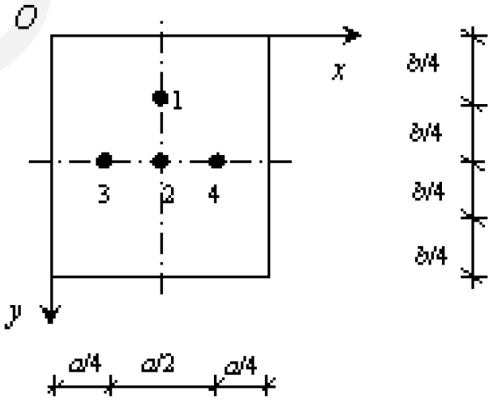
1.The normal line of the middle surface before deformation remains a straight line after deformation.

2.The normal line may be not vertical to the middle surface. The transversal shearing deformation effect is admitted and the stress vertical to the middle surface can be ignored.

Analysis model of the Powell stochastic inversion of the practical foundation parameters



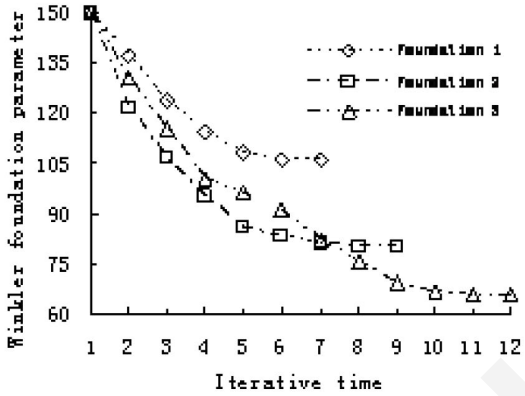
Concrete bearing plate on Winkler foundation

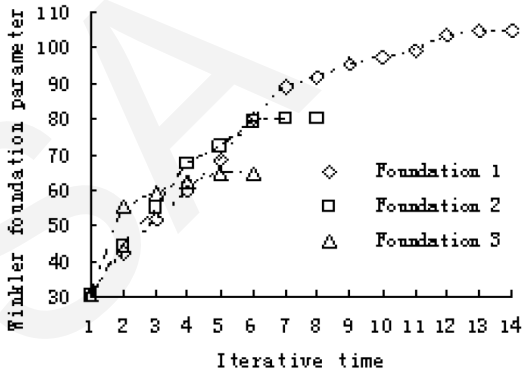


Four selected points on a concrete bearing plate

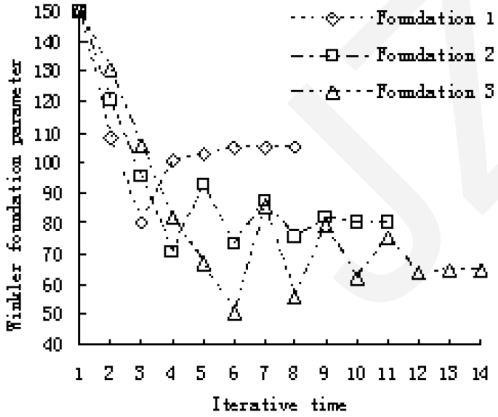
Iteration results of Powell stochastic inversion of the foundation parameters

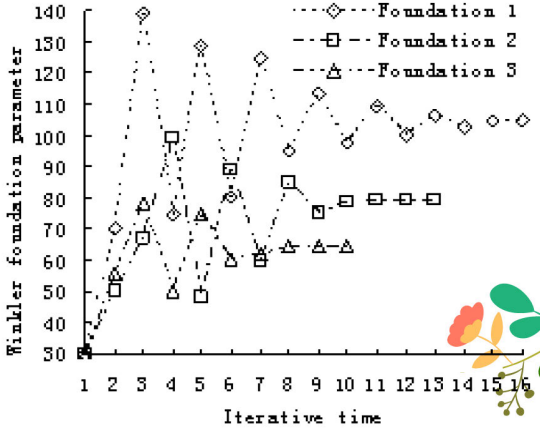
Case 1





Case 2





Conclusions

1. The Powell optimizing inversion theory of the foundation parameter based on generalized Bayesian theory is deduced and the Powell iterative inversion processes are steadily convergent to the true values, which indicates that the Powell inversion mechanical model is correct and reliable.

2. The derived Powell optimizing inversion model based on generalized Bayesian theory has universal significance for different kinds of foundation parameters and only the corresponding foundation model should be taken into consideration.

3. Unlike the Kalman filtering theory and the conjugate gradient theory, the partial derivatives of the systematic responses to the foundation parameters are not relevant to the Powell inversion process, which indicates that the Powell inversion theory is of higher computational efficiency.

4. Searching of the optimal step length is a fairly complicated problem in parameter inversion. The *quadratic* parabolic interpolation method derived in this paper can automatically determine the span of the optimal step length and then achieve the step length.