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INDUCED MECHANISM OF ROCKBURSTS IN DEEP UNDERGROUND MINING

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Summary

Rockburst is a sudden and violent failure of rock on the surface of a rock excavation in underground mining. Rockbursts have been regarded as the least understood and the most feared mining hazard. In underground excavation, stress redistribution can lead to slippage of some pre-existing faults or even a new faulting in the near field of an underground opening. Both fault slippage and faulting generate seismic waves that propagate from the hypocentre outward in the rock mass. It has been observed that a rockburst is induced by a seismic event when the seismic waves arrive at the free surface of the underground opening. The paper is aimed to study the effect of seismic wave's duration, shape, impact energy, and amplitude on roof rockbursts by using the method of dynamic buckling analysis. The governing equation of a stope roof's motion is set up and the induced mechanism of rockbursts is studied through a practical example. It is not the shape of a seismic wave but the impact energy to decide the occurrence of rockbursts. The longer the seismic wave duration, the more rockburst is produced if other parameters remain the same. The mechanism of parametric resonance in rockbursts is found, and the effect of perturbation of seismic waves exist during the occurrence of rockbursts. These insights would provide invaluable clues for the mechanism and control of rockbursts on stope roofs.

Induced mechanism of rockbursts in stope roofs

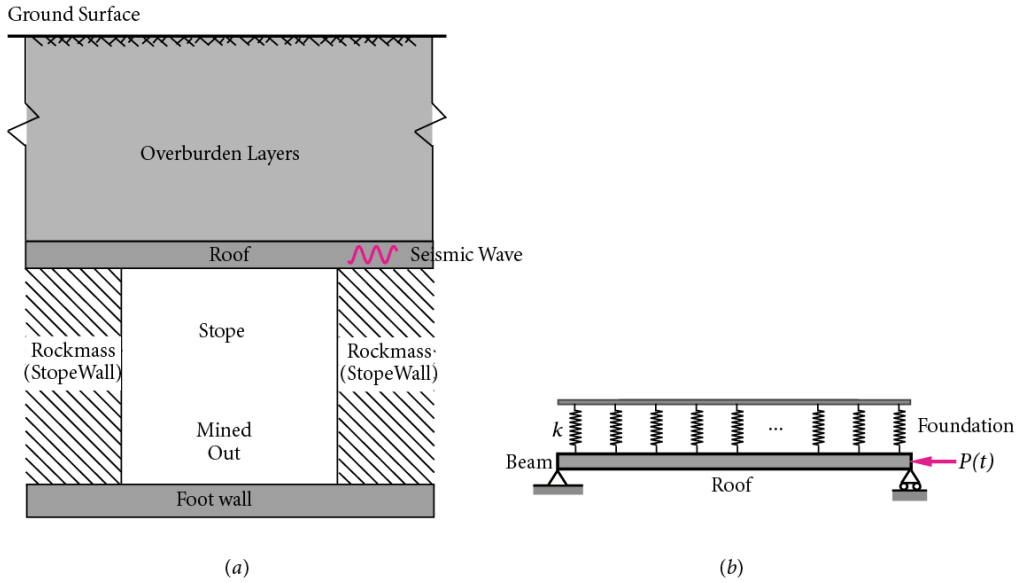

Fig.1 Stope roof in underground mining and its model as a beam on elastic foundations

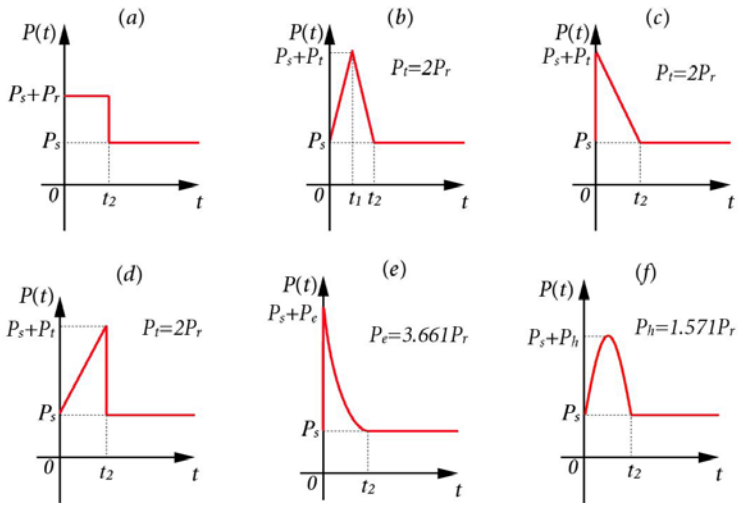

Figure 2 Various shapes of dynamic loadings (pulse) with the same impact energy and duration. (a)rectangular, (b)isosceles triangular, (c)left sawtooth, (d)right sawtooth, (e)exponential, (f)half sine pulse.

Fig.1 shows a stope roof in underground mining and its model as a beam on elastic foundations. The governing equation of motion is derived as a Mathieu-Hill equation. A numerical method is used to study the dynamic buckling of the stope roof, and the dynamic instability is taken as the occurrence of rockbursts [1-3]. The seismic waves, $P(t)$, might exhibit various duration, impact energy, shape, and amplitude as shown in Fig.2: (a)rectangular, (b)isosceles triangular, (c)left sawtooth, (d)right sawtooth, (e)exponential, and (f)half sine pulse. The results are listed as follows: (1) Equal impact energy will induce equal amount of rockbursts regardless of the shape of seismic waves. It is not the shape of a seismic wave but the impact energy to decide the occurrence of roof rockbursts. (2) The longer the duration of a seismic wave, the more rockburst will be produced. (3) The frequencies of seismic waves to induce rockbursts are located around double the natural frequency of the roof, i.e., parametric resonance. (4) There are some cases, when the amplitude of a seismic wave is very small, rockbursts can still be induced under circumstances of parametric resonance, i.e., there is a perturbation effect. The investigation provides insights on the induced mechanism and control of rockbursts on stope roofs in underground mining.

References

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