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Stress Wave Scattering and Dynamic Stress Concentration by Deep-Buried Diversion Tunnels (Postprint)

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Abstract

The dynamic stress concentration induced by stress wave scattering in underground structures constitutes a significant factor contributing to damage and instability of deep rock masses. Employing the wave function expansion method, this study derives an analytical solution for a fluid-filled circular lined cavern in an infinite elastic medium subjected to plane P-waves, and separately analyzes the effects of elastic and rigid linings on the dynamic stress concentration around the cavern. Building upon the steady-state response, the half-sine wave is adopted as the incident function, and through the introduction of the Dirac delta function and Heaviside step function combined with Fourier integral transform, an analytical solution for the dynamic stress around a fluid-filled circular lined cavern under transient P-wave action is obtained, with analysis of the influences of wavelength and time on the dynamic response. Furthermore, the stress distribution in the lining and surrounding rock under transient wave action is simulated via the finite element program LS-DYNA. The results demonstrate that numerical simulation outcomes align with theoretical calculations; waveform parameters, lining thickness, and material elastic modulus exert varying degrees of influence on the dynamic response; increasing lining thickness and appropriately adjusting the stiffness of lining material can yield enhanced support effectiveness; under transient disturbance, both substantial compressive stress concentration and prolonged tensile stress duration phenomena occur within the surrounding rock and lining.

Full Text

Preamble

The provided text consists primarily of corrupted data, PDF extraction artifacts, and LaTeX placeholders that cannot be meaningfully translated. No coherent

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Chinese academic content was identified beyond the section heading.

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

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