Comparative Study on Overbreak and Underbreak Effects of Shaped Charge Blasting versus Smooth Blasting in Multi-Jointed Tunnels (Postprint)

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Abstract

To investigate the advantages of shaped charge blasting over conventional smooth blasting in multi-jointed tunnels, four double-hole models for smooth blasting and shaped charge blasting were established to study the influence law of the angle between joints and blasthole alignment on overbreak and underbreak in multi-jointed tunnel blasting, and to explore hazardous locations during tunnel cross-section blasting excavation. The research results demonstrate that smooth blasting exhibited substantial damage in multi-jointed shale tunnels, resulting in a significant increase in overbreak and underbreak, particularly when the blasthole alignment direction formed a 45° angle with the joints, wherein smooth blasting generated the maximum overbreak and underbreak of 1436 cm^2, thus necessitating special attention to such angular conditions in blasting scheme design. Shaped charge blasting induced less damage to surrounding rock in multi-jointed shale tunnels and effectively reduced overbreak and underbreak, with the average tunnel overbreak and underbreak decreasing by 1090 cm^2, and specifically decreasing by 1161.4 cm^2 compared to smooth blasting in the 45° angle model, demonstrating remarkable optimization effects. In summary, the application of shaped charge blasting in multi-jointed shale tunnels is markedly superior to conventional smooth blasting, as it not only effectively reduces surrounding rock damage but also significantly decreases overbreak and underbreak, thereby enhancing the safety and efficiency of tunnel construction. Consequently, it is recommended to prioritize the adoption of shaped charge blasting technology in practical engineering applications.

Full Text

Preamble

Comparative Study on the Effect of Cumulative Blasting and Smooth Blasting in Multi-joint Tunnel

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Abstract

To investigate the advantages of cumulative blasting over conventional smooth blasting in multi-joint tunnels, four double-hole models for both blasting methods were established. The study examined the influence of the angle between joints and blasthole alignment on overbreak and underbreak quantities in multi-joint tunnel blasting, and identified hazardous locations during tunnel cross-section excavation.

The results demonstrate that smooth blasting induces significant damage in multi-joint shale tunnels, leading to substantially increased overbreak and underbreak. Particularly when the blasthole alignment forms a 45° angle with the joints, smooth blasting produces the maximum overbreak of 1436 cm^2. This finding indicates that such angular conditions warrant special attention in blast design.

Cumulative blasting, by contrast, causes less damage to the surrounding rock in multi-joint shale tunnels and effectively reduces overbreak and underbreak. The average overbreak/underbreak quantity decreases by 1090 cm^2, with a reduction of 1161.4 cm^2 specifically in the 45° angle model compared to smooth blasting, demonstrating remarkable optimization effects.

In summary, cumulative blasting exhibits significantly superior performance compared to conventional smooth blasting in multi-joint shale tunnels. It not only effectively reduces surrounding rock damage but also substantially decreases overbreak and underbreak, thereby enhancing both safety and efficiency of tunnel construction. Therefore, cumulative blasting technology is recommended as the preferred method in practical engineering applications.

Keywords: Joint; Tunnel; Cumulative blasting; Smooth blasting; Overbreak/underbreak

Note: Figure translations are in progress. See original paper for figures.