STRUCTURAL DESIGN IN PLANNING AND CONSTRUCTION OF PIERS AND WHARVES

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WEST COAST CONTRACTORS
Napa River Dry Bypass Project

By Sri Ram Ramankutty

BORED PILES FOR KLANG VALLEY MASS RAPID TRANSIT

Greater Kuala Lumpur/Klang Valley, Malaysia

The Klang Valley Mass Rapid Transit (KVMRT) project involves the construction of a rail-based public transport network which, together with the existing light rail transit (LRT), monorail, KTM Komuter, KLIA Ekspres and KLIA Transit systems, forms the backbone of the Greater Kuala Lumpur/Klang Valley region in Malaysia.

The project was approved by the Government of Malaysia in December 2010. The first MRT line to be implemented was the 51km Sungai Buloh-Kajang line. Construction of the line was officially launched on 8 July 2011 and expected to be fully operational by 2017.

The Government conducted a study on the proposal and approved the implementation of the Sungai Buloh-Kajang line first. The Government decided to implement the other two lines after further studies are done on the proposed alignment in conjunction with the Greater Kuala Lumpur/Klang Valley Land Public Transport.

With the Klang Valley MRT, the target having 50% of all journeys in the Greater Kuala Lumpur/Klang Valley region to be on public transport can be achieved.

KVMRT Progress

INTRODUCTION

Construction of elevated viaduct involves deep foundation of bored piling or cast-in-situ piles. The sizes of the bored piles range from 1.0 meter to 2.5 meters in diameter and reaches down to more than 50 meters. Third generation polymer - G3® System was widely used in the construction phase of bored piles to stabilize the soil for this project. This unique most advanced technology in polymer slurries provides great advantage to the progress and quality of the project.

PROJECT

The elevated viaduct for Klang Valley Mass Rapid Transit was divided into eight packages, namely V1 to V8. There is one underground package of 9.5km long designed to ease the traffic congestion in the heart of Kuala Lumpur city. The underground tunneling alignment runs from the Semantan North Portal past the urban transport hub of KL Sentral and the busy streets of Bukit Bintang and Chinatown to the Maluri South Portal.

The elevated viaduct span was supported by series of concrete piers which was built on top of thick concrete slab called pile cap. The load from the entire structure was then transferred to the bored piles beneath the soil. The load was either distributed along the length of the concrete bored pile through skin friction capacity or, in presence of hard rock layer; the load will be transferred to the hard strata beneath.

Due to the massive number of bored piles to be completed within a stipulated time frame and to produce bored piles with the highest quality possible, the usage of GEO's G3 System third generation polymer slurry again become an important element of this project. More than

PolyMud Membrane

60,000 m³ of soil has been excavated in this project under G3® System polymer slurry with zero quality problem detected in the completed bored pile.

GEOLOGICAL CONDITION

Wide range of soil profiles were encountered throughout the entire stretch of 51km comprises of sandy clay, silty sand, fine sand, mud, gravel, fractured limestone and granite rock. The Standard Penetration Test (N-Value) for the profiles above range 0 (very soft) to 50 (very hard). Depending on the location of the execution, the ground water table (GWT) lays between 1 to 15m below the working platform. Due to the unfavorable natural conditions, it has been extremely important to have a good soil stabilization solution that eliminates every possibility that may jeopardize the stability and quality of the bored pile.

STABILITY

The unique stabilization mechanism provided by the G3® System, guaranteed the stability of the bored piles throughout the execution until concrete was poured. PolyMud® which is the main component of G3® system hydrates with water to produce a highly viscous liquid. A thin film called "membrane" made of polymer strands is formed on the exposed excavation wall. This "membrane" is active creating a barrier that allows the application of hydrostatic pressure transfer to the excavation's wall. Hydrostatic pressure is the most effective method in controlling the excavation stability.

In various part of this project, where most difficult soil is encountered such as mud with 0 SPT-N values, Alfabond®, a co-polymer for joint application in the G3® System, is used to increase the suspension capacity of the slurry, thus density is increased. Higher density of the fluid will further increase the hydrostatic pressure against the excavation wall to provide greater stability.

The stability of the boreholes in this project was successfully achieved with a good understanding of soil profiles and implementation of procedures. As a result, an impressive total concrete overbreak of 6.3% was recorded for those piles executed under G3® system.

QUALITY

Producing a quality bored pile is a top priority for every project and is emphasized strictly in this KVMRT project. A clean slurry and pile toe is expected to guarantee the quality of the bored pile and enhance the capacity of the bored pile itself. Polymer slurry is checked and recorded in every stage of execution. Depending on the soil condition in various working area, the parameter of the slurry may differ. The average parameters that has been recorded in this project is; viscosity = 58s, density = 1.03 g/cm³, pH = 10 and sand content = 0.75%.

Chemical cleaning using Microbond®, another element of G3® system, eases the cleaning process of the pile toe after reaching the final

depth. Microbond® solution expedites the settlement of accumulated suspended particles in the slurry if the density is measured to be above 1.06 g/cm^3 or the sand content records greater than 3%.

All the piles executed in this project under G3® system proven to have zero quality problems. Below is the sample of the sonic logging test that has been carried out in one of the piles in KVMRT project.

Drilling Bored Pile with G3 System

VALUE ADDED

Implementing G3® system technology in KVMRT project brings major positive advantage in term of soil stability, quality and production.

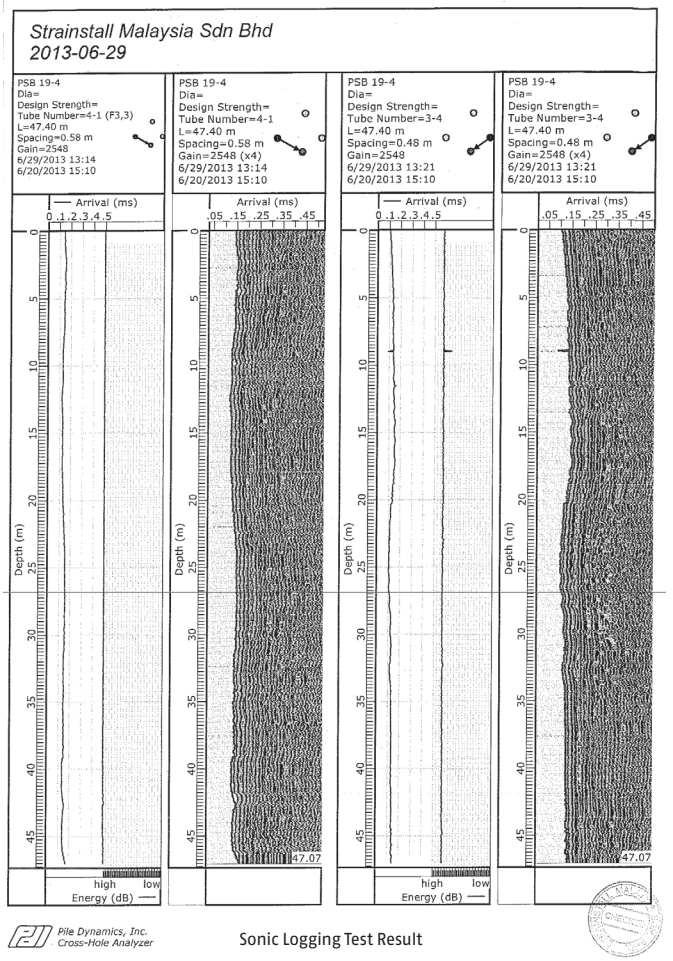
Microbond® solution cuts the slurry and pile toe cleaning down to between 15-30 minutes. This improves the production in a greater scale.

Drilling under G3® system, encapsulates the soil that being excavated by the drilling bucket. Free water is being eliminated and this means the soil does not fragment. This scenario leads to much cleaner work front when compared to other convention drilling fluids.

The equipment needed to produce and manage the slurry system on site is reduced by half with the systematic procedure of G3® system. This provides a great advantage for KVMRT stretch that generally operates in restricted space.

PolyMud® slurry, once mixed, can be used immediately unlike bentonite slurry that requires swelling period of minimum 12 hours. This has a great impact on the production cycle of the piles.

All products of GEO's G3® system are eco-friendly and disposal of the slurry after simple treatment does not harm the environment.



Pile Dynamics, Inc. Cross-Hole Analyzer

Sonic Logging Test Result

CONCLUSION

KVMRT project is an example of rapid infrastructure development in Malaysia. As fast developing nation, the implementation of new technology in construction has become vital advantage especially when quality has become a top priority. The development of GEO's G3® system in deep foundation slurries plays a significant role in achieving targeted results without compromising quality. More and more projects are being opted to be executed with GEO's G3® system solution which guarantees the results. ■