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An Investigation on Load Bearing Capacities of Cement and Resin Grouted Rock Bolts Installed in Weak Rocks

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Rock bolts have been considered one of indispensable support method to improve load bearing capacity of many underground engineering projects, and thus, various types of them have been developed until now for different purposes. Although mechanically anchored rock bolts can be successfully installed to prevent structurally controlled instabilities in hard rocks, in comparison with cement and resin grouted rock bolts, these types of anchors are not so effective in weak rocks characterized by relatively low mechanical properties. In order to investigate the applicability and to measure relative performance of cement and resin grouted rock bolts into weak and heavily jointed rock mass, a research program mainly consisting of pull-out tests was performed in a metal mine in Turkey. The rock materials excavated in this underground mining were described as basalt, tuff, ore dominated volcanic rocks and dacite. To achieve more representative results for rock materials found in this mining and openings excavated in varied dimensions, the pull-out tests were conducted on rock bolts used in many different locations where more convergences were measured and deformation dependent instability was expected to cause greater engineering problems. It is well known that the capacity of rock bolts depends on the length, diameter and density of the bolt pattern, and so considering the thickness of plastic zone in the studied openings, the length and diameter of rock bolts were taken as 2.4 m. and 25 mm., respectively. The spacing between rows changed between 70 and 180 cm. In this study, totally twenty five pull-out tests were performed to have a general understanding about axial load bearing capacity and support reaction curves of cement and resin grouted rock bolts. When pull load–displacement curves belongs to cement and resin grouted rock bolts were compared with each other, it was determined that cement grouted rock bolts carry more load ranging between 115.6 kN and 127.5 kN with a mean value of 119.4 kN. However, the axial pull-load obtained from resin grouted rock bolts ranged from 2.9 to 110.9 kN with a mean value of 45.7 kN. Achieving relatively lower axial pull loads for resin grouted rock bolts were attributed to the tendency of resin to flow easily throughout surfaces of discontinuities. During site investigation, it was concluded that 27 of 72 resin grouted rock bolts and 8 of 56 cement grouted rock bolts were determined to lose their support capacities. According to these observations, it was found that while support recovery of cement grouted increase to 85.7%, this ratio decreased to about 62.5% for resin grouted rock bolts. When these observations and pull-out test results are considered, it can be concluded that installing cement grouted rock bolts can be more effective than resin grouted rock bolts to support mining operated in weak and heavily jointed rock masses.