INFLUENCE OF GEOMETRIC PARAMETERS ON INTERNAL FORCES IN THE WALLS OF RECTANGULAR TANKS

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ABSTRACT

Rectangular tanks are commonly used in various industries for storing materials and products. The design of reinforced concrete liquid tanks, which must be preceded by a static analysis, is a complex issue requiring specialized knowledge and engineering experience. All types of actions, design situations, and resulting load combinations must be considered, including deformations caused by temperature gradients and the interaction of the bottom plate with the ground. Most tanks are designed and constructed with constant wall thickness, regardless of their rectangular or circular cross-section. However, tanks with variable wall thickness (e.g., trapezoidal cross-section) are rarely designed, despite their optimal fit to stress distribution. For hydrostatically loaded tanks, the load on the walls increases with depth, causing the highest bending moments at the wall-bottom connection, while the value at the top, free edge is zero. Thus, structural and economic considerations favour walls with thickness increasing with depth.

This article presents the results of a verification of static calculations of a monolithic rectangular tank with trapezoidal cross-section walls, comparing it with three other commonly designed tanks with different thickness and wall designs. Static calculations were performed using the finite difference method in terms of energy, employing the condition for the minimum energy of elastic strain stored in a bent plate resting on an elastic base. Traditional calculation methods were used by discretizing the object and creating systems of equations. Analysis of the results shows that constructing walls of linearly varying thickness results in a redistribution of bending moments compared to tanks with uniform wall thickness. This significantly impacts the required reinforcement area. Tanks with linearly varying wall thickness are more economical in terms of material use, aligning with the principles of sustainable construction.

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