Geotechnical problems in the Mekong Delta in comparison with Saga Plain

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1. INTRODUCTION

A big project like Ariake Sea Coastal Road is being advanced with the careful environment harmony in Saga lowland. Similar to Saga lowland, the Mekong Delta, Vietnam is formed as lowland. A collaboration in order to exchange experiences and advanced technologies and enhance understanding of the lowlands is essential for future development in the two areas. Therefore, this paper aims to compare and examine technological miscellaneous problems in Mekong Delta and Saga lowland.

2. CHARACTERISTICS OF THE MEKONG DELTA AND SAGA PLAIN

The Mekong Delta is the southernmost part of Vietnam, where just before the Mekong River joint the East Sea. The river runs from Yunnan (China), Burma (Myanmar), Laos, Cambodia, and the Mekong Delta (Vietnam) before joining to East Sea. It is also known as Cuu Long Delta which is named from the nine branches of the Mekong River (Fig. 1). The Mekong soil profile can be divided into five aquifers

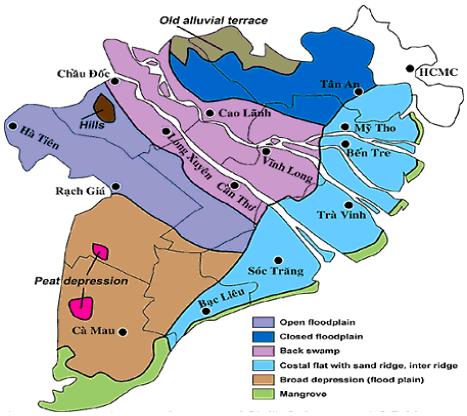

Fig. 1 Mekong Delta (Hung et al., 2000)

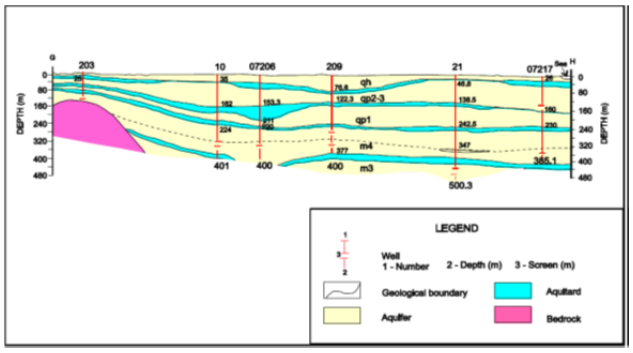

Fig. 2 Cross section of the Mekong Delta (Ghassemi and Brennan, 2000)

namely as Holocene (qh) up to around 45m depth, upper-middle Pleistocene (qp2-3) below Holocene up to 160 m depth, lower Pleistocene (qp1) extended 240m depth, Pliocene (m4) to around 400m depth , and upper Miocene (m3) at the bottom (Fig. 2).

Saga is the largest plain Kyushu Island, Japan. It is comprised of the area west of the Chikugo River and east of the Rokkaku River and the Ushizu River (Shimoyama et al., 2010). The Geographical Survey Institute of Japan defines the Saga Area in its 1/50,000 topographic map as the area centered on the Chikugo River, extending east of that river (the Chikugo Area) to the Saga Plain (east to the Kase River). It includes deposit of Holocene period from 10m depth up to the surface, and Pleistocene from 10m to 30m depth.

In Holocene formation of the Mekong Delta, the soil here consists mainly of clay minerals and quartz, the predominant clay minerals including illite and chlorite with lesser amount of kaolinite and semctite (James and Richard 1971). A typical profile of the Mekong soil includes a weather crust layer about 2.0 – 4.0 m thick on the top. Very soft clay layer varying thickness of 10.0 – 30 m is above a medium clay layer of 3.0-8.0 m. Underneath a sand layer of 0.3-0.8m is a very thick hard clay layer (Fig. 3). The water content of the soft ground is very high from 65 to 100%. The liquid limit is around the water content. Ground water level is from 0.5 – 2.0 m below the ground surface. The soft clay is very high water, high compressibility. Its characteristics challenge engineers to construct on this area or protect itself from erosion.

The profile of Ariake clay generally includes an about 4.0 m thick clay layer of Hasuike formation (aH_u) just below a fill layer of around 1.0. The Ariake clay formation (aA_c) in Holocene period includes clay, sandy clay and clayed sand. Below these layers is a Mitagata Formation (dM) including gravel, sand, which belongs to the Pleistocene period. The natural water content (w_n), liquid limit (w_L) and plastic limit (w_p) are factors that determine consistency of soils. The natural water contents of core specimens sampled from the Holocene Series are greater than their corresponding liquid limits, and the liquidity indexes exceed 1. The sensitivity St of the Ariake Clay Formation core was between 10 and 50 in general, and it was between 100 and 300 for core specimens taken from G.L. 8 m or deeper. The maximum S_t was approximately 200, according to a case study in the Nanri district of Kawasoe Town in Saga Plain (Miura et al., 1996), which is the largest St in this plain. The compression index

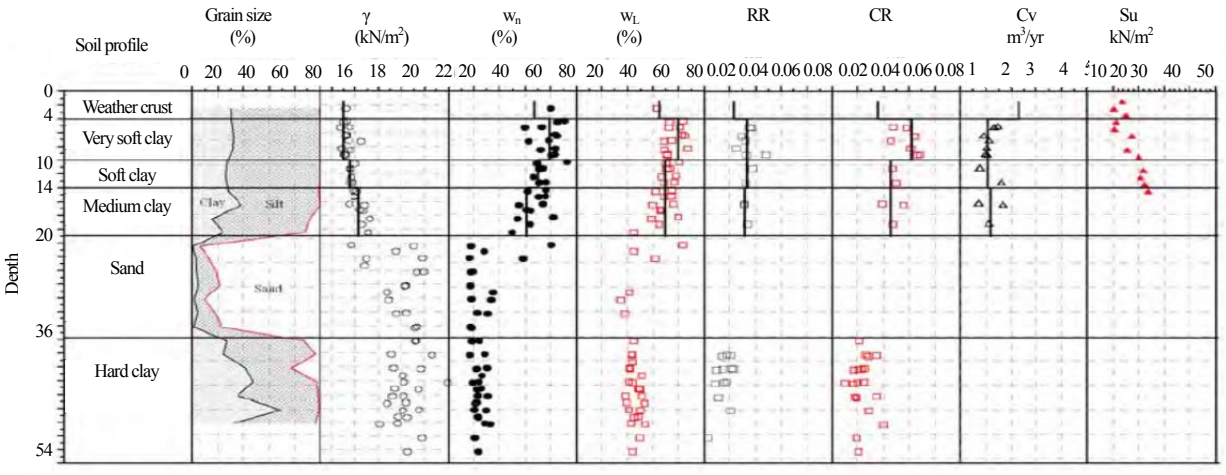

Fig. 3 Properties of Mekong soil (Quang and Giao 2013)

(C_c) in the Ariake Clay Formation is approximately 0.5 in the depth with a predominance of sand, and the index is approximately 2 (i.e., high compressibility) at depths deeper than G.L. 8 m with high sensitivity.

3. GEOTECNICAL PROBLEMS DUE TO SEVERE ENVIRONMENT

Like other lowlands, the Mekong Delta has been facing with serious problems of flood very year. When tide is high and specially accumulates with heavy rain in the rain season from July to February, most of the Mekong Delta is flooded even in cities (Fig. 4). Flood destroys houses, properties, animals and people every year. Furthermore, erosion is a big problem at the Mekong Delta. Due to the insufficient infrastructure system, a lot of structures have damaged and gone away. Specially, ground water in the Mekong Delta has been declined. Infected by salt water instruction becomes a problem of water quality there. Phuc (2008) indicates that ground water level decrease with time (Fig. 5) due to the increase in water consumption by welling.

Fig. 4 Erosion in An Giang province

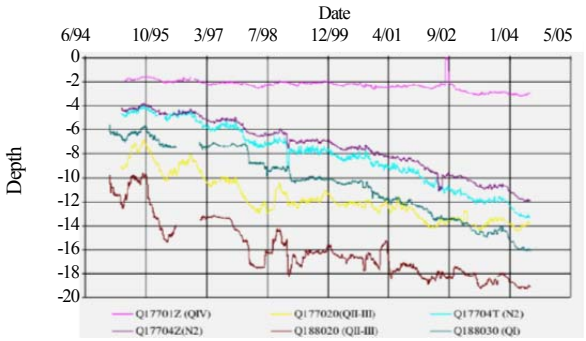

Fig. 5 Observed groundwater level in Ca Mau province (Phuc 2008)

Saga as well as other areas in Japan is well-known dealing with disasters which often happen at stratovolcanic archipelago. However, Saga Plain may be problem in salt leaching due to sea level change at the area. Salt leaching resulted in increased compressibility and decreased remoulded shear strength. In addition, Saga clay is very sensitive. The values of S_t at some special locations are around 250-300. It should be kept in mind for dynamic analyses. Therefore, these phenomenon should be carefully studied and investigated in Saga Plain to avoid engineering problems in near future.

4. CONCLUSIONS

To lowlands like Saga Plain or th Mekong Delta, an integrated system including sufficient infrastructures such as river bank and coastal protection, drainage and flood control, ground and groundwater monitoring, groundwater usage and management need to be considered to establish a sustainable development. Specially, erosion and flood control systems and groundwater management are essential to be studied and implemented as soon as possible to reduce suffering from severe environment in the Mekong Delta. In Saga Plain, amount of construction is increasing in the area, groundwater issues and effects of leaching should be taken into consideration.

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