Foresta 2 @ Sri Damansara

The Alternative Proposal of Caisson Pile in Deep Bedrock Zone

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Project Introduction

This development project is located at Sri Damansara which comprises of 2 blocks of 34 & 40 storeys apartment including 8 storeys of podium which consist of carpark podium, M&E service podium and guard house. The building foundation system is a Contractor's Alternative Design contract with the combination of 43 nos. of caisson piles (sizes ranging from 1000mm to 2500mm diameter) and 70 nos. of pad footing. The contract construction duration is 9 months. The scope of works includes caisson piling, pad footing, pilecap, lowest level of slab and underground M&E works.

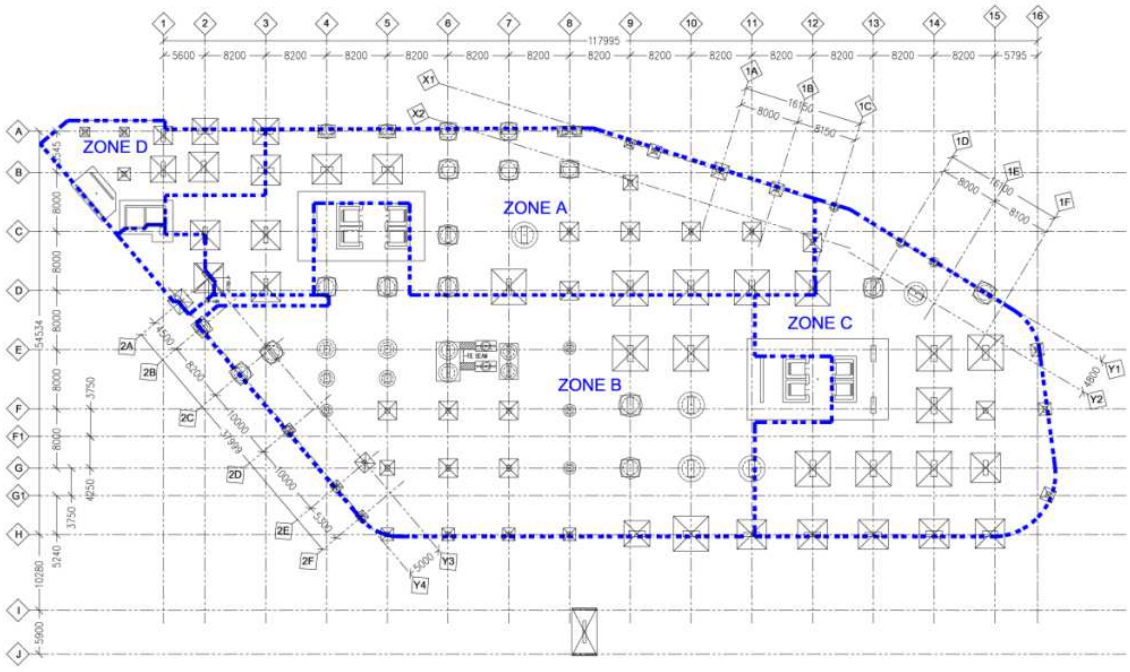

Figure 1 : Alternative Foundation Layout

Alternative Design Proposal

Caisson pile is selected to replace the original bored pile foundation and the conforming pad footing foundation is remained. By introducing a single pile for each column, the pilecap design can be optimised significantly. Besides, caisson piles are founded into sound bedrock as rock quality can be verified and determined during caisson rock socketing stage. Based on given soil investigation data, 50% of the building footprint is near rock surface where pad footing is introduced.

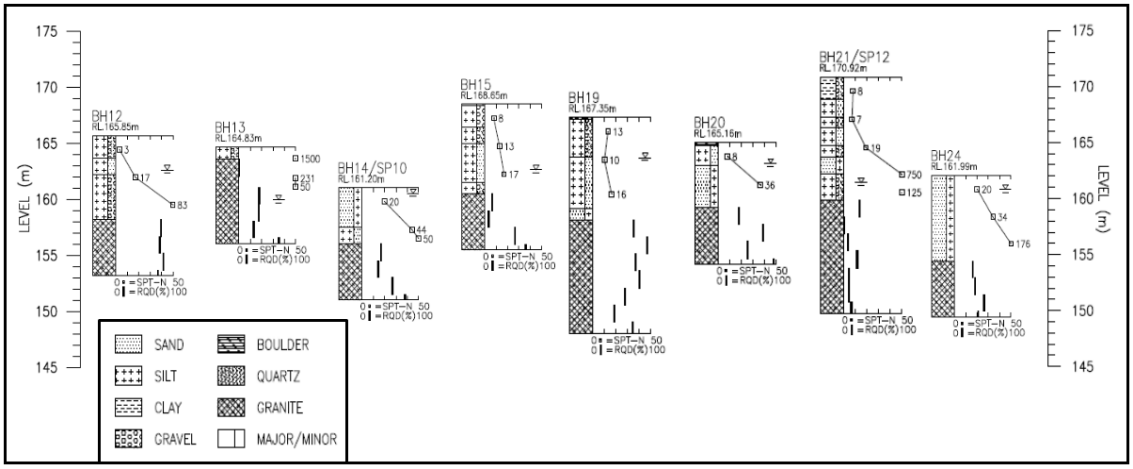

Figure 2 : Soil Borehole Log

Figure 3 : Caisson Plate Bearing Load Test

From the instrumented test pile result, the ultimate rock skin friction was able to achieve greater than 1500kPa and ultimate end bearing capacity greater than 9000kPa (Grade III/IV). In addition, from the preliminary footing plate bearing load test result, it was verified that the footing ultimate bearing capacity of 6000kPa was acceptable. For caisson pile design which is founded into Grade II/III granite rock, the ultimate bearing capacity of 15000kPa was used and verified by the caisson plate bearing load test.

In view of foundation design change (from original pad footing to caisson pile in deep bedrock zones), slab reinforcements were correspondingly reviewed as 'drop panel' sizes were reduced (bigger pad footing versus smaller caisson pilecap integrated with slab). Reinforcements in the slab were checked and strengthen based on structural analysis using SAFE software.

There have been are 1nos. of instrumented MLT on CP1000, 1 nos. of subsequent MLT on CP1500, 1 nos. of preliminary footing plate bearing load testing, 2 nos. of caisson plate bearing load test, 3 nos. of working footing plate bearing load test and 2 nos. of pile PDA testing in total. All test results were in compliance with the minimum factor of safety of greater than 2.0 in geotechnical capacity.

Figure 4 : Footing Plate Bearing Load Test

Construction Challenge

At the beginning of execution stage, rock probing was carried out in every single column point to determine the rock level to enable a detailed analysis before a final selection of foundation system can be adopted. In this context, quick decisions were required to arrive at a complete pile foundation solution which not only has catered for various bedrock condition and levels, but has also dealt with slope terrain and ground profile.

Figure 5 : LC3 Footing Hacking

It took one month to excavate 5m depth of rock in liftcore LC2 and 2.5 months to excavate 8m depth of rock in liftcore LC3 to form the footing base of the lifts. Manual rock splitting was also required in LC3 to complement the Hydraulic Breaker in view of the extreme sound granite rock.

Concrete temperature monitoring was conducted in LC3 to ensure engineering compliance in thermal crack control in a mass concrete structure. A special concrete mix with ice cubes was designed and used to fulfil the Engineer's requirements. Formwork is a good insulator and therefore it was left in place after the pour for 48 hours. Whereas on the surface, a polythene sheet was laid and covered with polystyrene board to delay the surface cooling. Water pumps were standby on site for dewatering (in case of rain) to prevent surface rapid heat dissipation.

Figure 6 : Site Aerial View Photo

In addition, there were 4 different structure levels and the only access was located at the lowest level platform i.e. PL 156.10 as shown in Figure 8. Hence, the basement structure work sequence was such planned to ensure the logistics and access were not affected and jeopardized.

Figure 7 : Insulation Done on Footing LC3

Furthermore, there were few caisson piles which encountered exceptional hard granite rock. Therefore, to meet the desired production rate, manual rock splitting technique was again adopted by drilling pilot holes in linear lines in the centre of caisson to create a "free face" for the rock mass to be splitted and be broken up.

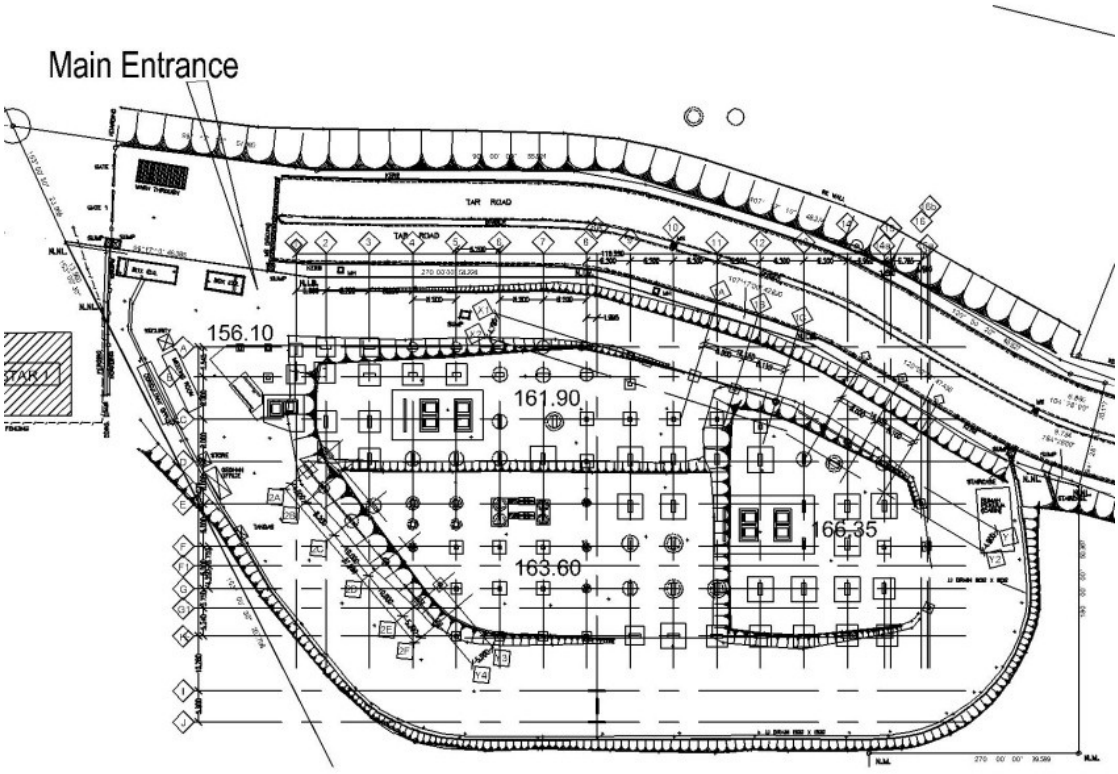

Figure 8 : Site Logistic Layout