

Case History of Intermittent Treatment by Compaction Grout Piles

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ABSTRACT

Intermittent compaction grout piles were used to improve foundation soils of Tokyo International Airport against liquefaction at the intersection area of the two runways A and B. The compaction grouting works were performed in five working stages. The grouting works of the fifth stage are described in this paper. The effectiveness of treatment is discussed in terms of the increase in N-value of the SPT test and the increase in the coefficient of earth pressure at rest (K_0) as measured by the self-boring pressuremeter test. Observations are made on the improvements at the boundaries of the treatment layers. Based on the presented improvement results, correlations are established of both the pre-treatment N-value and fines content with the increase in K_0 with respect to the injected grout volume.

KEY WORDS: Coefficient of earth pressure at rest (K_0); compaction grouting; intermittent grout pile; liquefiable soil; pressuremeter test.

INTRODUCTION

At the intersection area of A- and B-runways of Tokyo International Airport, compaction grouting was performed to minimize the liquefaction potential of the foundation soils during earthquakes. Compaction grouting was qualified as the appropriate ground improvement alternative, because of the possibility of performing the grouting works without much disruption to the normal operations of the airport. Unlike the commonly injected compaction grout piles that are continuous throughout the soil profile, intermittent compaction grout piles were injected to treat only the liquefiable soil layers. The compaction grouting works were performed in five working stages. This paper describes the grouting works of the fifth stage and discusses the obtained improvement in terms of the increase in N-value of the SPT test and the increase in the coefficient of earth pressure at rest (K_0) as evaluated by the self-boring pressuremeter (SBP) test.

DESCRIPTION OF GROUTING WORKS

A liquefaction potential assessment of the foundation soils of B-runway of Tokyo International Airport revealed that some of the soil layers are potentially liquefiable during earthquakes. Sand compaction piles were

used to minimize the liquefaction potential of these layers. For the intersection area of the two runways A and B, an alternative method was required to keep on the normal operations of the airport during the treatment period. Among the potential methods, compaction grouting was decided as the appropriate alternative, because of the possibility of keeping its large-size equipment away from the treatment area and the easy handling of its injection pipes, hoses and accessories to and from the treatment area. Another qualifying factor was that the drilling radius is small and thus causes minimal disturbance to the runway pavement that can be easily restored during the working hours. In addition, because the foundation soils consist of alternate layers of liquefiable and non-liquefiable soils, compaction grouting represented an economically feasible solution, since it can treat only the liquefiable layers. An added advantage of using compaction grouting is the flexibility of varying the injected grout volume to account for the variable condition of the foundation soils. Therefore, unlike the common compaction grout piles that are continuous and of uniform diameter, intermittent compaction grout piles of varying diameter were considered to improve the foundation soils of B-runway at its intersection with A-runway. The daily compaction grouting works were performed in seven hours in the night. This allowed for keeping on the normal operations of the airport with minimum disruption. Figure 1 shows the intersection of the two runways and the location of the compaction grouting treatment zone. Compaction grouting was performed in five working stages, S-1 through S-5. The locations and areas of these stages are shown in Fig. 2. In this paper, the grouting works are described and the improvement results are discussed for Stage S-5-1. At the intersection part, chemical grouting was used to improve the soils at two areas because of existing underground ducts and pipelines. The areas treated by chemical grouting are also shown in Fig. 2.

To minimize the disturbance of the runway pavement during the drilling and grouting works and during the normal airport operations, a specially manufactured steel casings (190 mm in outside diameter) with two internally welded rings (100 mm in inside diameter) and bolted caps were installed in the top 0.16 m of the pavement at the locations of the grout holes. The annular space (5 mm) between the casing and the pavement was filled with cement-bentonite milk. The drilling/injection pipe (73 mm in outside diameter) was guided by the casing during both drilling and injection. After completion of drilling and until starting injection, the casing was capped to allow for the normal operations of