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DETERMINATION OF DISPLACEMENT FIELDS USING DIGITAL IMAGE PROCESSING IN A TAILINGS DAM TEST MODEL UNDER INCREASING PORE WATER PRESSURE

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Pore Water Pressure management within porous media, particularly in tailings dams, is essential for ensuring the structural integrity of mining operations and mitigating environmental risks. This research applies Digital Image Processing (DIP) techniques to determine displacement fields in a laboratory-scale tailings dam model under controlled conditions. The implications of this research extend beyond tailings dam safety. It contributes to the broader understanding of water's role in the mechanical behavior of porous media, which is crucial for various applications, including groundwater management, soil stability, and hydrological engineering.

The experimental setup involves a tailings dam model subjected to a gradual increase in pore water pressure to simulate failure conditions. High-resolution images are captured continuously throughout the process, and advanced DIP techniques are employed to analyze deformation patterns. The research quantifies displacements and highlights the evolution of deformation within the porous media under stress-induced conditions. This study is novel in its integration of non-invasive DIP methods to detect early-stage deformation patterns that precede catastrophic failures, which are often missed by conventional monitoring techniques. This approach is particularly relevant in managing water pressure within porous media, addressing critical gaps in tailings dam monitoring practices.

Key findings reveal a strong correlation between pore water pressure increases and deformation trends, emphasizing the significant role of water dynamics within the dam's structure. Visualizing displacement fields provides a deeper understanding of how stress propagates through porous materials, enabling more accurate modeling and risk assessment of tailings dams. Additionally, the technique offers a cost-effective, scalable, and environmentally friendly alternative to traditional monitoring methods.

By advancing the technical competence of geotechnical engineering practices, this study supports the development of safer and more sustainable approaches to managing porous media in water-sensitive environments.

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References

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