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Static analysis of a tilted sinking well in the context of safe operation

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Sinking wells are widely used engineering structures, particularly in urban environments or in areas with limited construction space and difficult soil conditions. They are constructed using the "cut and sink" method, where the initial segment of the well is equipped with a cutting edge that enables the structure to penetrate the soil under its own weight. This technique allows for safe and efficient installation without the need for extensive excavation. However, during the sinking process, uneven soil resistance or improper execution can lead to tilting of the well, which poses structural and functional risks. This paper addresses key design and construction considerations, emphasizing the importance of accounting for the staged execution and three-dimensional behavior of the structure. A comprehensive analysis is presented regarding well tilting during installation, including causes, monitoring techniques, and methods for assessing the degree of tilt. The study proposes practical criteria for evaluating whether a tilted well can remain in service without compromising safety. It includes analytical formulas for calculating tilt angles and determining their impact on stress distribution in the surrounding soil. Through a detailed investigation, it was determined that a controlled and limited tilt may be acceptable, provided that the additional stress transferred to the ground does not exceed 20% compared to an ideally vertical well. Methods for real-time monitoring of tilt progression during construction are also discussed, aiding engineers in decision-making processes on-site. In the final section, a numerical example is provided to demonstrate the application of the discussed methods and criteria in a practical engineering scenario. This example illustrates the evaluation process of tilt acceptability and highlights the importance of early detection and correction during construction to ensure the long-term safety and performance of the structure.

Keywords: *sinking well, structural tilt, geotechnical design, soil stress, construction monitoring, cut and sink*