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The algorithm of calculus of the vertical displacement above an exploited surface

N. Dima, I. Veres and L. Filip
University of Petrosani, Petrosani, Romania (larisafilip@yahoo.com)

Considering the massive's parameters σ_x, σ_y, μ_x, μ_y, according to the formulas:

$$\sigma_X(h) = {}^1\!/_6 (R_1 + R_2) = {}^1\!/_6 h \left(ctg\gamma_{x1}(h) + ctg\gamma_{x2}(h)\right) \quad (1)$$

$$\mu_x(\xi, h) = \xi + \Delta\mu_x(\xi, h) = \xi + 0,5h \cdot \left(ctg\gamma_{x2}(h) - ctg\gamma_{x1}(h)\right) \quad (2)$$

and the equation:

$$\begin{aligned} w_{zz}(P,Q) &= W_N(x_p, h, \xi) \cdot w_N(y_p, h, \eta) = \\ &= \frac{1}{2\pi \cdot \sigma_x(h) \cdot \sigma_y(h)} \cdot \exp\left\{-{}^1\!/_2 \left[\left(\frac{x_p - \mu_x(\xi,h)}{\sigma_x(h)}\right)^2 + \left(\frac{y_p - \mu_y(\eta,h)}{\sigma_y(h)}\right)^2\right]\right\} \end{aligned} \quad (3)$$

A function of influence can be written; with this help we could calculated the sink of a point $P = (x_p, y_p, z_p = \xi + h)^t$ if the initial behavior $\alpha(Q)$ is known:

$$\begin{aligned} y_z(P) = \iint\limits_{Q_{xy}} \frac{1}{2\pi \cdot \sigma_x(\xi,h)\sigma_y(\eta,h)} \exp\left\{-{}^1\!/_2 \left[\left(\frac{x_p - \mu_x(\xi,h)}{\sigma_x(\xi,h)}\right)^2 + \left(\frac{y_p - \mu_y(\eta,h)}{\sigma_y(\eta,h)}\right)^2\right]\right\} \cdot \\ \cdot \alpha(\xi, \eta, \zeta) \cdot d\xi \cdot d\eta \end{aligned} \quad (4)$$

The integration is extended on the Q$_{xy}$ area, which describes the exploited surface, eventually considering the pre-convergence of the coal layer, situated at the border of the exploited area. Different from (1), the parameters σ_x and $\sigma_y$were extended with the parameters ξ and η. In this representation way, it is expressed the fact that the reaction of the massive made by a source $Q = (\xi, \eta, \zeta)^t \in Q_{xy}$ depends of the geometrical position from inside the exploited area. This means that the possible function of the influence angles could vary on the Q_{xy}area. Only an approximate solution could be obtained. The Q_{xy} area a network is overlapped, its lines are parallel with the main axes x and y. This network of the exploited area is formed by n_x•n_y, rectangular elements; its lines could have different lengths. By superposition, (4) becomes:

$$\nu_z(P) = \sum_{i=1}^{n_x} \sum_{j=1}^{n_y} \tilde{\alpha}(i,j) \cdot w(x_p, i, h) \cdot w(y_p, j, h) \tag{5}$$

where

$$w(x_p, i, h) = \frac{1}{\sqrt{2\pi} \cdot \tilde{\sigma}_x(i,h)} \int_{\xi_i}^{\xi_{i+1}} \exp\left[-{}^1\!/_2 \left(\frac{x_p - (\xi + \Delta\tilde{\mu}_x(i,h))}{\tilde{\sigma}_x(i,h)}\right)^2\right] d\xi \tag{6}$$

and

$$w(y_p, j, h) = \frac{1}{\sqrt{2\pi} \cdot \tilde{\sigma}_y(j,h)} \int_{\eta_j}^{\eta_{j+1}} \exp\left[-{}^1\!/_2 \left(\frac{y_p - (\eta + \Delta\tilde{\mu}_y(i,h))}{\tilde{\sigma}_y(j,h)}\right)^2\right] d\eta \tag{7}$$

Because $\tilde{\sigma}_x, \tilde{\sigma}_y, \Delta\tilde{\mu}_x$ and $\Delta\tilde{\mu}_y$ are constants, (6) and (7) could be solved by successive approximations. Moreover, due to the fact the two equations are identical the result of the equation (6) will be presented, as an example. By substitution:

$$\lambda_x(\xi) = \frac{x_p - (\xi + \Delta\tilde{\mu}_x(i,h))}{\tilde{\sigma}_x(i,h)} \tag{8}$$

(6) can be changed to a normal distribution:

$$w(x_p, i, h) = \frac{1}{\sqrt{2\pi}} \int_{\lambda_x(\xi_i)}^{\lambda_x(\xi_{i+1})} \exp\left[-{}^1\!/_2 \lambda_x(\xi)^2\right] d\xi \tag{9}$$

Using the values from tables of the dispersion function of the normal distribution with:

$$\Phi(u) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{u} \exp\left[-{}^1\!/_2 \lambda^2\right] d\lambda \tag{10}$$

the following relation is obtained for(6):

$$w(x_p, i, h) = \Phi(\lambda_x(\xi_i)) - \Phi(\lambda_x(\xi_{i+1})) \tag{11}$$