

Shear Behavior of Resin-Grouted Rebar Rock Bolts in Saskatchewan Potash Mines

Potash deposits in Saskatchewan are located deep below the surface of the earth. Potash mines use and create long tunnels; these tunnels can create instability in the areas immediately above, beside and below the tunnels. This is to be expected: the weight of the material above will want to move into the empty space of the underground tunnels. Also, the earth moves naturally: underground matter (different rock and mineral layers including clays and sands) are not completely stationary. In order to stabilize underground mining tunnels, mining engineers use what are called resin-grouted rebar rock bolts. These bolts, which are made of reinforced steel bar, are inserted in holes drilled in the ceilings of mine tunnels and are set in place with quick-setting resin. The bolts are long enough to go through several layers of unstable media (clay, for example) to attach to a “strong” rock layer a short distance above the tunnel. Rock bolts are a critical piece of safety equipment for mining and need to be monitored closely to ensure the stability of underground mine facilities.

Rock bolts failing due to shear stress (forces acting laterally on bolts, occurring when layers of earth shift perpendicular to the length of the bolt (see diagram)) is of particular concern to mine engineers. To address this, researchers in the Civil, Geological and Environmental Engineering Department at the University of Saskatchewan developed a project called “**Shear Behavior of Resin-Grouted Rebar Rock Bolts in Saskatchewan Potash Mines**”. The project, conducted in laboratories and within working mine tunnels, investigated the effect shear plane separations have on the performance and ultimate strength (in shear) of the rebar rock bolts, whether existing models can predict rebar behavior in underground potash mines and to confirm if using fiber-optic strain measurement techniques could accurately measure strain in rebar and endure harsh underground conditions.

The project found that the thickness of the shear plane (shear plane aperture) was the biggest factor in predicting shear failure of resin-grouted rock bolts. Lateral pull testing revealed that all rebar types yield at very low loads and displacements. The use of fiber-optic instrumentation was beneficial in allowing the researchers to determine strain distributions in rebar but was limited in measuring strain over 1%. The researchers developed a chart for potash mining engineers to quickly assess the integrity of installed resin-grouted rebar rock bolts; these charts were checked against established models and were found to be comparable, thereby confirming the results of this successful research project.

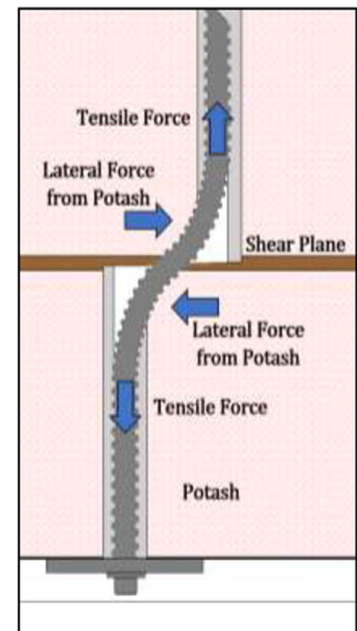


Figure from Snell, G. (2019). *Shear Behavior of Resin-Grouted Rebar Rock Bolts in Saskatchewan Potash Mines: A Practical Research Summary*. University of Saskatchewan.

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