

Park Residence @Medini

Additional SI Borehole for optimisation of pile length design

(by Ms. Yap Fui It, Design Engineer) (2015 Oct-Dec)

Project Introduction

This is one of the prime residential development project in Medini Johor which comprises of 3 blocks high rise condominium with 40 storey, 44 storey and 46 storey respectively, including 10 storeys of podium car park with a few unit of retails. The foundation is under Contractor Alternative Design using 243 number of bored pile with sizes ranging from 600mm to 2000mm diameter and 67 number of caisson pile with sizes ranging from 2200mm to 2600mm diameter. The total construction duration is 7 months which including piling and pile cap works. The most challenging of this project is the determination of pile length where the actual ground condition is partly in Sedimentary formation of Sandstone and partly in poor residual Granite formation. The later was encountered during the additional soil investigation and actual bored pile construction.



Site Photo

Alternative Design Proposal

We proposed a combination of bored pile and caisson pile with mostly single pile system to replace the original full bored pile in multiple piles group arrangement. Based on the available soil investigation data during the tender stage, the piling layout was divided into 8 zones for pile length design.

Based on our earlier experience in Encorp Marina project in the same area, we have confidently designed the optimum pile length in the Sedimentary formation area in order to keep our pricing competitive.

Design Challenges

As per the provision of Bill of Quantity, 10 nos. of additional soil investigation borehole, ABH were being carried out. We started to find out the unpredictable ground condition at ABH2 in Zone 2. Decision was made to add ABH11 near to the earlier BH1 for verification and ABH12 to find out the transition zone in between Zone 1 & 2. Unfortunately, ABH12 was the worst result and the required pile length more than 60m! In order to have more confident in determining the pile length within the transition zones, we then immediately decided to do ABH13 & 14 in that problematic area.

Zone 1-Worst ABH

ABH12			
Depth (m)	STP-N	Colour	Soil
0	0	Light Brown	sSi
1.5	7	Light Brown	sSi
3	8	Light Yellow	sSi
4.5	10	Light Yellow	sSi
6	14	Light Red	sSi
7.5	16	Pale Red	sSi
9	15	Pale Red	sSi
10.5	15	Light Orange	sSi
12	17	Medium Orange	sSi
13.5	22	Medium Orange	sSi
15	21	Dark Orange	sSi
16.5	23	Dark Orange	sSi
18	26	Pale Purple	sSi
19.5	24	Light Purple	Si
21	28	Light Purple	Si
22.5	31	Light Orange	Si
24	32	Light Orange	Si
25.5	36	Light Red	sSi
27	40	Light Purple	sSi
28.5	55	Light Purple	sSi
30	30	Pale Grey	sSi
31.5	35	Pale Grey	sSi
33	34	Pale Grey	sSi
34.5	32	Light Grey	sSi
36	36	Light Grey	sSi
37.5	36	Light Grey	sSi
39	45	Pale Grey	sSi
40.5	48	Pale Grey	sSi
42	43	Light Grey	sSi
43.5	42	Light Grey	sSi
45	32	Light Grey	sSi
45.7	53%/0%	Dark Brown(Highly Weathered & Very Poor)	SD
47.2	85%/0%		SD
48.2	103	Dark Brown	sSi
49.5	103	Dark Brown	sSi
51	47	Dark Orange	sSi
52.5	45	Light Red	sSi
54	50	Light Orange	sSi
55.5	41	Dark Orange	sSi
57	43	Dark Orange	sSi
58.5	40	Dark Orange	sSi
60	45	Dark Orange	sSi
60.45			END @60.45m

Zone 5-Intermediate Result

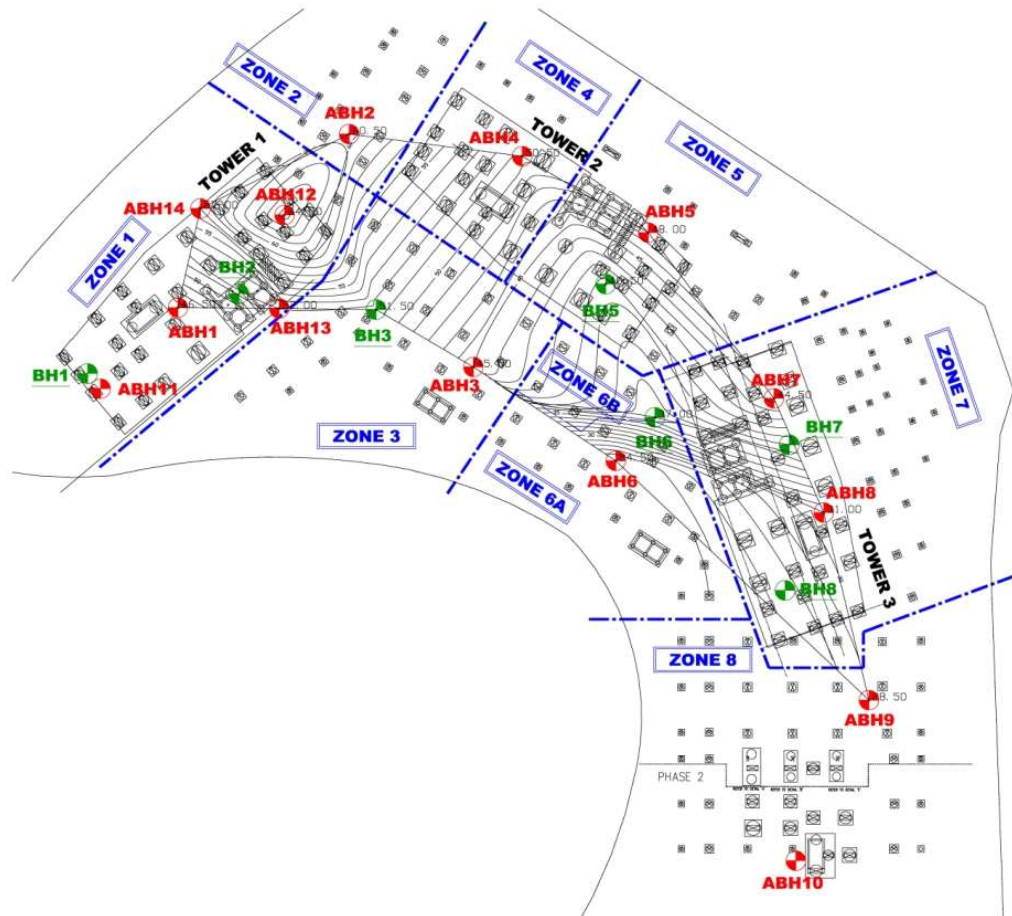
ABH5			
Depth (m)	STP-N	Colour	Soil
0	0	Medium Orange	Si
1.5	7	Medium Orange	Si
3	8	Dark Brown	Si
4.5	10	Dark Brown	Si
6	27	Light Brown	Si
7.5	24	Light Brown	Si
9	44	Dark/Light Brown	Si
10.5	56	Medium Red	Si
12	32	Light Purple Dark	Si
13.5	30	Light Purple	Si
15	39	Dark Brown	Si
16.5	44	Dark Brown	Si
18	32	Light Purple	Si
19.5	35	Light Purple	Si
21	38	Pale Grey	Si
22.5	41	Pale Grey	Si
24	36	Light Purple	Si
25.5	67	Pale Grey	sSi
27	125	Dark Brown	sSi
28.5	143	Dark Brown	sSi
30	33	Dark Brown	sSi
31.5	36	Dark Brown	sSi
33	56	Dark Brown	sSi
34.5	79	Dark Brown	sSi
36	73	Dark Brown	sSi
37.5	100	Dark Brown	sSi
39	136	Pale/Light Grey	sSi
40.5	143	Pale/Light Grey	sSi
42	>300	Pale/Light Grey	sSi
43.5	>300	Pale/Light Grey	sSi
45	>300	Pale/Light Grey	sSi
45.075			END @45.075m

Zone 8-Good Result

ABH9			
Depth (m)	STP-N	Colour	Soil
0	0	Light Red	sSi
1.5	8	Light Red	sSi
3	79	Dark Orange	sSi
4.5	71	Dark Orange	sSi
6	38	Light Orange	Si
7.5	41	Medium Orange	Si
9	13	Pale Yellow	Si
10.5	48	Pale Yellow	Si
12	250	Medium Orange	sSi
13.5	250	Medium Orange	Si
15	250	Dark Brown	sGr
16.5	300	Light Orange	sGr
18	250	Dark Orange	siS
19	46%/0%	Light Orange	SD
20.5	214	Pale Grey	Si
21	214	Pale Grey	Si
22.5	300	Pale Grey	Si
24	300	Pale Grey	siS
25.5	214	Pale Grey	siS
27	300	Pale Grey	sSi
28.5	250	Light Grey	siS
30	>300	Light Grey	Gr
30.2	29%/0%	Light Orange	SD
31.7	250	Light Grey	Si
33	250	Light Grey	Si
34.5	>300	Light Grey	Si
36	250	Light Grey	Si
37.5	300	Light Grey	Si
39	250	Light Grey	Si
40.5	214	Light Grey	siGr
42	>300	Light Grey	siGr
43.5	250	Light Grey	siGr
45	>300	Light Grey	siGr
45.07			END @45.07m

On the other hand, ABH11 was shown very good result as compared the earlier BH1 and ABH1. Finally, with the additional total 14 nos. of ABH, we then confidently designed the pile length in respectively zones.

However, we encountered some of the pile length in 2 adjacent zones were different too much after our preliminary design stage. As such, we decided to further divide into sub-zones for the pile length in transition area.



Layout 1 : Pile Length Mapping for BP1800

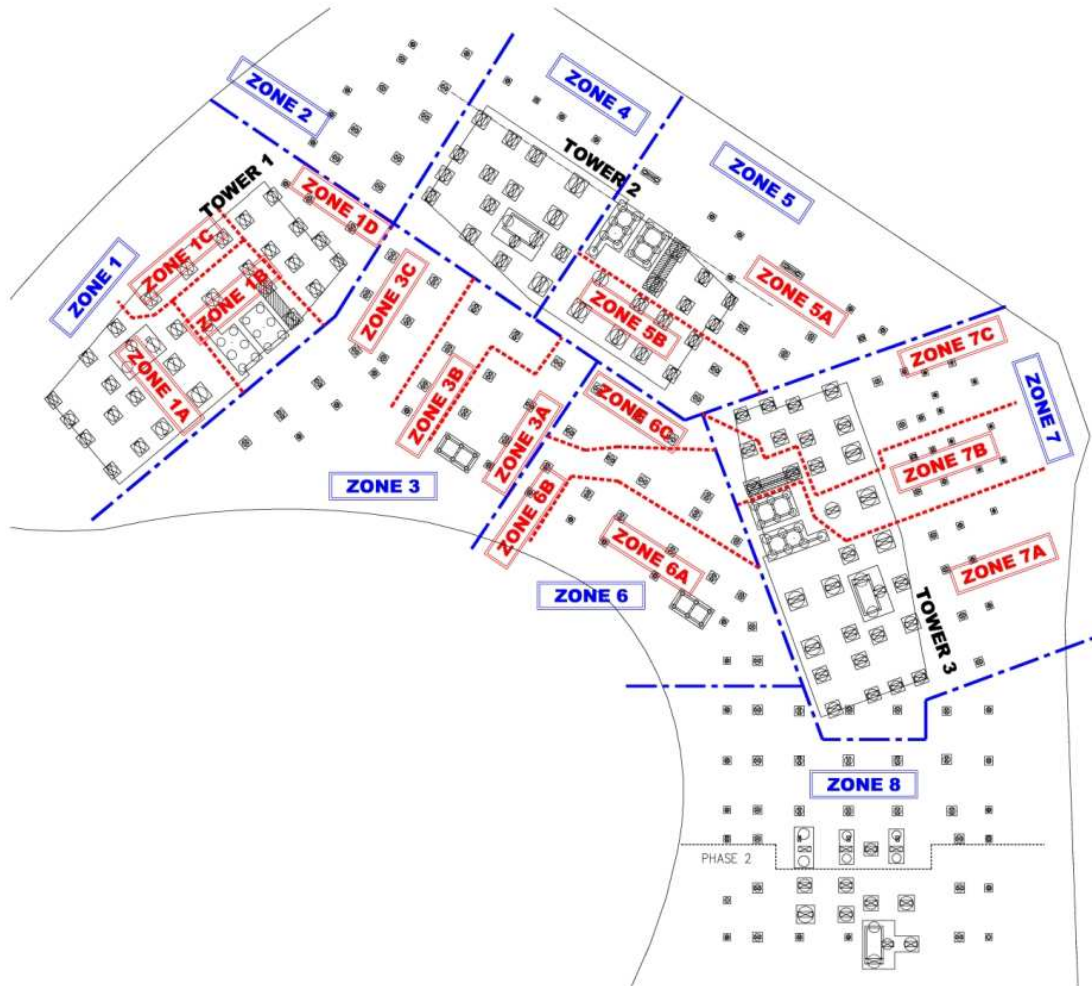
There were two contour mappings were prepared which indicated the designed pile length for bored pile type BP1800 and BP1200, according to the ABH results. Then, we only demarcated all the zones' boundary lines according to these mapping.

Nevertheless, our design process and review were not stopped here! We encountered Granite bedrock in Zone 1B, 1D & 4 with depth ranging from 43m to 55m during the actual bored pile construction. It was a big surprise to us as none of the BH and ABH encountered Granite bedrock or boulder even to the depth of 60m. As such, we reviewed the pile length design in consideration of soil friction and rock socket. In addition, the rock samples were sent for rock point load test to verify the adopted design parameters for rock socket length calculation.

Upon completion of the project, total 3 nos. of subsequent MLT and 37 nos. of PDA testing have been carried out to verify the performance of working piles at various Zones. All of the

test results were shown in compliance to minimum factor of safety of more than 2.0 in geotechnical capacity.

We wish to take this opportunity to thank the Consultant Engineer who has spent a lot time with us in the pile design issues and they are very helpful and responsive.



Layout 2 : Final Piling Layout with Sub-Zones