INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Thesis Title*: **Evaluation of Compressibility and Hydraulic Characteristics of Soft Slurries and Tailings in 1g and Ng Environments based on Finite–Strain Consolidation***

Name of Thesis Supervisor(s)	:	**Prof. T.V. Bharat**
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SHORT ABSTRACT

Global technological advancements and industrial developments have led to the generation of large quantities of slurry wastes such as mine tailings and dredged clays. Frequent tailings dam failures and excessive subsidence in land reclamation projects emphasize the need for strict guidelines to ensure the safe and efficient management of these waste slurries. These materials, with high water content, experience significant self-weight deformation, making their consolidation behavior critical for the stability and functionality of containment facilities. The finite strain consolidation theory provides a suitable framework to analyze this behavior, with compressibility and hydraulic conductivity functions serving as essential parameters. Routine testing for these functions is often labor-intensive. This study explored a tailor-made centrifuge as an alternative to the conventional oedometer for determining compressibility parameters. Numerical analyses established effective scale factors based on effective radii reported in earlier studies and examined discrepancies between predicted and observed settlement values. The relationship between the degree of consolidation and settlement time scaling factors was analyzed for varying model-to-centrifuge radius ratios and acceleration factors. Inverse analyses were conducted on centrifuge settlement data to predict conductivity parameters using available compressibility data. Graphical methods used for estimating hydraulic conductivity parameters from 1g settlement-time data were extended to centrifuge consolidation data. Back-estimation of compressibility and conductivity functions was also performed using metaheuristic optimization algorithms. Three novel algorithms, Hybrid Particle Swarm Optimization, Modified Artificial Bee Colony, and Hybrid Artificial Bee Colony, were developed to improve robustness, reliability, and convergence speed. These algorithms were compared with standard Particle Swarm Optimization, Artificial Bee Colony, and Quantum Particle Swarm Optimization algorithms. The study also proposed using pore pressure data at the slurry base as an alternative to temporal settlement data in highly turbid slurries for inverse analyses of hydraulic conductivity coefficients. The graphical and optimization-based methods successfully predicted constitutive functions using synthetic and published data, showing strong agreement with experimental results. These approaches provide efficient and reliable tools for evaluating containment structure safety and facilitating secure waste slurry management.