17 Residence @Sect 17-PJ

Alternative proposal of Cantilever Diaphragm Wall to replace the Temporary Sheet Pile Shoring System

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Project Introduction

17 RESIDENCE is a mix development project that involves construction of a dry and wet market with multipurpose hall, 2 blocks of service apartment which consist of 425 units at 17 storeys, as well as 5 levels of podium car park and 2 levels of commercial retail. This is a Design and Build Contract for basement retaining wall and foundation piling system.

The project is located at an existing open car park area next to the open wet market in Section 17 Petaling Jaya, surrounding by double storey shop lots in 3 side and double storey terrace houses in 1 side of the site.

Site Photo

Alternative Design Proposal

The original design was full bored piling system with pile sizes ranging from 600mm to 1650mm diameter. The alternative piling system is very similar with the original design, where we proposed an 1800mm diameter of bored pile size, instead of 1650mm diameter, and adopted higher working capacity by using higher concrete grade of bored pile.

On the other hand, a 600mm thick of diaphragm wall was proposed to replace the original RC basement wall with temporary sheet pile shoring system installed behind the RC wall. This is to facilitate 1 level of basement excavation with high head room of more than 5m of height and the basement wall will be constructed exactly next to the boundary line. Therefore, a cantilever diaphragm wall which is much stiffer than the sheet pile system was proposed in order to provide an obstruction free condition for basement construction and within the boundary line.

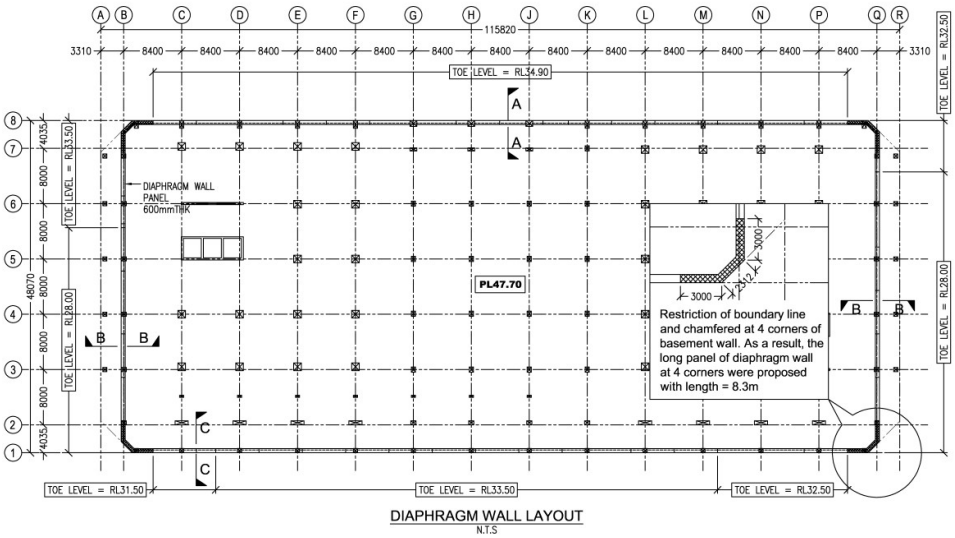
Design Challenges

The original ground level is generally flat and it is ranging from RL52.00 to RL53.50 with granite residual formation soil. Based on the soil investigation done by the Client, there is only 1 out of 10 nos. of borehole was encountered grade IV Granite rock and hence, the initial pile design was in fixed length basis. However, an additional soil investigation by us shown there are 5 out of 6 nos. of borehole that encountered Grade II and better Granite rock in about 40m depth from EGL. As such, we changed the pile design to include rock socket length with varies soil length depth and maximum pile length (soil only), in case there is no bedrock encountered during pile construction. The combination of soil and rock friction pile was then tested with a full instrumented maintained load test and the design parameters of soil and rock were validated.

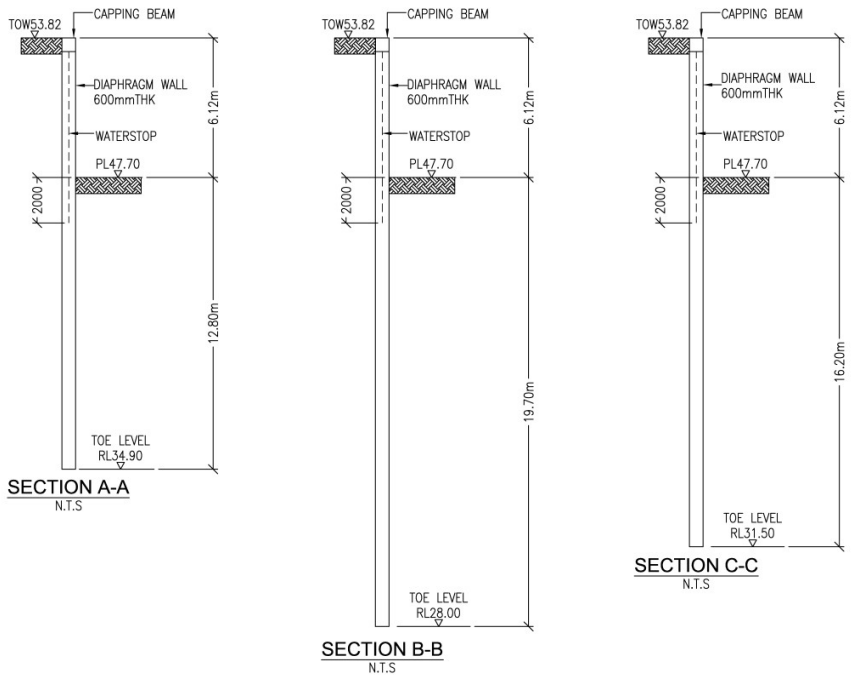
For diaphragm wall design, the main challenge is the soil parameters and types of wall analysis to be adopted in Plaxis wall analysis software. Many discussions with the Geotechnical Consultant were held to finalise the soil parameters for the worst boreholes i.e. BH6 and BH10 where the SPT-N values are less than 2 and with very high content of clay from EGL to 4.5m depth of soil layer. The wall analysis types of Drained and Undrained condition have been considered in such soil condition for the critical case.

Diaphragm Wall Machine GB46

Due to high axial loading to the diaphragm wall and weak soil condition, the penetration depth of wall is relatively deep compared to the conventional cantilever wall, as shown in below Sections A-A, B-B and C-C, i.e. 2 to 3.2 times the retained height.



DIAPHRAGM WALL LAYOUT
N.T.S



Construction Challenges

Due to the restriction of boundary line and optimised of building space, the 4 corners of basement wall are chamfered as shown in the below plan. As a result, an unusual longer panel of diaphragm wall was proposed at all 4 corners to suit the conditions of boundary line and basement wall alignment. Extra care and precaution have been taken during the steel cage hoisting and concreting process for these 4 panels construction.

For this unusual 8.3m long and tricky chamfered shape (for diaphragm wall construction), the excavation was carried out in multiple bites (stages). The excavation has to be done in a quick but precise manner in order not to disturb the excavated soil face. The process of hoisting and installation of the diaphragm wall reinforcement cage were also a very challenging one. Our engineer has to calculate the actual centroid of gravity (C.G.) of the reinforcement cage for a balance hoisting and precise installation. Any imbalance will cause the reinforcement to tilt and make the installation impossible. Apart from the construction challenges, we are also required to overcome the numerous complaints from the surrounding residents and traders.

We have gained a lot of valuable experience of diaphragm wall construction as well as the planning of site logistic and handling of bentonite in such a busy development area.