

At Gallery,

By using equation 26, since k value is > 0.5 .

$$SLD = 3.29 \text{ t/m}^2$$

$$ASL_{\text{gallery}} = \frac{N_b A_s}{w R_s} = \frac{4 \times 16}{4.8 \times 1.5}$$

$$ASL_{\text{gallery}} = 8.88 \text{ t/m}^2$$

$$FOS = \frac{ASL}{SLD} = \frac{8.88}{3.29} = 2.70$$

At Junction,

By using equation 27

$$SLD = 6.23 \text{ t/m}^2$$

$$ASL_{\text{Junction}} = \frac{N_b A_s}{w R_s} = \frac{16 \times 16}{(4.8 \times 4.8) \times 1.0}$$

$$ASL_{\text{Junction}} = 11.11 \text{ t/m}^2$$

$$FOS = 1.78$$

9. CONCLUSION

The numerical simulation method is used to analyze the rock load height considering key parameters such as the strength of rock mass, stress ratio, gallery width, depth and $\frac{G_w}{G_h}$ ratio. Following conclusion has been drawn from the analysis.

Generalized empirical equations have been developed for estimation of rock load height during development stage of bord and pillar mining. Estimation of Support load requirement has been divided into two categories named as gallery and junction.

At Gallery or face the empirical equation of rock load height is further divided into two parts based on k value because of its importance. For, $k = 0.5$ equation 25 shows that rock load height is directly proportional to the $\frac{G_w}{G_h}$ and inversely proportional to $\frac{G_w}{G_h}$ in case of $k > 0.5$ shown in equation 26. From the simulation process, it has also been observed for $k = 0.5$, the yield of the roof has maximum at the corner of pillar and type of failure is shear. For, $k > 0.5$, yield of roof is like a dome shape, and maximum failure has been observed at the center of the gallery. Type of failure is tension at the center of pillar near roof surface and shear failure at both the corner of the gallery.

Equation 27, represent the rock load height at junction during development stage. From the analysis it has been observed that the failure does not change with change the value of k. So, only one simplified equation represents the rock load height at junction including all the key parameters.

Using the expression 29, it can easily estimate the number of bolts required in the gallery during development stage of an underground coal mine maintaining factor of safety more than 1.5. The developed equations can be used for all type of the development gallery either by conventional or mechanized

method of operation with SDL, LHD or continuous miner. This equation cannot be used for laminated roof where the thickness of immediate roof strata is within the range of bolt length.

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