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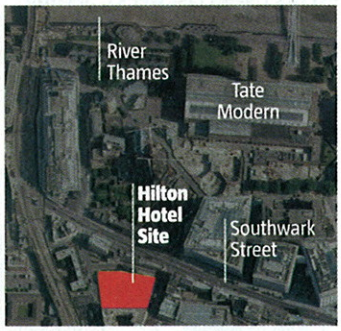
# LOADED QUESTION

## WHY SUPPORTING A LONDON RIVERSIDE BASEMENT EXCAVATION CALLS FOR INNOVATIVE, ADJUSTABLE PROPS

# HOLDING PLAYERS

Measuring loads in the props supporting a large basement excavation has proved an eye-opener for all concerned, as **Margo Cole** reports.


**Corner support:** Massive tubular steel props support the corners of the excavation (main picture). How the finished hotel will look (botttom right)




Regeneration work at the Bankside Cultural Quarter on London's South Bank is far from simple, especially where basement construction is concerned. Ground conditions are poor and the high water table fluctuates with the tidal flow of the nearby river Thames.

One of the largest basements currently under construction in the area is a 28,000m³ excavation that will form two sub-surface levels of a nine-storey hotel.

The secant walled box, bounded on three sides by existing roads and on one side by a party wall, is particularly notable for the propping system being used to support the wall loads during construction. It is also notable that the loads within those props can be monitored and altered to reflect the true load going through the retaining walls.

The new basement will eventually house the spa, ballroom and meeting rooms for a five star Hilton hotel, which is due to be completed in time for the Olympics next year. It is being constructed by GTM, a powerful joint venture between Galliford Try and McGee, which, between them, have the in-house resources to build the entire hotel without bringing in a single subcontractor.

They also have sufficient design capabilities to have offered a range of alternative proposals at tender stage.

This included the design of the wall around the basement excavation which was originally to have been sheet piled.

The contractor's substructure and piling manager Paul Gildea explains: "There were a lot of deep foundations and brick culverts, so we're having to dig down 6m to 7m to take out the heavy obstructions, particularly along the line of the piles, where the obstructions were much bigger than expected from the desk study.

"The consultant had come up with a sheet piled wall, but this would have been very expensive, because of the obstructions and the depth at which they would have had to be toed in. Instead, we've gone for a secant piled wall around the entire perimeter."

**"There were a lot of brick foundations and deep culverts so we are having to dig down 6m to 7m to take out the heavy obstructions"**
Paul Gildea, GTM

Ground conditions are – typically for land immediately south of the Thames – very poor, consisting of around 2.5m of made ground on top of very poor quality alluvial deposits and peat, with the underlying London clay at least 10m down.

"This is part of a wide river basin, and there was an old channel in the area," explains McGee managing director Declan Sherry.

The piles that form the wall are up to 15m deep, and are toed into the clay to form a watertight seal against the groundwater, which sits just 3m below ground level. On three sides, where the site is bounded by existing roads, the piles were installed to full depth from ground level, and are 600mm in diameter, installed at 900mm centres – "pretty slender for the depth of dig", according to Gildea, who designed the substructure.

A recently constructed building is on the boundary with the fourth side. Party wall arrangements required the contractor to maintain a gap between the two structures, but this offset, plus the 450mm diameter of the secant piles, would have eaten into space within the basement.

To maximise space at upper basement level, GTM has installed the piles from a lower level, and then built a capping beam at this level from which a reinforced concrete wall will be built as close as possible to the existing building.

Verticality was a big issue during all the piling, both to ensure that the wall did form a proper seal against water ingress and to prevent loss of »

# GEOTECHNICS: BANKSIDE BASEMENT

» space within the basement. One option would have been to case the piles but, according to Gildea, that would have required 12m of casing for each one, making it a very expensive option. Instead, the firm used a specially stiffened auger on its main piling rig, which installed around 700 piles to form the watertight box.

A smaller rig was used to install the piles on the party wall side of the site.

From the start of the job, one of the main considerations was how to prop the excavation. "It's quite a deep dig, and we looked at various options to try to minimise propping," says Gildea.

"Our intention was to use structural steel propping, but we thought there might be advantages in flexibility by having a proprietary system fitted with monitoring systems because we could react to actual forces."

He admits the JV was "reluctant to get someone else in to do the propping". But GTM's desire to do as much of the job as possible without the need for subcontractors is not simply a matter of pride – it is one of practicality. "We've got control of the whole area," explains Galliford Try project manager Barry Kingscote. "We always wanted to do it this way because it makes the whole programme quicker. We can react to problems or changes by bringing our own kit in."

Sherry adds: "Any change gets an immediate response from GTM. With a more traditional arrangement there would be a more articulated arrangement to manage that change."

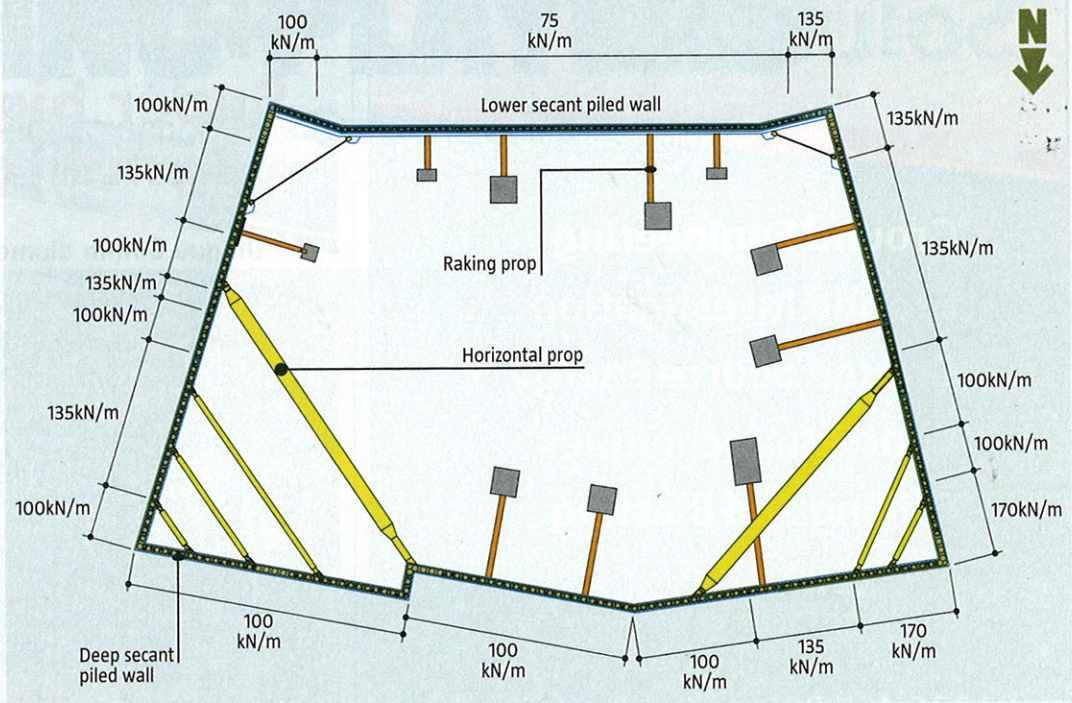
As Gildea says, on a more traditional contract, with the main contractor bringing in subcontractors for all the piling and concreting, there would probably be three or four different contractors on the project by this stage of the work, whereas on this job McGee has done all the piling, excavation and concrete work itself, cutting out difficult interfaces.

When it came to the propping, the JV decided there would be benefits in bringing someone else in.

"There are a lot of things that come with a proprietary system that are just not possible with structural steel," says Gildea.

Chief among these is the potential to measure the actual loads going through the props and, if necessary, to adjust the propping regime accordingly.

**PROPPING SEQUENCE: LINE LOADS IMPOSED ON SECANT WALL**




**"There are a lot of things which come with a proprietary system that are just not possible with steel"**
Paul Gildea, GTM

The firm GTM brought in was Groundforce Shurco, which has been working hard recently to raise its profile in the large basement propping market.

It has come up with a system of massive tubular steel props, positioned horizontally across the corners of the site. Walls are also supported by a series of raking props.

"One of the key objectives was to minimise the number of props – particularly the number of raking props," explains Groundforce Shurco senior engineer Matthew Green.

Gildea produced line loads for the entire perimeter wall, and passed these onto Groundforce Shurco. "We designed the propping system based on these line loads and the limitations on the site," explains Green.

"We tried to optimise prop centres, sit the straight [horizontal] props on the capping beam and use pile caps as thrust blocks for the raking props."

The result is an array of 19 different props, the longest of which is 33m long and 1.22m in diameter. GTM's original structural steel solution had double this number.

Groundforce Shurco offers the capability to monitor actual loads going through the props using a strain gauge in the load pin at one end. This gauge is connected to a transmitter that emits a signal to a GPS, which sends it to a server where the information is accessible to the entire construction team.

One of GTM's concerns was with loads at either end of the party wall, where there is a 4m step in capping beam level, and the potential for imbalance in the two props that support the walls on either side of the corners. The contractor opted to have load monitors installed in these two props, and has found that both are performing well below design load, so the vertical eccentricity does not seem to be causing any problems.

A slightly less accurate way of calculating the load going through the props is to measure the hydraulic pressure on the props and convert this back to a load value. Once the props were all in place, Groundforce Shurco did a pressure test on each of them and assessed that the load going through the large prop was twice the calculated load.

"We applied a positive load to the adjacent props and decreased it in the big prop, and that balanced out the load," explains Green.

GTM has installed monitors to measure deflection in the capping beam, and the proprietary system gives the contractor the flexibility to respond to the readings. "If we're getting excessive deflection in the capping beam we can do something about it," says Gildea. "With structural steel we tend to design each prop to a specific load, which means you can't react to a situation."

Sherry also describes himself as a "convert" to the propping system, especially on sensitive sites. "We would usually excavate with our own fabricated structural solution, but you don't know what's going on in those props," he says.

With the props in place, GTM has been installing bearing piles for the hotel's main cores and support structures. Three different types of rig have been used to install 268 piles. They are a combination of continuous flight augered piles in the centre of the box and cased rotary piles in the corners and range from 12m to 26m in depth.

Next on the construction programme is the main nine-storey superstructure, which includes a large post-tensioned transfer slab.