

Basement and Foundations

Diaphragm Wall and Barrette Piling

THE SAIL@MARINA BAY
SINGAPORE



An innovative retaining wall and barrette pile foundations for a high rise condominium

The New Downtown of Singapore is being built on reclaimed land in front of the existing Central Business District and poses several challenges in the design and construction of the basement and foundation systems. With a complex geology and a thick layer of very soft marine clays, the choice of foundation system becomes very important. Additionally old quay walls and various abandoned marine structures from Singapore's rich maritime history complicate the construction of the underground works.

Furthermore, a mass transit rail tunnel ran through the site just 20m from the basement excavation which imposed strict movement criteria and meant that a stiff retaining structure was required.

With a tight construction programme the Main Contractor was interested in a robust retaining wall and foundation solution which could be built quickly and would allow the subsequent works to proceed smoothly. Bachy Soletanche developed an innovative



View of the excavated basement with exposed barrette heads

OWNER:	CITY DEVELOPMENTS LTD/AMERICAN INTERNATIONAL GROUP
ENGINEER:	MEINHARDT SINGAPORE PTE. LTD.
MAIN CONTRACTOR:	DRAGAGES SINGAPORE PTE. LTD.
PERIOD OF WORKS:	JUNE 2005 - NOVEMBER 2005

WORKS PERFORMED:

Diaphragm Wall

- Perimeter: 220m ; surface area: 6,532m² ;
- Depth: 29m ; thickness: 800mm & 1,000mm

Barrette Piles

- Number: 79 ; surface area: 13,700m² ;
- Depth: up to 67m ; sizes: 2,800 x 1,200mm & 2,800 x 1,000mm ;
- All toe grouted ; 1 preliminary & 2 working load tests up to 3,600 tonne



solution using a multi-cell diaphragm wall with cross walls strutting below formation level and a single “flying” strut to support the excavated portion.

This system gave a geometry of the multi-cell wall which did not require any additional lateral support so no jet grouted slab was required saving cost and more importantly saving significant time for the overall programme.

The foundation system chosen was barrette piles which are constructed using the same equipment as the diaphragm wall thus avoiding further encumbering the site.

Bachy Soletanche’s solution was adopted by the Main Contractor and re-baptised the “peanut”. The diaphragm wall and barrette piles were constructed concurrently and after completion of the wall and foundations, two load tests were required. The capping beam and the two “flying” struts cast in-situ.

Working 24 hours a day and with 6 rigs at one stage the wall and foundations were completed on time allowing the contractor to forge ahead with the bulk excavation. The geology of the site meant that



General view of construction with 5 rigs working

underlying the 35m thick layer of very soft marine clay the barrette foundations had to be founded in either the notorious Fort Canning Boulder Bed which is a very hard clay matrix with very strong boulders with strengths of up to 200MPa or into a dense Old Alluvium material. Approximately a third of the foundations were founded in the boulder bed.

All the barrette piles were injection grouted at the toe to ensure a good

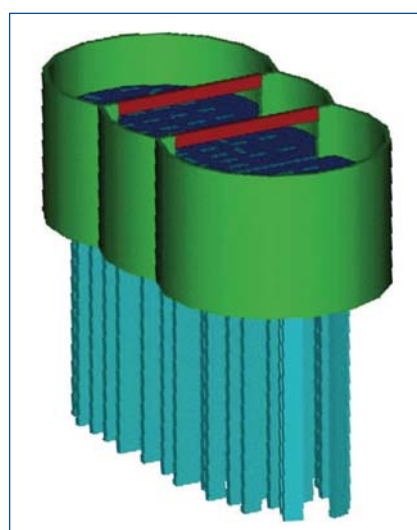
end bearing and on completion of the works, two working load tests were successfully carried out.

Conclusion

The innovative retaining system proposed by Bachy Soletanche linked to the high capacity barrette piles allowed an economic solution for the basement and foundations of the prestigious condominium development, also ensuring that the project got off to the best possible start.



Steelfixing for the 3m thick base slab underway



Schematic of “Peanut” with barrette piles.

