

Application of Micro-Tunneling Technique to Rectify Tilted Structures Constructed on Cohesive Soil

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Abstract : Foundation differential settlement and supported structure tilting is an occasionally occurred engineering problem. This may be caused by overloading, changes in ground soil properties or unsupported nearby excavations. Engineering thinking points directly toward the logic solution for such problem by uplifting the settled side. This can be achieved with deep foundation elements such as micro-piles and macro-piles™, jacked piers and helical piers, jet grouted soil-crete columns, compaction grout columns, cement grouting or with chemical grouting, or traditional pit underpinning with concrete and mortar. Although, some of these techniques offer economic, fast and low noise solutions, many of them are quite the contrary. For tilted structures, with limited inclination, it may be much easier to cause a balancing settlement on the less-settlement side which shall be done carefully in a proper rate. This principal has been applied in Leaning Tower of Pisa stabilization with soil extraction from the ground surface. In this research, the authors attempt to introduce a new solution with a different point of view. So, micro-tunneling technique is presented in here as an intended ground deformation cause. In general, micro-tunneling is expected to induce limited ground deformations. Thus, the researchers propose to apply the technique to form small size ground unsupported holes to produce the target deformations. This shall be done in four phases: •Application of one or more micro-tunnels, regarding the existing differential settlement value, under the raised side of the tilted structure. •For each individual tunnel, the lining shall be pulled out from both sides (from jacking and receiving shafts) in slow rate. •If required, according to calculations and site records, an additional surface load can be applied on the raised foundation side. •Finally, a strengthening soil grouting shall be applied for stabilization after adjustment. A finite element based numerical model is presented to simulate the proposed construction phases for different tunneling positions and tunnels group. For each case, the surface settlements are calculated and induced plasticity points are checked. These results show the impact of the suggested procedure on the tilted structure and its feasibility. Comparing results also show the importance of the position selection and tunnels group gradual effect. Thus, a new engineering solution is presented to one of the structural and geotechnical engineering challenges.

Keywords : differential settlement, micro-tunneling, soil-structure interaction, tilted structures

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