In mine workings and extraction faces, measures must nearly always be taken to prevent rock falls, bumps, rock bursts of coal and gas, etc., due to stress redistribution within the solid rock. The question thus arises: under what conditions do these harmful (but sometimes beneficial) phenomena appear in mines as a result of stress redistribution within the rock, and what part does the character of the redistribution play? To answer this question we must have an adequate picture of the extent and character of stress redistribution in rocks during mining operations, taking into account those characteristics of the solid rock which affect redistribution.

There are few reliable experimental data for assessing stresses and their redistribution in solid rock. In natural conditions we cannot delineate all the characteristics of stress redistribution. Theoretical studies, enabling us to describe and explain the stress redistribution, which may directly or indirectly affect self-caving of rocks, shock bumps and other phenomena are required. But to do this we must select a model of the medium enabling us to describe the redistribution to some extent. It is widely believed that in formulating problems of rock mechanics related to mine workings, the solid rock must not be considered (as is so often the case [1-6]) from the viewpoint of the mechanics of continuous media, and that the laws of elasticity theory cannot be used for describing rock stress. This opinion is based mainly on theories of natural fracturing of rocks and a comparison between breaks in the continuity of the periphery of a mine working and the fracture of equivalent materials on test benches when holes are made geometrically similar to a working. In our opinion, in the majority of cases this picture does not correspond with the facts. The question of the continuity and elasticity of rocks in situ is basic in formulating problems of rock mechanics and we must therefore consider it in greater detail.

It must be borne in mind that in natural conditions, in the presence of hydrostatic stress, fissures are closed by rock pressure. They may be opened up if stress redistribution in mine workings removes the rock pressure in any direction, or if the mean tangential stresses in rocks weakened by fissures reach the rock's ultimate shearing strength across the thickness of the layer. This is observed primarily at the periphery of the waste area. Outside this region, where hydrostatic stress is retained and the tangential stresses are less than the ultimate shearing strengths, the strata remain continuous and the relation between deformations and stresses will obey the laws of elasticity theory. These laws are not applicable to the fractured rocks adjoining the mine working. In formulating problems of rock mechanics we must therefore often take into account the fractured rock or make appropriate corrections in solutions which have made no allowance for boundary conditions. The size and shape of the zone of fractured rock will be determined by those of the working, the strength of the rocks, the mining method and, in particular, the initial stressed state, characterized by the vertical pressure \( p \) and the lateral pressure \( q = \alpha p \). This applies especially to fracturing of equivalent materials on a test stand when notches are made in them corresponding to mine workings.

In natural conditions the coefficient of lateral pressure is the least known value. The question thus arises, does a change in \( \alpha \) have a marked effect on the dimensions of the fractured zone? What is the value of \( \alpha \) in the undisturbed strata? Below, an attempt is made to answer these questions, starting from an analysis of the stressed state and the behavior of the surrounding rock during extraction operations in a horizontal seam before primary caving of the face. Since the face length often exceeds the thickness of the extraction slice or seam, we will limit the analysis to stresses governed by plane deformation of the solid rock.

Figure 1 gives a diagram of the position of the seam and the waste area, between the surrounding rocks, at depth \( H \).
It is known that before the primary caving of the face the rocks of the main roof and floor are undisturbed. Their exposed surfaces do not display rock falls or fissures across the strike. We can thus infer that if the surrounding rocks are reasonably strong and the waste area supported, stress redistribution in the solid rock before primary caving obeys the laws of elasticity theory up to the surface of the waste area, except in adjacent, relatively small areas of maximum stress in the seam.

The author of [1] did not take into account seam compressibility in absence of supports in the waste area when he formulated the problem of extraction operations before primary caving of the face, and its solution by methods of elasticity theory, describing stress distribution in the surrounding rock. At an initial rock pressure determined by the relationships

\[
\sigma_x^0 = \gamma (y - H), \quad \sigma_y^0 = \gamma (y - H), \quad \tau_{xy}^0 = 0,
\]

(1)
taking into account a support whose reaction is distributed uniformly in the waste area, the solution in [1] for stress components \(\sigma_x, \sigma_y, \tau_{xy}\) and displacement components \(u\) and \(v\) reduces to

\[
\begin{align*}
-\frac{\sigma_y}{\gamma H} &= x \left(1 - \frac{y}{H}\right) - \frac{2}{\gamma H} \Re \Phi (z) + \frac{2}{\gamma H} y \Im \Phi (z); \\
-\frac{\tau_{xy}}{\gamma H} &= \left(1 - \frac{y}{H}\right) - \frac{2}{\gamma H} \Re \Phi (z) - \frac{2}{\gamma H} y \Im \Phi (z); \\
\tau_{xy} &= -2 y \Re \Phi (z); \\
2\mu (u + iv) &= z \bar{\tau} (z) - \bar{\tau} (z) - (z - \bar{z}) \Phi (z); \\
\Phi (z) &= \frac{\gamma H - N}{2} \left[ 1 - \sqrt{\frac{z + \frac{L'}{2}}{z - \frac{L'}{2}}} + \frac{\frac{L'}{2}}{\sqrt{z - \left(\frac{L'}{2}\right)^2}} \right] \\
\bar{\tau} (z) &= \int \Phi (z) \, dz, \quad z = x + iy; \\
\mu &= \frac{E}{2(1 + \nu)}; \quad x = 3 - 4\nu.
\end{align*}
\]

Here \(L'\) is the length of the waste area, disregarding seam compressibility; \(\nu\) and \(E\) are Poisson's ratio and Young's modulus respectively, typifying the elastic properties of the solid rock as a whole.

This solution does not give a true picture of the distribution of rock pressure on the seam over the relatively small areas adjoining the waste. Near the latter the seam is in a state of maximum stress and load distribution upon it in these areas is therefore determined mainly by the seam's bearing capacity. But the load \(\sigma_y\) on the seam, determined by Eqs. (2) and (3), may be considered as equivalent to the load \(F(x)\) determined by the seam's bearing capacity near the waste area. Bearing in mind the St. Venant conditions, this discrepancy between the true pressure distribution on the seam and that determined by Eqs. (2) and (3) has virtually no influence on stress distribution within the rocks, except in the relatively small areas of maximum stress.

To determine the length \(I\) of the area of maximum stress in the seam and the discrepancy between \(L\), the true length of the waste area, and \(L'\), the fictitious length, following [4] we can use the equations

\[
F \left(\frac{L}{2} - I\right) = \bar{\tau} \left(\frac{L}{2} - I\right)
\]

(6)

which expresses the continuity of the load on the seam at the boundary of maximum stressed state, and