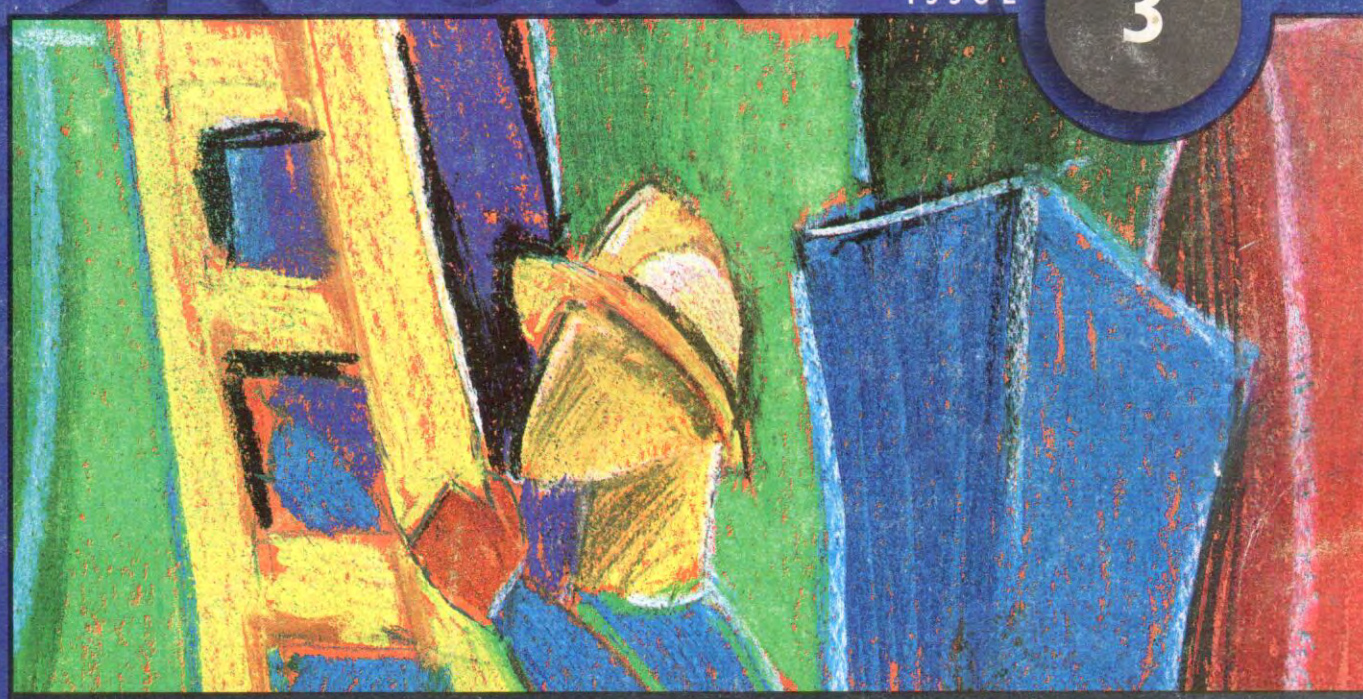
BICC

BUILDING INDUSTRY
CONSULTATIVE COUNCIL

ISSUE 3



HEALTH & SAFETY GUIDELINES

EDUCATION & RESEARCH

DEEP EXCAVATIONS

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Excavation Clauses in Civil Code

In Ch 16 para. 439, it is stated that it shall not be lawful to make any excavation at a distance less than 76 cm from party wall. Para 440 then continues that, notwithstanding the observance of the distance, whoever makes any excavation shall be bound to make good any damage caused by such excavation to his neighbour's building.

Present Day Practice

With deep basements 15 m deep being a common occurrence nowadays, the above 76 cm distance provision of the Civil Code is outdated. Before proceeding with excavation, a site structural geological survey followed by a structural survey of adjacent premises, the extent of premises surveyed depending on the depth of excavation, is a must. Old survey sheets, together with old place names could help identify any geological characteristics of the site. It is rare for this reconnaissance information gathered to be adequate.

The site survey should identify the fault/rapture orientation, position, length and spacing of the fractures. The fractures may range from joints with rough surfaces and cohesive fillings, to massive faulted zones containing expansive soils.

If continuous fractures dip into the slope **then** this gives a stable rock mass (fig.1)
If continuous fractures dip out of the slope **then** this gives an unstable formation (fig.2)

On the other hand **if** discontinuous. widely spaced fractures dip out of the slope **then** only local strengthening required (fig.1)

From the above findings, to be considered is also the time of the year when the excavation is to be left exposed. **If** during the rainy season due to lubrication of the seams **then** a rock slippage may be induced. It has to be then ascertained whether stabilising works are necessary. These to ensure stability to adjoining 3rd party or street works.

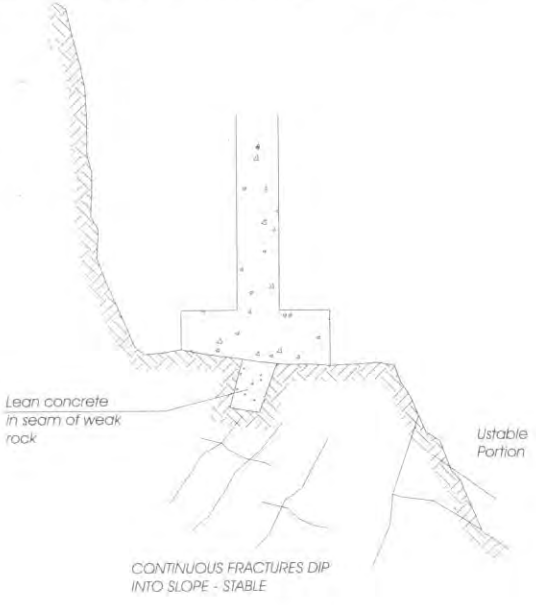


FIG-1

Excavation Procedures

If surveys completed. **then** the order of the excavations may be decided upon. The state of the founding material up to the bedrock level dictates the

required shoring and strutting necessary, to retain the exposed material. Once bedrock reached, the depth existing of shattered rock would dictate the amount of rock outstand necessary, considering also the existing structural layout of adjacent premises.

If points of high load concentrations such as columns exist **then** a thicker outstand is required than under intermediate walling. A piered form of rock excavation could than be necessary with the outstanding rock excavated, when rock face had been stabilised by appropriate basement construction (fig.3).

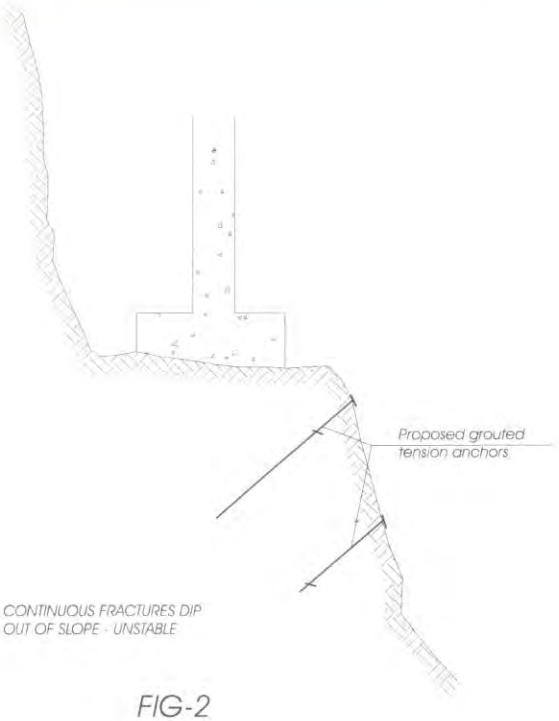


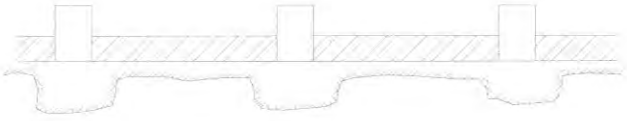
FIG-2

If roadworks are being exposed due to the excavation, **then** a retaining wall needs to be constructed to retain the exposed material. For granular material a stepped mass retaining wall is adequate with the thickness of its base approximating to H/2 - H/3, (H being height of material retained), depending on the type of granular fill retained, height of water table and traffic surcharges (fig 4) for clay retained material, further checks are to be carried out for any possible toppings due to slip circle slippages.

If excavating close to existing foundations, **then** the stability of these foundations are to be ascertained. Whether capable of supporting the existing depth of retained material (fig.5). The loading from above, onto these foundations add stability towards the overturning effects of the foundation walling.

If it is decided to reduce damage from vibrations, **then** for the top shattered rock layer a rotary form of excavation producing a crushing and chipping action, is embarked upon, instead of using heavy dynamic pneumatic or hydraulic percussion drills machinery, close to existing party walls.

To be noted that a pneumatic drill produces a shock wave that has a high peak stress. Whilst the shock wave produced by a hydraulic drill is more uniform. The result is that a hydraulic drill can produce a shock wave with higher total energy and therefore a higher penetration rate (up to 50% higher) together with greater control of the drilling functions and reduced noise and exhaust.



PLAN VIEW of Pocketing Form of Excavation Necessary in Vicinity of High Loading

FIG-3

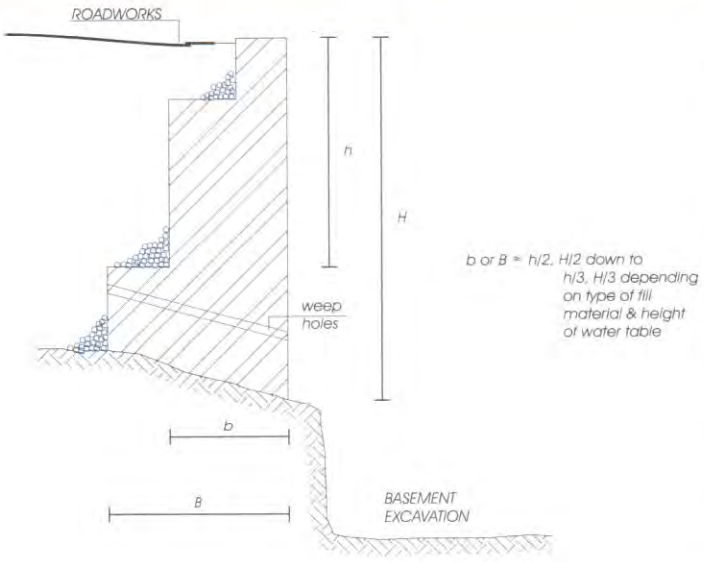


FIG-4

Excavation Machinery Vibration Effects

A mechanical excavator mounted with a 70mm bit hammer could impact approximately 50 times per second (50 Hz) with a 300KN impact of magnitude. What should be the closest distance that this equipment comes to a load bearing a water retaining structure?

If for tolerable damage to be caused, **then** vibration monitoring has shown that even with the largest hammers available, vibration within a 3m radius will approach the minimum damage threshold, only when the drill starts to penetrate rock outcrop. Once deeper down, or at a larger distance, vibration effects become negligible. To be noted that excavation rates of 1300m3/day in rock have now been achieved.

Noise intensity produced at a point may be an indication of damage being caused. Stressed or poorly installed windowpanes may fracture at 150db, whilst cracking to plaster occurs above 170 db. Pressures in the order of 5 to 10KN/m^2 are produced when the sound level of about 170db is achieved, sufficient for walls and floors to collapse.

If safety of ear damage from impulsive noise is to be considered, **then** any single impulsive noise should not exceed 140db.

Guidance exists regarding explosion firing close to buildings, when a maximum safe level of 128db is given.

If excavating in the vicinity of pools and water retaining structures, **then** a lower limit than 128db is to be adopted

In blasting, another useful parameter adopted is the peak particle velocity, PPV. for many years a safe limit of 50mm/s PPV was an acceptable design standard. Lower values are now being suggested.

If the probability of damage is to tend towards zero **then** a PPV of 12.5mm/s is to be adopted. On the other hand **if** buildings with existing defects, have visible cracks in masonry **then** PPV is to be limited to 5mm/s. **If** ruins and building of great historical value are in the vicinity **then** PPV is to be limited to 2mm/s PPV.

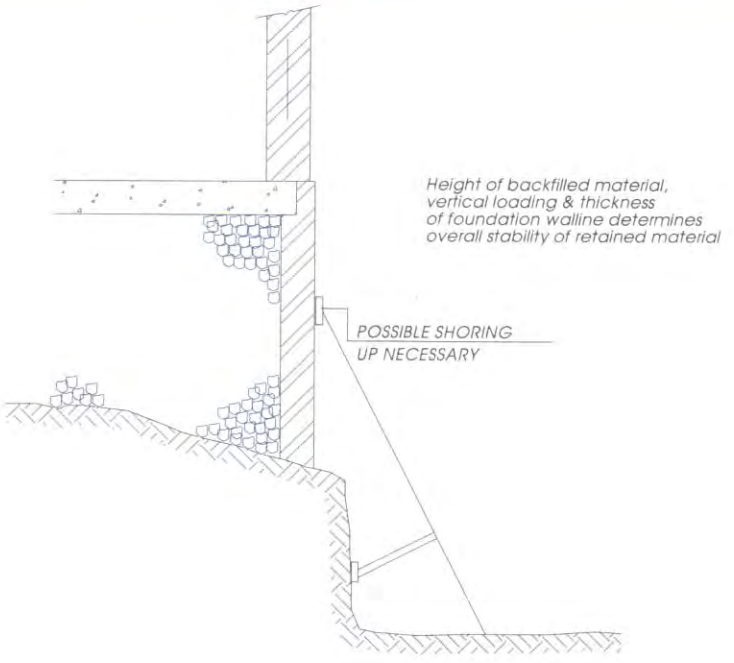


FIG-5

Environmental Considerations

The Contractor has an obligation to the health and safety of both his crew and the public He is to take all necessary measures to eliminate noise and dust due to drilling.

If noise is a nuisance to the public **then** a silenced compressor with a silenced engine is to be used. Additionally the crew is to be provided with a soundproof cabin and ear protection.

If dust is a nuisance to the public, **then** dry dust collector is to be used. Additionally for the crew a pressurized and air-conditioned cabin is to be provided.