

Controlling Differential Settlement of Large Reservoir through Soil Structure Interaction Approach

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Abstract : Construction of a large standby reservoir was required to provide secure water supply. The new reservoir was required to be constructed at the same location of an abandoned old open pond due to space constraints. Some investigations were carried out earlier to improvise and re-commission the existing pond. But due to a lack of quantified risk of settlement from voids in the underlying limestone, the shallow foundations were not found feasible. Since the reservoir was resting on hard strata for about three-quarter of plan area and one quarter was resting on soil underlying with limestone and considerably low subgrade modulus. Further investigations were carried out to ascertain the locations and extent of voids within the limestone. It was concluded that the risk due to lime dissolution was acceptably low, and the site was found geotechnically feasible. The hazard posed by limestone dissolution was addressed through the integrated structural and geotechnical analysis and design approach. Finite Element Analysis was carried out to quantify the stresses and differential settlement due to various probable loads and soil-structure interaction. Walls behaving as cantilever under operational loads were found undergoing in-plane bending and tensile forces due to soil-structure interaction. Sensitivity analysis for varying soil subgrade modulus was carried out to check the variation in the response of the structure and magnitude of stresses developed. The base slab was additionally checked for the loss of soil contact due to lime pocket formations at random locations. The expansion and contraction joints were planned to receive minimal additional forces due to differential settlement. The reservoir was designed to sustain the actions corresponding to allowable deformation limits per code, and geotechnical measures were proposed to achieve the soil parameters set in structural analysis.

Keywords : differential settlement, limestone dissolution, reservoir, soil structure interaction

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