The Soil Problems in Constructions of Airport

Res. Asst. Burak GÖRGÜN
Bilecik Şeyh Edebali University
Engineering Faculty, Civil Engineering Department
Bilecik, Turkey

Assoc. Prof. Dr. Nazile URAL
Bilecik Şeyh Edebali University
Engineering Faculty, Civil Engineering Department
Bilecik, Turkey

ABSTRACT

Time, in the globalized world, is one of the most important factors about the economy, science and health. Mankind has made various efforts to use time efficiently for many years. In these studies transport came to the fore and it has become indispensable. In the light of today's technological conditions, air transport is developing at an increasing rate. Every day many aircrafts are produced, which have different speeds, weight and volume, for serve to transport. Therefore to make structures for easy and safe transport need a stable soil. Particularly suitable areas for the airport grounds in cities today, not being physically proper that construction of the airport made on soil with low bearing capacity, swelling potential of an expansive soil, settlement of soil etc, areas. In this study, soil problems encountered in the construction of airports will be explained and a summary of studies on the solution of these problems will be presented.

Keywords*—component; formatting; style; styling; insert (key words)*

I. INTRODUCTION

Soil commonly used throughout the history of mankind, and perhaps the most complex building material. Most of the deformations that occur in civil engineering works cause of the ground movements. The roads, dams, nuclear power stations and the airports are built on the soil so before the building design and the construction, first have to know about settlement and bearing capacity for safety. Today, swelling of soil and collapsing are common soil issues. Clay layers has a low permeability. Clay layers have very high degree of swelling. While the dry state or very low water consistency is view of a solid structure, the percentage of water increases, it is large changes in volume and texture in soil. Between grains of the ground to deteriorate over time and after this strong bond structure leads to deterioration of the natural structure. These features cause sometimes permanent cracking and exceeding the permissible settlements. Swelling soils, weak soil and longer settlement time of soft clay lead to very serious disturbances and complete failure of structures on the especially roads, dams and most importantly on the filling airports. to problematic soils, usually it is used additives in geotechnical practice. This additive materials are lime, Portland cement, fly ash, lime-cement-fly ash admixture, emulsified asphalt, cement kiln dust, Geofiber reinforcement, salt, and non-traditional polymer stabilizers.

Lime is popular additives used to improve fine grained soils. Construction of Denver International Airport was used lime stabilization method. Lime treatment advantages, a decrease in the liquid limit and an increase in the plastic limit results in a significant reduction in plasticity index and it gives the ability to process the problematic soils, due chemical reaction between soil and lime a reduction in water content occurs, lime addition increases the optimum water content but decreases the maximum dry density and immediate increase in strength and modulus results. The effect of lime on soil is shown immediate and long term stabilization. Increased workability of soil is the result of immediate modification and increased strength and durability is considered long term stabilization that takes place during and after curing. The immediate increase in strength results from flocculation-agglomeration reaction and leads to better workability, whereas long term strength gain is due to pozzolanic reactions. Generally, It can be observed that as lime content increases, swell pressure decreases significantly. This enables its use in reducing the swelling potential of expansive soils (Mallela et al. 2004, Thompson 1966).

Another method of soil improvement is cement stabilization. Cement treatment causes chemical reaction similar to lime. It is observed soils and clayey materials with low plasticity index are better suited to be stabilized with cement (Currin et al. 1976; Engineering manual 1110-3-137 1984). Whit cement stabilization, reduction in plasticity index and swell potential, and increase in strength, modulus of elasticity and resistance against the effects of moisture and freze thaw can be achieved by cement stabilization. The addition of cement was found to increase optimum water content but decrease the maximum dry density (Tabatabi 1997). In addition stabilization method is Fly ash and Lime-Cement-Fly ash stabilization. Fly ash contains silica, alumina, and different oxides and alkalis in its composition, and is considered as a pozzolanic material (Das 1990). Fly ash can improve the engineering properties of soil. Coarse grained soils can be stabilized by a combination of lime and fly ash. it is used to produce a hardened cementitious material with improved compressive strength when mixed with lime and fly ash (Muhunthan and Sariosseiri 2008).

II. Soil Problems In Airport

The lack of availability of higher quality materials and the added costs for these materials are replaced with materials of better quality. Especially, it is used more than soils for construction of higway and airport. These material high water content and low workability of these soils pose difficulties for construction projects. Frequently, additives such as lime, cement, fly ash and cement kiln dust are used to improve their engineering properties. The choice and effectiveness of an additive depends on the type of soil and its field conditions.

Construction of Kansai International Airport was used vertical sand drains. It is considered that of the airport construction experienced some problems which, could be characterized as a geotechnical failure. In construction, firstly, the top 20 m of the seabed (Holocene clays) were treated within the design island area by installing vertical sand drains to accelerate compaction under the backfill (Figure 1). Next, the perimeter seawalls were built (Figure 2). Later, the land reclamation took place, in which the granular fill, taken from a number of excavations in the Osaka area, was placed within the seawalls up to a depth of about 3 m below the water level using bottom-dump barges. Last was accomplished by means of four large barges, anchored inside the seawalls, which transferred the fill brought by the smaller barges from across the bay, to bring the island to the required 4 m above the water level. This height is to guarantee that the airport will not be swamped by high tides brought by typhoons that hit the coast of Japan every September. Thanks to the vertical drains, the top 20 m of the Holocene clay reached almost 90% of its final 6 m settlement during the construction (Handy, 2002). These settlements were being compensated by an additional 6 m thick layer of fill and additional height of the seawalls (Puzrin et al 2010).

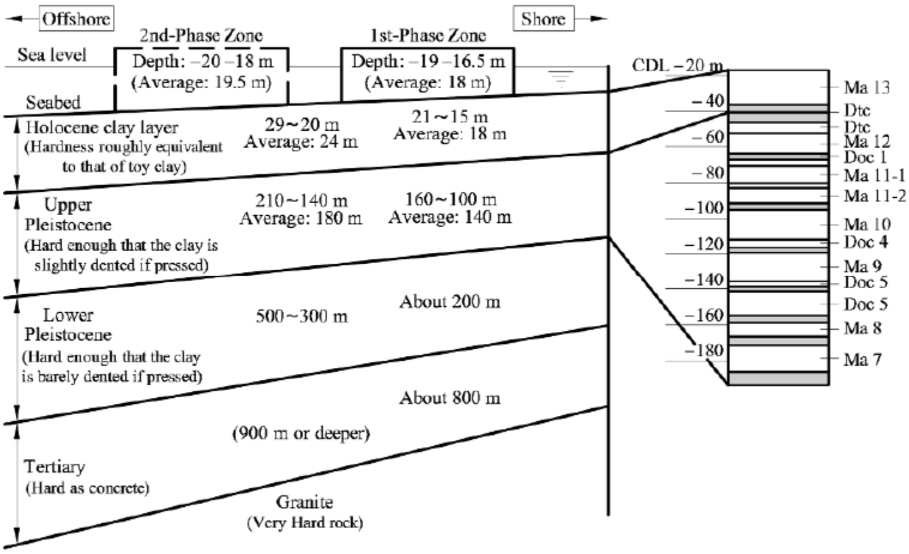

Figure 1. The soil profile of the seabed (Puzrin et al 2010)

In Kentuck Airport was used cement modified soils. During the design it was discovered that the soils to support the one to three foot taxiway embankment were weak and therefore would create issues with stability. To improve the stability of the weak in-situ soils was used porland cement to construction of the embankment. In Figure 3 is shown mixer incorporating portland cement (Smith 2009).

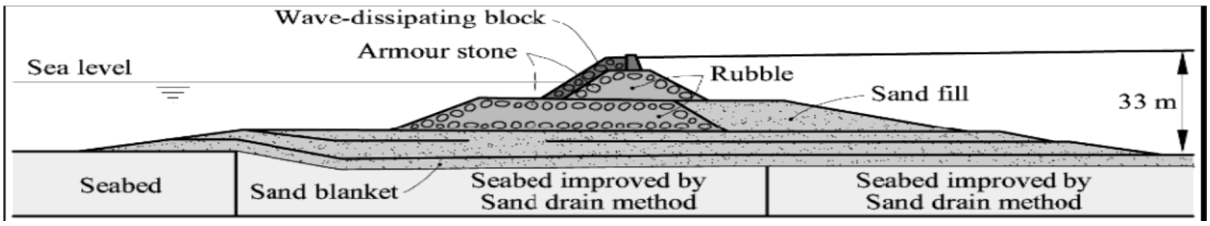

Figure 2. The cross-section of a seawall (Puzrin et al 2010)

Figure 3. The cross-section of a seawall (Puzrin et al 2010)

The subgrade soils of the Washington Dulles International Airport were significantly weak, therefore it was used the cement stabilized to support base (Figure 4). To address the issue of poor subgrade support conditions, the following options were considered undercut the poor subgrades and replace them with good quality borrow materials with a minimum CBR value of 20, crush the demolished concrete pavement structure and use it as crushed recycled concrete base to improve the subgrade support conditions, and addition of small amounts of lime, fly ash and / or ordinary Portland cement to the top 12 inches of the existing subgrades (Syed, 2007). When lime stabilized subgrades, require 7-days or more of curing to develop the desired strength. Similar concerns were also expressed with the use of lime-fly ash as the stabilizer. So ordinary Portland cement was evaluated as the candidate stabilizer in view of the high early strength provided by cement stabilized subgrade soils (Skokie, 1995).

Construction of the Suvarnabhumi Airport was used preloading with PVD for ground improvement on soft clay layer (Bangkok Clay). Most of geotechnical studies focused on the strength and deformation characteristics of the soils and used them for ground improvement design. The effectiveness of ground improvement using preloading with PVD is presented through the deformation and settlement of a series of test embankments and the change of soilproperties as well. The initial swamp areas consisted mainly of unconsolidated sedimentary beds with succession of soft peat layers. The thickness of these unconsolidated sediments is known to vary from a few meters to up to meters in some areas in the Botany Basin. Despite surcharging the fill in the course of the airport developments over the years, it is considered that consolidation settlement will be continued throughout the life of the airport (Chin et al 2008). In Figure 5 is given comparison of settlements in the PVD and non-PVD areas. In addition, construction of the Houston International Airport was used lime-cement-fly ash stabilization (Little et al 2000) and construction of Denver International Airport was used lime stabilization method.

Figure 4. Mixing soil-cement for subgrade stabilization

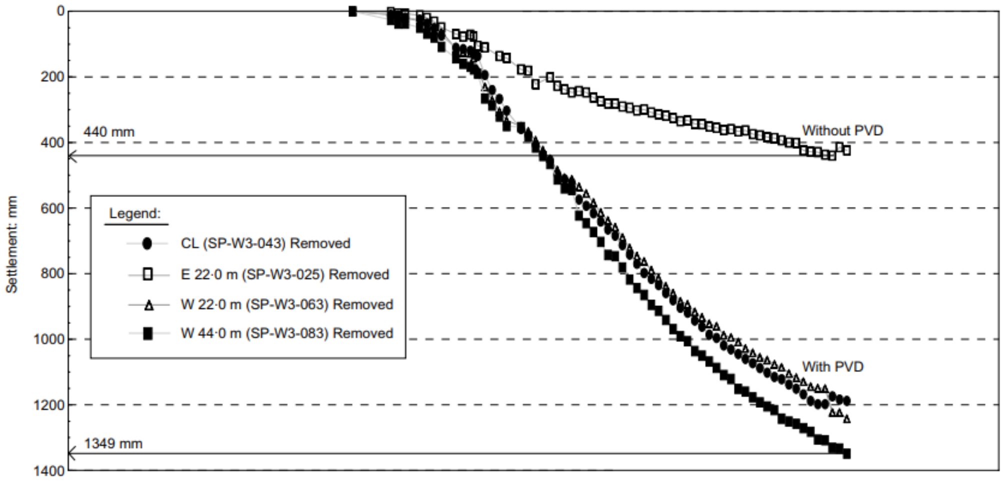

Figure 5. Comparison of settlements in the PVD and non-PVD areas (Moh and Lin, 2003).

III. CONCLUSION

Some geotechnical area is on the issue of the use of soils (silts, soft clay) for fills ofhigway and airport. The lack of availability of higher quality materials and it is added lime, cement, fly ash, soilswereinadequatetosupporttheconstructionoftheairport,itwouldchoiseproperimprovementmethod.Itis wantedthismethodistobetechnicallyviable,cost-effectiveandtimelytomeettheprojectdeadlines.Theadditionofthesematerialswasfoundtoimprovethedrying rate,workabilityandcompactioncharacteristicsofthesoils.Significantimprovementinunconfinedcompressiv estrength,modulusofelasticity,settlementofproblemsoilsareattainedby thesematerials.

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