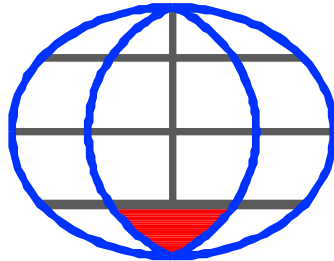


BACHY



SOLETANCHE

Equipment Proposal for CTE/Braddell Road Interchange



KS3000 - Low Headroom Rig

1. The Project

The project consists of the upgrading of the Central Expressway and Braddell Road Interchange, principally by the provision of an underpass to ease the traffic flow along Braddell Road.

The underpass will be constructed by traditional L shaped retaining walls for the shallow approach ramps and using diaphragm walling techniques for the deeper retaining structure. The diaphragm wall sections covers approximately 100m of road length of which approximately 30m is under the existing CTE flyover.

The diaphragm wall will consist of two 1200mm thick walls on both sides and a 1000mm thick central wall. A total of 9,000m² of concrete diaphragm wall is envisaged.

The main contractor for the project is ECON and the specialist foundation element is being co-ordinated by Econ Piling Pte Ltd. In order to select a competent contractor for the execution of the Diaphragm Wall, Econ have invited Bachy Soletanche Singapore Pte Ltd to propose a solution for the low headroom element of the works.

2. The Proposed Equipment

The proposed equipment is an adaptation of the highly successful and robust hydraulic diaphragm wall excavation rig, KS3000. This machine has worked extensively in Singapore, most recently on the Kampong Java Police Station, Singapore Exchange Centre (right) and at Clarke Quay Station on the NEL. There are several advantages of hydraulic diaphragm wall equipment, particularly in tight situations where the accurate control of the digging tool is a pre-requisite to work on sites. As the grab jaws are open and closed hydraulically, the equipment is generally quieter and generates less vibration than conventional equipment. Furthermore, and most importantly, this type of equipment is highly productive which allows for faster construction times or alternatively, less equipment is required to achieve the same result.



The low headroom version of this equipment was first developed for work on the Cairo Metro and has recently worked in Bangkok, again for the new metro line. The KS3000 rig can either be powered by an external power pack attached to the back of the crane or by using a base crane equipped with its own internal hydraulic system.



The same grab body, the powerful H90 is used for the low headroom version and the

same jaws can be fitted, making the equipment highly versatile.

The mini-KS is capable of excavating to a depth of 70m and the diaphragm wall thickness can vary from 600mm to 1.5m. In Bangkok this machine excavated a 1.2m thick diaphragm wall to 65m without problems.

3. Safety

Low headroom equipment by its nature is used in confined environments beside roads or railway lines where the safety of the general public and sensitive structures is a primary concern.

The mini-KS equipment has several advantages over conventional cable grab equipment, in that the action of hydraulic grab to excavate takes much of the strain out of the base crane. The main ropes are not subject to any additional forces other than lowering and raising the grab body. There is therefore a lot less general fatigue on the equipment meaning that with the normal proper maintenance the machine is less liable to failure.



However, it is important not to be over confident and a number of 'belt and braces' type safety features can be fitted to the machine ensuring that there is no danger to people or structures due to

unexpected problems. For example stay cables are attached to the body of the machine and the stub jib section to ensure that in the unlikely event of a rope failure the jib would not ‘whiplash’ upwards and damage the overhead structures. Similarly, stay ropes are fitted to the back of the rig to ensure that failure of the derricking rope will not lead to the jib falling forwards.

For the main and secondary lines, the crane is equipped with a retention system for these two ropes to ensure that a failure of one does not result in an uncontrolled whipping of the wire rope.



In certain cases the mini-KS rig can be fitted with the automatic SAKSO system. This can lock the rig into a certain pattern of movement. After an initial cycle, the operator will ‘lock’ the system to ensure that the rig cannot move beyond

certain predetermined limits. This ensures that the machine does not slew into obstacles or jib up or down beyond the programmed limits. Such equipment is normal fitted when the equipment is working very close to existing structures or railway lines.

As mentioned previously the hydraulic equipment creates less noise and vibration than a conventional grab. Therefore during the excavation operation there is less disturbance to the immediate environment with less risk of damage to services or adjacent properties.

4. Quality

The major difference in the low headroom version over its standard KS3000 is the absence of the stub kelly which acts as a guide in the initial stages of excavation controlling verticality at the critical stage in the process. However, the engineers responsible for the mini-KS have resolved this problem by including an inclinometer system within the body of the grab to measure XYZ deviation. Similarly, the machine uses special cables attached to the grab body to measure the twist of the grab as the excavation progresses. Any deviation of the drilling tool is therefore identified and can be rectified immediately by the

operator, either by slowly and carefully ‘reaming’ the excavation to return to tolerance or by the addition of ‘wedges’ onto the grab to physically push it back into position.

The problems of verticality and twist are the most common problems affecting low headroom diaphragm wall work. The KS resolves these problems normally associated with conventional cable grabs. A conventional cable grab excavates by ‘biting’ into the ground, using its weight to allow the jaws to grab up the



soil. Low headroom grabs are shorter and therefore much lighter. Therefore the purchase that the jaws can have on the ground is smaller. This means that the operator has to be more ‘vigorous’ in his actions. This makes it more difficult to control the grab and can lead to deviations.

Another problem common with cable grabs is the twisting action caused by the use of both of the base crane’s wire ropes to open and close the jaws. This is generally well controlled

by using right and left strung ropes and when the base crane is perpendicular to the excavation. However, on many low headroom situations space is at a premium and it is not possible to site the crane perpendicular so a twisting action is generated when the grab is jaws are being closed. This again causes tolerance problems that can lead to difficulty in positioning the steel cages, poor diaphragm wall joints, and/or out of vertical walls. The mini-KS is able to resolve these problems because it does not rely on the body weight to dig (although the H90 body is essentially the same as the standard version) and uses a rotating hydraulic joint (above) to allow it to work at any position without any twisting action being applied to the digging tool.