

# Diaphragm Wall

## Piccadilly Line, Heathrow Airport

United Kingdom



### Construction of Diaphragm Wall utilising a hydraulic diaphragm wall grab

When BAA began construction of Terminal 5 Heathrow it was necessary to extend the Piccadilly Line to link up with a new tube line extension. Bachy Soletanche were awarded the contract to form the perimeter of a 41m long x 25m wide rectangular cofferdam box to allow construction of an underground railway junction between two of the world's busiest airport runways.

The box was then to be excavated into an 18m deep access shaft to allow temporarily closed Piccadilly Line running tunnels beneath to be broken into and the junction formed to feed Terminal 5.

Ideally, a Hydrofraise grab with its four computer-guided cutting wheels would have been utilised were it not for Heathrow's ground conditions. The predominant stiff London clay would have tended to clog up the Hydrofraise's 1m diameter cutting wheels, therefore, a KS3000 hydraulic grab was mobilised which offered both the required cutting speed and 1 in 200 verticality—much greater than that achievable with conventional rope grabs.



*Diaphragm Wall Grab*

CLIENT:	BAA
MAIN CONTRACTOR:	Morgan Vinci JV
ENGINEER:	Mott MacDonald
DURATION OF WORKS:	12 weeks

#### WORKS QUANTITIES

3275 sq m wall  
1200m width  
25m deep panels  
34m barrettes

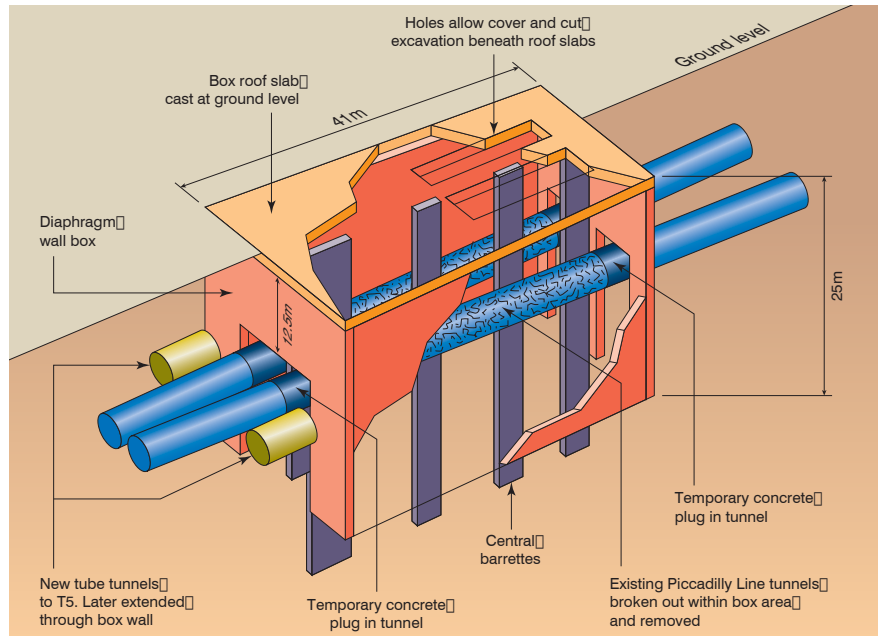
To ensure accurate control of the hydraulic grab, its alignment is guided by a Kelly bar fixed to the top of the grab unit. As the grab is raised this vertical bar slots into a box ensuring the whole frame remains central and vertical for the next bite. Before it takes that bite, the frame rotates horizontally through 180°.

The grab's interlocking jaws have six teeth on one side but only five on the other. This would encourage successive bites to veer slightly sideways so instead the automatic rotation ensures the cut remains straight.

The walls 25 panels, vary in both length and depth. At 7.1m the longest panels were excavated in three bites of the grab's 2.7m wide jaws and most extend 25m deep, well below tunnel inverts.

Reinforcement was pre-fabricated off site in sections and delivered at night during airport shutdown hours. The reinforcement was then joined together with couplers during installation.

Work was carried out to a very strict programme as the site required the possession of several aircraft loading/unloading bays and there was a deadline for the Piccadilly Line to be re-opened.



3D Schematic View of Works

Up to five 25m deep diaphragm wall panels a week were completed giving a 40 per cent greater production than with a conventional rope-operated grab.

Several 1.2m thick panels lying directly above the two tunnels as they pass across the box, were excavated only 12.5m deep and stop only 800mm above the crown of each Tube tunnel.

To ensure bentonite support mud could not escape into a tunnel from the base of these shorter panels, so threatening the stability of its excavation, a 6m length of each tunnel directly beneath the wall was plugged in advance with a lean mix concrete.



The above photograph shows the exposed wall. The difference in the texture of the surface of the wall is due to the ground strata. The top half of the wall was excavated through sand and gravels but below the visible line the ground was made of stiff clay.