OPTIMIZATION OF RECTANGULAR TANK CROSS-SECTION USING TRUST REGION GRADIENT METHOD

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ABSTRACT

In various industries, rectangular tanks are commonly used for storing liquids and other materials. The design and optimization of these tanks are crucial for ensuring structural integrity and material efficiency. Traditional designs often utilize constant wall thickness, which does not align optimally with the stress distribution, leading to potential overuse of materials and increased costs. Recent studies have shown that tanks with variable wall thickness, such as trapezoidal cross-sections, can better match stress distributions, particularly under hydrostatic loads, resulting in more efficient use of materials. This research aims to build upon previous studies by introducing an advanced optimization algorithm based on the Trust Region Gradient Method to further refine the cross-sectional design of rectangular tanks. The primary objective is to minimize the material usage while maintaining structural safety and performance under various load conditions, including hydrostatic pressure and thermal effects. The proposed algorithm iteratively adjusts the tank's wall thickness, seeking an optimal configuration that reduces bending moments and material costs.

Initial static calculations is verified using the finite difference method, emphasizing energy minimization conditions for elastic strain in bent plates on elastic foundations. This approach is compared with traditional discretization methods to validate accuracy. The trust region method is then applied to optimize the design, with a focus on achieving a balance between structural integrity and economic feasibility. Preliminary results indicate that the trust region gradient method can significantly enhance the design process, leading to substantial material savings and improved structural performance. The algorithm's effectiveness is demonstrated through case studies comparing tanks with constant and variable wall thickness. This research contributes to sustainable construction practices by promoting designs that use materials more efficiently and meet safety standards.

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