

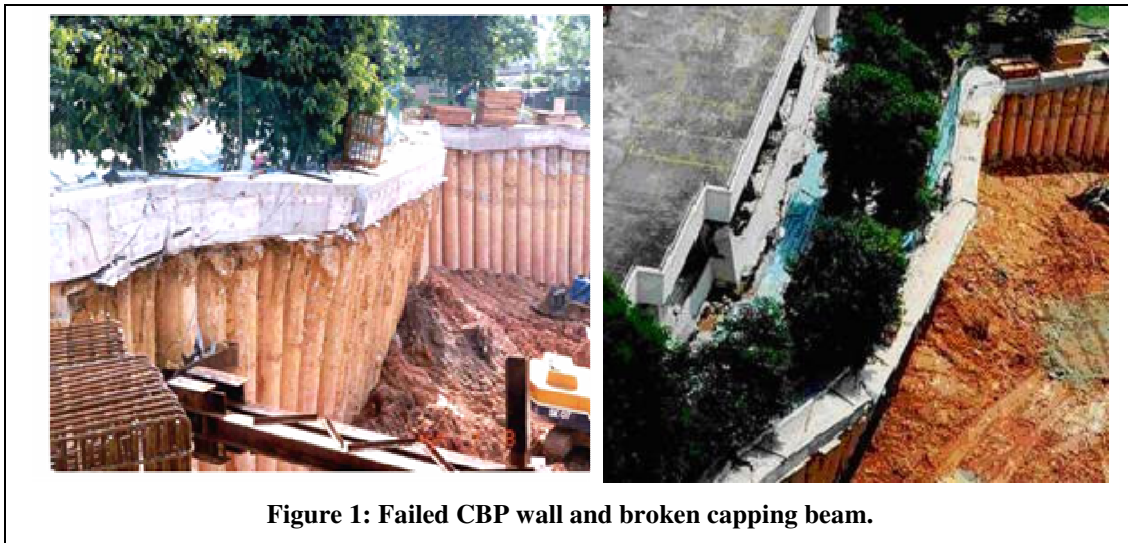
# FAILURE OF CONTIGUOUS BORED PILE EARTH RETAINING WALL

## Type of building work

A 4-storey condominium with two basement was to be built on a slope of a hill. There are completed multi-storey condominium buildings at the top of the hill. A row of reinforced concrete contiguous bored pile (CBP), of diameter between 900mm and 1,100mm, was constructed to act both as earth retaining structure for the excavation for basement construction works as well as the permanent wall for the basements. The CBP were embedded between 8m and 15m below the excavated/formation level.

## What went wrong

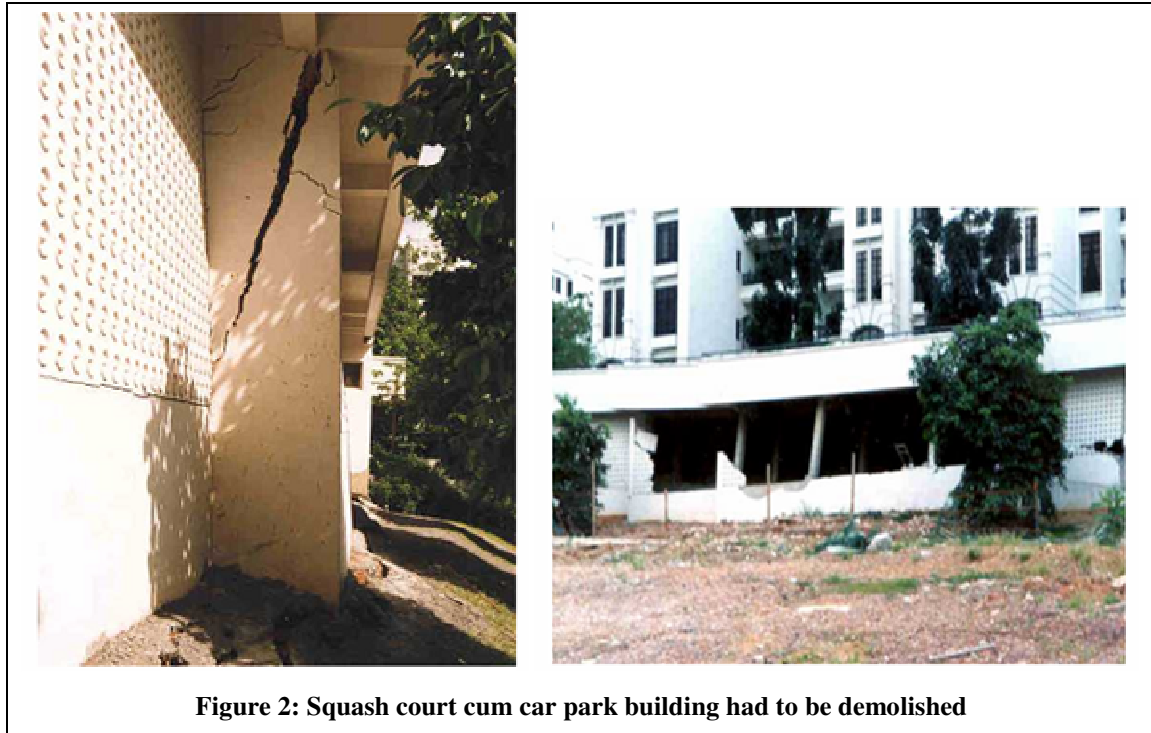
The design of the CBP wall called for one layer of struts to be provided at mid-level of the excavation. This was however not provided and the builder excavated the full depth to formation level without providing the proper struts. This left an unrestrained height of between 10 metres and 15 metres. The builder aggravated the situation by allowing water to collect at the base excavation, thus softening the soil which provides the passive resistance. After 5 days of continuous rain, the pressure behind the wall could have increased and the wall yielded. A capping beam tying the CBP at the top of the wall was sheared off.



**Figure 1: Failed CBP wall and broken capping beam.**

As there were buildings adjacent to the CBP wall, the excavated site had to be backfilled immediately. Non-stop round the clock backfilling operation was carried out over 7 days to restore the site back to its original level in order to stabilise the site condition.

Excessive ground movement caused serious structural damage to the squash court cum car park building at the top of the hill. The building was closed and eventually demolished and re-built.



### **Learning points**

- a) The critical design considerations, namely the need for struts, must be properly shown on the construction drawings. At no time should these considerations be altered without prior consent by the design professional engineer (PE). If major modifications are to be made, the PE must carry out a re-analysis to check for structural adequacy of the alteration before implementation.
- b) The design of earth retaining walls should allow for hydrostatic pressure built up behind it and unplanned over-excavation. Precautions should be made to taken to prevent unnecessary built-up of hydrostatic pressure.
- c) Instruments to monitor ground movement should be installed to provide an early warning system and enable corrective action to be taken early.