

Ground Improvement Using Deep Vibro Techniques at Madhepura E-LoCo Project

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Abstract : This paper is a result of ground improvement using deep vibro techniques with combination of sand and stone columns performed on a highly liquefaction susceptible site (70 to 80% sand strata and balance silt) with low bearing capacities due to high settlements located (earth quake zone V as per IS code) at Madhepura, Bihar state in northern part of India. Initially, it was envisaged with bored cast in-situ/precast piles, stone/sand columns. However, after detail analysis to address both liquefaction and improve bearing capacities simultaneously, it was analyzed the deep vibro techniques with combination of sand and stone columns is excellent solution for given site condition which may be first time in India. First after detail soil investigation, pre eCPT test was conducted to evaluate the potential depth of liquefaction to densify silty sandy soils to improve factor of safety against liquefaction. Then trail test were being carried out at site by deep vibro compaction technique with sand and stone columns combination with different spacings of columns in triangular shape with different timings during each lift of vibro up to ground level. Different spacings and timing was done to obtain the most effective spacing and timing with vibro compaction technique to achieve maximum densification of saturated loose silty sandy soils uniformly for complete treated area. Then again, post eCPT test and plate load tests were conducted at all trail locations of different spacings and timing of sand and stone columns to evaluate the best results for obtaining the required factor of safety against liquefaction and the desired bearing capacities with reduced settlements for construction of industrial structures. After reviewing these results, it was noticed that the ground layers are densified more than the expected with improved factor of safety against liquefaction and achieved good bearing capacities for a given settlements as per IS codal provisions. It was also worked out for cost-effectiveness of lightly loaded single storied structures by using deep vibro technique with sand column avoiding stone. The results were observed satisfactory for resting the lightly loaded foundations. In this technique, the most important is to mitigating liquefaction with improved bearing capacities and reduced settlements to acceptable limits as per IS: 1904-1986 simultaneously up to a depth of 19M. To our best knowledge it was executed first time in India.

Keywords : ground improvement, deep vibro techniques, liquefaction, bearing capacity, settlement

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